United States Department of Agriculture

# Fiscal Year 2014 Tongass National Forest

# Annual Monitoring and Evaluation Report

## Summary Overview

## Monitoring Questions and Technical Evaluation

Forest Service Alaska Region

Tongass National Forest R10-MB-770 September 2015

**USDA Nondiscrimination Statement**

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at http://www.ascr.usda.gov/complaint_filing_cust.html and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992.

Submit your completed form or letter to USDA by:

1) mail: U.S. Department of Agriculture

Office of the Assistant Secretary for Civil Rights

1400 Independence Avenue, SW

Washington, D.C. 20250-9410;

2) fax: (202) 690-7442; or

3) email: program.intake@usda.gov

USDA is an equal opportunity provider, employer, and lender.

Federal Recycling Program
Printed on Recycled Paper

United States Department of Agriculture

# Tongass National Forest 2014 Annual Monitoring and Evaluation Summary

## Inside this report


Physical and Biological Environment....3

Human Uses and Land Management....21

Economic and Social Environment....31


## Points of Interest


Monitoring Overview....2

Monitoring and Evaluation Program....2

1. Air Quality....3

2. Climate Change....3

3. Biodiversity – Restocked Harvested Forest Lands....4

4. Biodiversity – Habitat for Old-Growth Associated Species....4

5. Biodiversity – Young-Growth Treatments....5

6. Insects and Disease....6

7. Invasive Species – Status and Trends....6

8. Invasive Species – Prevention and Control....7

9. Biodiversity Ecosystem – Old-Growth Associated Species and Subspecies....8

10. Biodiversity Ecosystem – Change in Old-Growth by Biogeographic Province....8

11. Biodiversity Ecosystem – Old-Growth Matrix....9

12. Biodiversity Ecosystem – Rare Plants....10

13. Stream-Fish Habitat – Management Indicator Species11

14. Streams-Fish Habitat – Aquatic Habitat Condition (Fish Passage)....12

15. Streams-Fish Habitat – Riparian Vegetation....13

16. Wildlife Terrestrial Habitat – Management Indicator Species....14

17. Wildlife Terrestrial Habitat – Federally Listed Threatened or Endangered & Region Sensitive Species....16

18. Wildlife Terrestrial Habitat – Geographic Distribution16

19. Soil and Water – Soil Productivity....17

20. Soil and Water – State Water Quality Standards....18

21. Soil and Water – Watershed Health....19

22. Wetlands....20

23. Karst and Cave Ecosystems....21

24. Timber Resources – Economic Timber Sales, Shelf Volume, and Contract Volume....21

25. Timber Resources – Standards and Guidelines.....22
26. Timber Resources – Allowable Sale Quantity.....23
27. Timber Resources – Tongass Timber Reform Act ...23
28. Timber Resources – Adaptive Management Strategy Threshold.....24
29. Timber Management – Non-Interchangeable Components.....24
30. Timber Management – Proportional Mix of NIC I and NIC II .....25
31. Transportation System .....26
32. Transportation System .....26
33. Mining and Minerals Exploration.....27
34. Subsistence Management.....28
35. Wilderness .....28
36. Heritage Resources .....29
37. Recreation.....30
38. Wild, Scenic and Recreational Rivers.....30
39. Scenery .....31
40. Economics.....31
41. Costs and Outputs .....32
Program Contact .....33

## Monitoring Overview

The 2014 Annual Monitoring and Evaluation Report summarizes specific monitoring completed during fiscal year (FY) 2014 in accordance with the Tongass Land and Resource Management Plan (Forest Plan). Chapter 6 of the Forest Plan specifies an annual written summary of forest-wide monitoring programs.

Some monitoring protocols and questions were updated to better define and focus monitoring work during the completion of the 2008 Forest Plan Amendment. This report serves as the annual written summary of forest-wide monitoring program. A five year summary of Forest Plan monitoring was completed in 2012. Changes relative to recommendations in the five year evaluation and a transition to comply with the 2012 Planning rule is ongoing.

Monitoring work is currently underway for most of the questions in this report. Monitoring is completed through years of data collection and evaluation.

A full reference report for each question is available by hyperlinks in this report.

If you have questions or comments about this report, please contact Cathy Tighe at the Ketchikan Forest Supervisor's Office, 907-228-6274.

## Monitoring and Evaluation Program

Monitoring and evaluation are quality control processes for implementing the Tongass Forest Plan. They provide the public, the Forest Service, and other agencies with information on the progress and results of plan implementation. Monitoring and evaluation comprise an essential feedback mechanism within an adaptive management framework to keep the Plan dynamic and responsive to changing conditions. The evaluation process also provides feedback that can trigger corrective action, adjustment of plans and budgets, or both, to facilitate action on the ground.

The Forest Supervisor is responsible for coordinating the preparation of the annual monitoring and evaluation report. This report summarizes the monitoring activities and results from FY2014. It addresses and evaluates each of the questions listed in the monitoring plan.

Generally, the annual report focuses on the information gathered during the year and identification of issues requiring immediate attention. A more comprehensive evaluation process takes place every fifth year. The evaluation includes recommendations for remedial action, if necessary, to make management activities and their effects consistent with the Forest Plan.

# Physical and Biological Environment

## 1. Air Quality

### Is air quality being maintained?

The City of Juneau, Mendenhall Valley area is in maintenance status for PM 10 and PM 2.5 National Ambient Air Quality Standards. The wilderness lichen plots (S. Etolin, Coronation, and Kootznoowoo) that were visited in 2014 assisted in achieving a higher score for the air element in the Chief's 10-Year Wilderness Stewardship Challenge. The 2014 lichen analysis results will be presented in 2015. The consistent monitoring every ten years allows wilderness managers to gather trend data and to be aware of the environmental conditions that represent the wilderness character for air quality. The plots that contain contaminants elevated above threshold will be monitored in 8 to 10 years to determine the trend in concentrations and any effects to the lichen community at those sites.

**Collecting lichen tissue for contaminant analysis in South Etolin Wilderness. Photo by Karen Dillman**

**Lake in S. Etolin Wilderness near where permanent air quality lichen monitoring plots reside. Photo by Karen Dillman**

## 2. Climate Change

### What are the long-term changes to the permanent snowpack and how does it affect the physical and biological environment?

The Tongass developed a Climate Change Team that is working with EcoAdapt to develop limited climate vulnerability assessments focuses on snow, ice, and water. Glacier and snowpack changes can indicate climate trends that are relevant to national forest management. Changes in glaciers and snowpack alter stream flow, water quality, and habitats important to fish, wildlife, and communities.

This report summarizes new information and ongoing efforts related to climate change, snowpack changes (glaciers, permanent and seasonal snowpack), and streamflow.

Climate change vulnerability assessments and multi-stakeholder collaborations are in progress. These can focus on at risk resources managed by the Tongass.

Monitoring recommendations include maintaining current snow courses and stream gauges and establishing additional monitoring sites in salmon producing watersheds in the southern and outer coastal areas of the Tongass.

## 3. Biodiversity – Restocked Harvested Forest Lands

### Are harvested forest lands restocked within 5 years after harvest?

The 2008 Forest Plan requires that all harvested stands be restocked within 5 years of timber harvest. All harvested lands were examined following treatment. Typically, natural regeneration occurs on 100 percent of harvested stands. If natural restocking does not occur, artificial regeneration is required, but this has not occurred in the past several decades on the Tongass. All stands harvested in FY2009 were certified as restocked in FY2014 or an earlier fiscal year. All lands harvested prior to FY2009 have also been certified as re-stocked.

Young Alaska yellow-cedar tree. Photo by Shelia Spores

Fully stocked unit. Photo by Shelia Spores

## 4. Biodiversity – Habitat for Old-Growth Associated Species

### Following young-growth treatments, is the change in understory vegetation providing improved habitat for key old-growth associated species?

#### Young-Growth Studies

The Tongass has been working to improve the value of young-growth stands for wildlife and to improve their value for future harvest. This is accomplished using a wide variety of precommercial thinning, and sometimes pruning treatments, under the guidance of the Tongass Young-Growth Management Strategy (USDA 2015). Some of the objectives of this strategy include greater integration in meeting multiple resource needs in managing young-growth and continuing to increase our knowledge of young-growth management treatments through programs such as the Tongass-Wide Young-Growth Studies (TWYGS).

Based on the Forest Service Activity Tracking System (FACTS) database, 5,814 acres of young-growth forest on the Tongass was precommercial thinned in FY2014. Of this, 303 acres were thinned for wildlife habitat. Five acres of openings were also created for wildlife. No slash treatments were done in FY2014. Over the last ten years (2005 – 2014), a total of 57,798 acres have been precommercial thinned on the Tongass, including 4,085 acres with a

wildlife emphasis. In that same time period, 680 acres of openings were created for wildlife and 392 acres of slash were treated.

Results of TWYGS from the first 4 to 8 years post-treatment indicate that several thinning prescriptions enhance the value of young-growth stands for deer. However, a long-term understory response to these treatments is still necessary to have an informed thinning program for wildlife. Thus, continued monitoring is essential.

Initial results suggest that thinning in older young-growth stands provides a delayed understory response.

With the anticipated transition to second growth harvest on the Tongass, our understanding of the understory response to commercial thinning is important. The Prince of Wales Commercial Thinning Study will provide a scientifically credible, replicated, long-term experiment to inform the Tongass transition to harvesting young-growth, including its effects on the value of the understory for deer.

### Small Mammal Response to Young-Growth Treatments

The availability of small mammals as prey can influence the abundance and distribution of northern goshawk (Salafsky et al. 2005) and marten (Thompson and Colgan 1987; Weckworth and Hawley 1962; Flynn and Schumacher 2009). Small mammals have been shown to respond to forest succession following timber harvest in other parts of the Pacific Northwest with a short-term increase in abundance during the early stages of succession, but declines as the canopy closes (Carey and Wilson 2001; Sullivan and Sullivan 2001; Sullivan et al. 2001; Wilson and Carey 2000; and Yahner et al. 1992). The small mammal response to young-growth study should inform us of the features of the understory in young-growth that small mammal prey need. This information may inform future habitat monitoring in young-growth, should some of these vegetation features not currently be measured in the TWYGS.

## 5. Biodiversity – Young-Growth Treatments

### Are young-growth treatments improving other key habitat components for old-growth associated species?

This monitoring question includes assessment of understory species composition to determine if the change in understory vegetation following young-growth treatments provided improved habitat for key old-growth associated species, and if young-growth treatments improved other key habitat components for old-growth associated species. These objectives provided the basis for developing a habitat monitoring protocol for implementation following silvicultural treatments in young-growth forests on the Tongass.

A suggested habitat monitoring protocol has been proposed for addressing this question, but has not been tested or applied in the field, Suring 2011. Preliminary work to develop Graphical Interface tools to establish baseline values for the landscape attributes was planned in FY 2014 but personnel constraints have delayed that work until FY2016. According to the protocol, there will be reports at the start and end of the five year reporting.

**Mycologist surveying at Staney Creek. Photo by Karen Dillman**

### Terrestrial Fungi in Young-Growth Stands

The protocol is currently being developed to answer this biodiversity question; thus, the evaluation criteria are not yet complete.

Efforts in FY2014 include a contract to continue fungal surveys on Prince of Wales (POW) Island in

selected young-growth and old-growth forests. The selected sites contain similar soil type so that comparisons can be made on a broad scale as to the functional groups found in the young-growth and old-growth stands. This will identify the possibility of fungi being used to determine if old-growth forest associated species are present in young-growth stands.

The goals of the 2014 fungi project on POW are to provide a species list and frequencies of each species found on each unit. Analysis Of Variance tests use frequency data to test the hypotheses of different species composition in old-growth versus young-growth units. Monitoring will be used to detect patterns and relationships in the species distribution data.

Using macro-fungi to answer this biodiversity question proposes to improve soil productivity interpretations through a better understanding of fungal occurrence in different soil types, vegetation, and successional stages across the Forest. Understanding the factors influencing fungal occurrence will inform soil restoration efforts and young-growth productivity dynamics.

## 6. Insects and Disease

### Are destructive insects and disease organisms increasing to potentially damaging levels following management activities?

Management activities do not appear to be exacerbating insect and disease problems on the Tongass. Hemlock dwarf mistletoe and many stem decay pathogens are less frequent after treatment. Yellow-cedar decline in young-growth, hemlock canker, and shoot diseases are issues to watch for in young, managed stands. Stem decays may become prevalent in managed stands as they age due to bole wounding caused by partial harvest or commercial thinning. It is possible to promote or maintain stem decays and mistletoe in stands managed for non-timber objectives in order to enhance habitat, ecological processes, and other old-growth characteristics.

Yellow-cedar decline is a leading example of the impacts of changing climate on a tree species. Management can favor yellow-cedar on sites with deeper soils or sufficient snowpack to meet conservation goals. Prospects for the salvage of dead yellow-cedar are promising in some areas with concentrated yellow-cedar snags, road access, and land-use designations that permit harvest or salvage. The completed draft yellow-cedar strategy provides guidance yellow-cedar management in Alaska.

The Early Detection Rapid Response program monitors several invasive insects that threaten Alaskan Forests.

Although insect and diseases are not currently causing significant problems in managed stands, we must remain vigilant. The monitoring work conducted annually by the State and Private Forestry branch of the Forest Service, Forest Health Protection group, and Tongass National Forest Silvicultural staff is sufficient to assess threats and impacts from insects and disease.

**Inchworm. Photo by Shelia Spores**

## 7. Invasive Species – Status and Trends

### What are the status and trends of areas infested by aquatic and terrestrial invasive species relative to the desired condition?

In 2014, no monitoring for invasive animal species was conducted on the Tongass. No occurrences of Atlantic salmon were detected in the waters of the Tongass by ADF&G or the Forest Service. According to ADF&G, European green crab have not yet been detected in Southeast Alaska waters, but monitoring efforts in 2014 were limited to areas around the cities of Ketchikan, Sitka, and Juneau. ADF&G reports that invasive marine tunicates have

been detected in marine harbors in Ketchikan and Sitka.

Seven high-risk invasive plant sites were visited across the Forest in 2014, with infestations covering a total of 2.72 acres. High-priority invasive plant species recorded include brittlestem hempnettle (*Galeopsis tetrahit*), field mustard (*Brassica rapa*), oxeye daisy (*Leucanthemum vulgare*), reed canarygrass (*Phalaris arundinacea*), white clover (*Melilotus alba*), black bindweed (*Polygonum convolvulus*), orange hawkweed (*Hieracium aurantiacum*), and field sowthistle (*Sonchus arvensis*). All seven sites had one or more infestations of invasive plant species that are a high priority for control on the Tongass National Forest.

The high-risk sites visited in 2014 will be revisited at least once during the five-year monitoring cycle, and the new data collected will be compared to the initial monitoring data to determine if infestations have spread or have been reduced or eliminated, or if new infestations have become established.

**Black bindweed (Polygonum convolvulus), an invasive plant. Photo by Rick Turner**

## 8. Invasive Species – Prevention and Control

### How effective were our management activities, including those done through partnerships, in preventing or controlling targeted invasive species?

Prevention measures for invasive plants implemented in FY2014 were based on project and site-specific circumstances including overall risk of spread, degree of invasiveness of the non-native plants in the project area, and the likelihood of successfully preventing further spread.

**Clipped Scotch thistle seed heads for disposal.**

A total of 60.6 acres of invasive plant treatments were completed in 2014, compared to 67.1 acres in 2013, 122.8 acres in 2012, 144.7 acres in FY 2011, and 222.5 acres in FY 2010.

Invasive plant prevention measures were implemented on the Ketchikan-Misty Fiords Ranger District in FY 2014 as part of projects and other activities. Weeds were monitored and removed in the Hyder area, including nearby quarries associated with mineral materials special-use permits. Monitoring invasive plant infestations at Quartz Hill was implemented during road inspections. A previously documented infestation of oxeye daisy was not relocated.

**Tarp over orange hawkweed along the roadside on Zarembo Island, Wrangell Ranger District**

The Petersburg and Wrangell Ranger Districts recently completed the first district-level invasive plant treatment environmental assessment (EA) on the Forest. This analysis covered all treatment options (manual, chemical, and mechanical) for high priority invasive species and sites within both ranger districts, including wilderness areas. Under this district weed EA, 2.6 acres of infestations were treated using herbicide.

Partnerships and educational activities are helpful in prevention and control efforts for invasive plants, both on National Forest System lands and lands outside agency jurisdiction. Invasive plant education/partnership activities were conducted on five ranger districts in 2014.

## 9. Biodiversity Ecosystem – Old-Growth Associated Species and Subspecies

**Is the old-growth habitat protected under the Forest Plan being maintained to support viable and well distributed populations of old-growth associated species and subspecies?**

A non-significant Forest Plan Amendment was included in the Big Thorne Project Record of Decision for modification of the small old-growth reserves (OGRs) in the following VCUs: 5790, 5800, 5810, 5820, 5830, 5850, and 5950. The net result of these changes to the spatial distribution, size, and composition of the Old-Growth Habitat Land Use Designation (LUD) in these seven VCUs is an increase of 645 acres being added to the OGR system as well as an increase of 107 acres of POG. Road miles and young-growth acres within the boundaries of the OGRs were reduced. The amount of POG, including large-tree and low elevation POG, interior forest acres, goshawk and marbled murrelet nesting habitat, and deer and marten winter habitat was reduced in some OGRs.

The changes that occurred as a result of the Big Thorne ROD continue to meet the minimum Forest Plan acreage requirements, meet Old-Growth Habitat goals and objectives outlined in the Forest Plan, and are consistent with direction in Appendix K of the Forest Plan. Overall acreage of the reserve system has been increased by 645 acres, a very minor portion of the overall Tongass-wide conservation strategy acreage (change of less than one tenth of one percent of the Tongass National Forest).

## 10. Biodiversity Ecosystem – Change in Old-Growth by Biogeographic Province

**Are the effects of biodiversity shown through the cumulative change in old-growth by biogeographic province consistent with the estimates of the Forest Plan (change could include effects of timber harvest, land exchanges or conveyance, windthrow, insect and disease, climatic change, etc.)?**

In FY2014, there were no changes in land use designations due to land exchange or conveyance since signing of the 2008 Forest Plan.

During FY2014, 2,488 acres of productive old-growth, 1,221 acres of high productive old-growth, and 99 acres of large tree stands were harvested across five biogeographic provinces.

The finalization of the Sealaska land exchange in March 2015, was after the period covered by this monitoring report. This will be included in the FY15 monitoring report.

The effects of biodiversity shown through the cumulative change in old-growth by biogeographic province are consistent with the estimates of the Forest Plan. There have been no substantial changes in the last year as a result of land exchanges or conveyance, windthrow, insect and disease, climate or other changes that would result in a significant change in biodiversity.

### Lichen Monitoring

Epiphytic lichen communities are highly sensitive to changes in environmental pollution and climate, making them excellent candidates for long-term monitoring of ecosystem integrity (Root et al. 2014; 2015, Gauslaa 2014, Jovan 2008, Geiser & Neitlich 2007). They lack roots to store water and their physiology is completely dependent on humidity and rainfall occurring at times when temperatures favor photosynthesis (Palmqvist et al. 2008). They are intricately tied to many ecosystem processes such as wildlife food, habitat, and nesting material, nutrient cycling and enhancing biodiversity.

Currently, this monitoring question is being answered by evaluating the effects on biodiversity as a result of cumulative change in old-growth habitat by assessing changes in the amount of potential old-growth habitat across the Tongass in relation to annual changes in timber harvest (Biodiversity Evaluation Criteria, USDA 2008b, page 6-8). In 2014 and 2015, further refinements to help answer this question will be developed by modeling the existing lichen community data from old-growth habitats to identify climate zones and indicator species to climate. The model can be used in the future to score monitoring plots based on species' presences and their climatic tolerances. Biodiversity of lichen communities in old-growth forests may be influenced by climate and therefore climate change.

**Old man's beard lichen *Usnea longissima* and others of similar morphology. Photo by Karen Dillman**

## 11. Biodiversity Ecosystem – Old-Growth Matrix

### Is old-growth structure retained in the matrix adequate and is it representative of old-growth types across VCUs and across the Forest?

The 2008 Forest Plan replaced the goshawk and marten standards and guidelines with a legacy standard and guideline that requires legacy forest structure be maintained in specific value comparison units (USDA Forest Service 2008b, page 4-90). The intent of this standard and guideline is to maintain the matrix as a functional part of the conservation strategy for wildlife while providing flexibility to address on-the-ground issues while implementing timber sales. The standard and guideline is applied to harvest units located in value comparison units (VCUs) that may be at risk of losing their effective contribution to the conservation strategy due to past timber harvest. Therefore, it is intended to maintain the effective contribution of these at risk value comparison units by retaining sufficient legacy forest structure in harvest units (USDA Forest Service 2008b, page 4-90).

The legacy standard and guideline was applicable to only one acre of the 2,707 acres of timber harvest completed in FY2014 for the following reasons, as listed in the 2008 Forest Plan and record of decision:

- The units harvested occurred in VCUs that were not listed as retention of legacy structure required because less than 33 percent of productive old-growth habitat was harvested (IBID);
- The units harvested were less than 20 acres in size (IBID); or

- The timber sale was under contract before the effective date of the 2008 Forest Plan (ROD Category 1, USDA 2008a, page 68-69).

Harvesting in FY2014 occurred in one VCU listed in the legacy standard and guideline. Legacy was not retained in the Power Lake timber sale in VCU 5860 (Thorne Bay Ranger District) because the harvest unit was less than 20 acres and the sale was listed as a Category 1 sale in the 2008 Forest Plan ROD. Harvest was just over one acre; one acre of legacy was also retained.

## 12. Biodiversity Ecosystem – Rare Plants

### What are the cumulative effects of changes to habitats that sustain rare plants?

#### Prince of Wales Island Rare Plant Population Monitoring

Results indicate no significant change in lesser round-leaved orchid population density from 2013 to 2014. Monitoring data had indicated a significant annual decrease in density for the two previous years. This previous downward trend might have been related to periodic dormancy. Individuals of this species can become dormant for one or more years, and then continue growth. Although results suggest the decline in population density has stopped, continued monitoring is needed to see long-term population trends.

Monitoring data for whiteflower rein orchid populations did not show a significant change from 2013 to 2014.

For the two populations of large yellow lady's slipper, monitoring shows a 25 percent decrease in total individuals. This is in contrast to the 20 percent increase recorded between 2012 and 2013. This may be due to natural periodic dormancy of individuals.

**Large yellow lady's slipper. Photo by Kristen Lease**

#### Kruzof Island Dune Tansy Population Monitoring

Although newly erected barriers are helping to keep ORV traffic away from the dune tansy population and habitat, stream and beach erosion continue to impact meadow habitat, threatening loss of individual plants. Continued stream and beach erosion of habitat is likely unavoidable and could eventually destroy the existing population. Salvage and transplanting threatened plants to adjacent suitable habitat is a strategy to prevent extirpation of this species on the Tongass.

Due to its relative common occurrence elsewhere in Alaska and globally, dune tansy was removed from the Alaska Natural Heritage Program rare plant tracking list in 2012. Consultation amongst professionals concluded that as the only known location of this plant in the region, it makes a significant contribution to the biodiversity of the Tongass.

## 13. Stream-Fish Habitat – Management Indicator Species

### Are the trends in abundance of the fish management indicator species (Dolly Varden char, cutthroat trout, coho salmon, and pink salmon) related to changes in habitat associated with forest management, climate change or other factors?

#### Resident Dolly Varden Char and Cutthroat Trout Monitoring

A thorough statistical analysis of an 11-year resident fish dataset is complete and a manuscript is expected to be finalized and peer reviewed by winter 2015. The manuscript focus is landscape drivers of resident Dolly Varden char and Cutthroat trout presence, abundance, and size across the Tongass. We expect results of this analysis to provide insight on future resident fish monitoring efforts.

Because of the short duration of monitoring efforts under the newly revised protocol, no detailed analysis of results is practical at this time. Sampling efforts will continue.

#### Coho Salmon Abundance Monitoring

Coho salmon occur in nearly 4,000 streams in Southeast Alaska. Annual wild commercial harvest of coho salmon in Southeast Alaska is reported by the Alaska Department of Fish and Game. The 2014 wild coho salmon harvest was 2.45 million fish, down from the 2013 catch of 2.57 million fish. Regardless of the 2014 wild coho salmon harvest decline from the previous year, it still ranked the 5th highest harvest since statehood (Skannes et al. 2015). The 2014 average dressed weight of troll-caught coho salmon (6.4 lbs) was higher than 2013, just slightly above the 10-year average weight of 6.2 lbs., and 0.5 lb. heavier than the 5-year average (Skannes et al. 2015).

**Coho salmon fry.**

#### Pink Salmon Abundance Monitoring

There are more than 2,500 pink salmon spawning streams in Southeast Alaska (Piston and Heinl 2011). Annual commercial harvest of pink salmon in is reported by the Alaska Department of Fish and Game. Commercial harvest is in part a good indicator of annual abundance and potential trends for pink salmon.

According to ADF&G data, the total 2014 estimated Southeast Alaska (not including Yakutat area) pink salmon harvest of 37.2 million fish was below the recent 10-year average (2004-2013) of 41.5 million fish and above the long-term average harvests, ranking the 21st largest harvest since 1962 (Conrad and Gray 2014). The even-year low returns pattern has perpetuated since 2006 and continued in 2014, and was especially evident in Northern Southeast inside waters.

There were no pink salmon or pink salmon habitat monitoring efforts conducted during 2014. The forest discontinued attempts at framing a monitoring

protocol for this species in 2010. A recommendation has been made to drop this species from the management indicator list because of the extreme difficulty in being able to detect meaningful level of change as a result of Forest management practices.

The Tongass continues to work with ADF&G to review the annual pink salmon commercial harvest and escapement index data for general trend information.

## 14. Streams-Fish Habitat – Aquatic Habitat Condition (Fish Passage)

### Is the natural range and frequency of aquatic habitat conditions maintained?

#### Fish Passage at Road Crossings

Upstream migration is essential for many fish species. Anadromous fish (fish that migrate from the ocean to freshwater to spawn) require access to spawning habitat. Juvenile anadromous fish migrate during their freshwater life stage, seeking seasonal habitats. Resident fish (fish that spend their entire life in freshwater) also may migrate seasonally in response to food, shelter and spawning needs.

Providing for fish passage at stream and road intersections to ensure fish migration is important when constructing or reconstructing forest roads. Improperly located, installed or maintained stream crossing structures can restrict migrations, adversely affecting fish populations. These structures can present a variety of potential obstacles to fish migration. The most common obstacles are excessive vertical barriers, debris blockages, and extreme water velocities that can inhibit fish passage, especially smaller or juvenile fish.

As part of a multi-year monitoring project, 40 culverts on fish streams were monitored in FY 2014 to assess their ability to provide fish passage. These culverts were chosen from 246 culverts installed, reinstalled or retrofitted in fish streams from 1998 through 2014. The culverts monitored in 2014 are located on Chichagof, Wrangell, Zarembo and Prince of Wales Islands. From 2009 through 2013, 138 fish stream culverts were monitored on Kupreanof, Kuiu, Wrangell, Mitkof, Zarembo, Revillagigedo and Prince of Wales Islands. Nine culverts installed in 2012 and 2013, using a Minimally Engineered Aquatic Organism Passage (MEAOP) design, are monitored annually including FY 2014.

The monitored fish stream crossings, constitute approximately 67 percent (164) of the culverts (excluding bottom-less culverts) recently installed, reinstalled or retrofitted on the Tongass.

**Culvert Inlet, Road 3015250, Milepost 0.030**

Eighty-six percent of the culverts monitored are Green or Yellow and have met the acceptable passage criteria established in the Juvenile Salmon Passage Matrix. They are consistent with State of Alaska juvenile fish passage standards and are assumed to provide unimpeded juvenile and adult fish passage. Five percent of the culverts are Gray and require more comprehensive analysis to determine passage status. The remaining 9 percent are Red and are assumed not to provide adequate passage at all desired stream flows. The majority (68 percent) of the 164 stream crossings monitored were installed between 2000 and 2005.

The 15 crossings determined not to be consistent with juvenile passage standards can be generally attributed to different reasons.

1. Three of the 15 Red culverts were known fish stream crossings requiring passage considerations but were installed without fish passage design due to project personnel being unaware of aquatic passage objective.
2. Four of the Red crossings were installed without passage considerations because they were not identified as crossings requiring fish passage until after construction was completed.

3. Two of the culverts not meeting juvenile passage standards are MEAOP designed culverts and have not accumulated enough bedload within them to provide adequate roughness and moderate water velocity. These culverts will potentially continue to accumulate bedload.
4. Two of the Red culverts are stream simulated designed culverts that have had sections completely scoured free of bedload.
5. One culvert is not providing adequate passage because it is blocked by woody debris.
6. Three are Red due to inadequate fish passage design considerations.

**Culvert bedload, Road 3015250, Milepost 0.030**

## 15. Streams-Fish Habitat – Riparian Vegetation

### Is riparian vegetation maintained or restored to a condition that supports key riparian functions?

Windthrow is a natural and important phenomenon of Southeast Alaska. It recycles forest stands while maintaining and renewing the forest ecosystem. Timber harvest has the potential to increase the rate of windthrow in adjacent stands, including riparian management areas (RMAs), beyond that found within the natural range of variability. Monitoring the incidence of windthrow in riparian management areas and comparing that to windthrow found in control riparian areas assesses whether the buffers are retained within the natural range of variability.

The incidence and characteristics of windthrow is monitored in riparian buffers of Class I, II and III streams on the Tongass National Forest that are associated with timber sales consistent with the Forest Plan. Windthrow is monitored in both RMAs and within adjacent areas where trees are retained to provide a zone of reasonable assurance of windfirmness (RAW).

The amount of windthrow is measured as the number of windthrown trees compared to the total number of originally standing trees in the buffer. The number of trees felled due to windthrow is documented and measured using low-altitude digital still aerial photographs.

The year 2014 was the fifteenth consecutive year that windthrow within stream buffers was monitored. The monitored stream buffers are generally located within the southern half of the Forest, where recent timber harvest has occurred. There are 260 monitored stream buffers. They are located on five ranger districts and are associated with 36 timber sales and 142 units that were harvested from 2000 through 2007. This monitoring contains the majority of RMAs associated with harvest activity on the Tongass, during this period.

Buffers are monitored annually for the first five years after harvest and then again 10 and 15 years after harvest. During 2014, buffers associated with units harvested in 2004 were resampled.

To date, not all acquired imagery has been analyzed. Analysis has not been completed on imagery collected from 2010 to 2014 for harvest units from 2003 to 2007. This represents 273 data points of the approximately 1,750 collected.

Based on the monitoring results, timber harvest has likely increased the rate of windthrow in the monitored areas beyond that found within the natural range of variability. However, the data suggests that

a large majority of the monitored buffers have remained mostly in natural conditions. No windthrow has been detected in 44 percent of the monitored areas and the average amount of cumulative windthrow is 6.8 percent. The cumulative windthrow mortality in the buffers is highly variable and ranges from zero to 85 percent.

**Low altitude digital aerial image of harvest unit and associated stream buffers.**

## 16. Wildlife Terrestrial Habitat – Management Indicator Species

**Are population and habitat trends for Management Indicator Species (MIS) consistent with expectations? Are these trends due to changes in habitat conditions or other factors? If they are tied to habitat conditions, is there a direct relationship with forest management, climate change or other factors? Terrestrial MIS include red squirrel, black bear, brown bear, marten, river otter, Sitka black-tailed deer, mountain goat, gray wolf, Vancouver Canada goose, bald eagle, red-breasted sapsucker, hairy woodpecker, & brown creeper.**

The 1982 regulations to implement the National Forest Management Act require that management indicator species (MIS) be identified as part of each forest plan. MIS serve multiple functions in forest planning: (1) establish explicit forest plan objectives for fish and wildlife habitat, (2) facilitate analysis of forest plan alternatives, and (3) provide a means to monitor the effect of forest plan implementation. Much of the direction for MIS is outlined in CFR 219.19, together with direction for ecosystem diversity and species diversity. As such, MIS represents one part of biodiversity and species management.

**Black bear and bald eagle at Anan Creek, Wrangell Ranger District**

The 13 MIS identified for the Tongass are primarily associated with the spruce and hemlock forests of Southeast Alaska that represent 98 percent of the productive old-growth forests (POG) of the Tongass. POG provides important habitat for many MIS. However, some species use a variety of different habitats but rely on prey species associated with old-growth (e.g., wolves).

Population and habitat trends of MIS are not included in this report. These analyses are completed every 5 years (see the 2012 Annual and 5 Year Monitoring and Evaluation Report for the most recent analyses of population and habitat trends).

Although trend information is not included here, monitoring did occur in FY2014.

The ADF&G completed sealing records on furbearers taken by any means and for any purpose. They also conducted hunter/trapper questionnaires.

Estimating Sitka black-tailed deer populations in Southeast Alaska is difficult because much of the landscape is densely vegetated; therefore, estimation techniques based on seeing the animals do not work well. For this reason, ADF&G and the Tongass use fecal pellet counts as an index for deer population abundance. The assumption is that changes in the density of pellet groups reflect changes in the population.

ADF&G is developing techniques for estimating mountain goat populations. They have been fitting mountain goats with radio collars in Southeast Alaska since 2005. A total of 354 goats were marked across four study sites.

**Sitka black-tailed deer**

ADF&G and the Tongass have initiated a study on central Prince of Wales Island to develop a means for evaluating wolf abundance, appropriate management levels, and sustainability. This project duplicates the study undertaken during the 1990s, with the capture, radio-collaring, and monitoring of a sample of wolves. In addition to the radio-collaring effort, wolf hair is being collected using noninvasive techniques (e.g., hair snares) to estimate numbers using mark-recapture methodologies.

The U.S. Geological Survey (USGS) conducted the Alaska Landbird Monitoring Survey (ALMS) and Breeding Bird Survey (BBS) ALMS is administered by the USGS in Anchorage and is designed to monitor long-term trends in breeding populations of landbirds (and other bird species) within all ecoregions of Alaska. BBS is administered by the USGS Patuxent Wildlife Research Center in Maryland. The BBS is designed to provide a continent-wide perspective of population change in breeding birds.

The United States Fish and Wildlife Service (USFWS) has been conducting aerial surveys of bald eagles in Southeast Alaska since 1967. They also census waterfowl. These surveys generally take 5 years to complete. All saltwater shorelines are surveyed once in summer and in winter. One-fifth of the total saltwater shoreline is surveyed per year

The University of New Mexico, in partnership with the Museum of Southwestern Biology, and in

cooperation with the Forest Service and various Alaska agencies, completed field work on the Investigations of Southeast Landscapes including Endemic Species (ISLES) project in 2013 and turned in a final report during FY2014 (Cook et al. 2013).

## 17. Wildlife Terrestrial Habitat – Federally Listed Threatened or Endangered & Region Sensitive Species

### Is current management providing for sufficient habitat of federally listed threatened or endangered species (TES) and Alaska region sensitive species?

No projects proposed in FY2014 on the Tongass are likely to have an adverse effect to threatened or endangered species. Most of the FY2014 projects are expected to have no effect on threatened and endangered wildlife or their habitat. Projects include special use permit renewals, trail maintenance, boat launch improvements, small timber sales, precommercial thinning, and fishpass and communication site maintenance.

Only one proposed project may affect listed species or their habitat but the effects are expected to be insignificant or discountable. Vessel traffic and Marine Access Facility activity associated with the action alternatives of the Saddle Lakes Timber Sale, located near Ketchikan on Revillagigedo Island, could have short-term minor effects to humpback whales. Forest Service operations, including those of permit holders and contractors, are required to follow the Marine Mammal Protection Act, reducing anticipated effects. Saddle Lakes Timber Sale is the largest project analyzed in FY2014 on the Tongass.

No proposed projects are likely to cause a loss of viability of Alaska Region sensitive species. The majority of “may adversely impact individuals, but not likely to result in a loss of viability in the planning area, nor cause a trend toward Federal listing” determinations were for the Queen Charlotte goshawk. These projects included timber sales, precommercial thinning, trail work, and fishpass and communication site maintenance. No other projects are expected to have impacts on goshawks.

#### Northern Goshawk Nest Surveys

In FY2014, 25 goshawk call station surveys were conducted across three districts. No responses to calls were detected. No new active goshawk nests were found. One historic nest location was surveyed and found the nest in usable condition. In addition, an area about 0.6 acre surrounding a potential drill site at the Hecla/Greens Creek Mine had a tree-by-tree inspection for nests and nesting activity using binoculars; no nests or nesting activity was observed.

## 18. Wildlife Terrestrial Habitat – Geographic Distribution

### What is the geographic distribution and habitat relationships of mammalian endemic species on the Tongass?

#### ISLES

The University of New Mexico and the Tongass collaborated to inventory mammals and their distribution on the Tongass through the ISLES (Island Surveys to Locate Endemic Species) project between 2009 and 2013. This work was a continuation of mammal inventory work started in 1991. The final report on their research was received in FY2014.

From 2010 through 2012, the University of Wyoming identified understory vegetation important to small mammal (including endemic species) diversity and abundance in young-growth forests on Prince of Wales Island. A final report was received in FY2014.

### Small Mammal and Carnivore Response to Tongass Young-growth Treatments

This study assesses vegetation and structure of young-growth that influence small mammal abundance. This is relevant to marten, which rely on small mammals as prey. Study objectives include determining:

- Which Tongass-wide Young-growth Study treatments enhance the abundance of small mammals,
- The habitat variables the populations respond to, and
- The response of marten and ermine to small mammal abundance.

Four habitat types were studied: young-growth (control group), thinned young-growth, old-growth, and clearcut. Mark-recapture methods were used to estimate small mammal and marten abundance. Small mammals were live trapped and marten and ermine were trapped using hair-snares. DNA was extracted from the hair samples and used to identify individuals. Trapped small mammals studied and marked with a passive integrated transponder tag for permanent identification. Blood samples were taken from small mammals and, in combination with plant samples, stable isotope analyses was used to identify small mammal diets. Small mammal feces were collected for diet analyses. Vegetation was sampled to assess food availability (Flaherty and Ben-David 2012).

Mice and shrew densities varied across the years and exhibited no relation to forest treatments. Ermine captures were correlated with the density of Keen's mice in the same year. Marten captures were correlated with the density of mice the previous year.

## 19. Soil and Water – Soil Productivity

### Are the soil conservation practices implemented and effective in meeting Alaska Regional and Soil Quality Standards and maintaining soil productivity?

Soil quality monitoring in 2014 focused on 1) soil conditions following the use of ground-based yarding equipment on slopes over 30 percent gradient, 2) soil compaction on the North Kuiu Stream Restoration Project equipment access trails, and 3) the amount of soil disturbance caused by Off-Highway Vehicle (OHV) use for game retrieval on the Yakutat Forelands. Monitoring reports were written for each of these three projects.

1) In recent years, some loggers want to use shovel yarding on steeper slopes to reduce logging costs (shovel logging is about ½ the cost of a short span cable system and about ⅓ the cost of helicopter logging). Rutting, soil displacement, and soil erosion have been noted on some shovel trails where shovel yarding has been used on steep slopes.

**Shovel yarder on a steep slope in the Diesel Timber Sale area**

In 2014, monitoring identified differences in soil conditions as a result of shovel yarding on different soil slope classes.

If a decision is made to allow ground-based equipment on slopes over 35 percent gradient, the trails should be agreed upon by the shovel operator and sale administrator and/or in consultation with a soil scientist. If allowed, a plan should be made for rehabilitating soil conditions on trails on slopes over 35 percent gradient.

2) The North Kuiu Island stream restoration project required about 1,200 pieces of wood. Most of this wood was moved to the stream with ground-based equipment. To move the wood to the stream, six access trails approximately 10 meters wide were cut through 46 year old young-growth. The trails were needed for the machines to skid or swing the wood to the stream, similar to shovel yarding. Unlike shovel yarding, where 1 or 2 passes are made over a shovel trail, the number of passes required to move wood to the stream was typically more than 50 with some trails receiving more than 100 passes.

Soil bulk density samples indicate that overall the soils under the access trails are not compacted due to relatively low clay content, the presence of thick duff layers and high organic matter content in the upper layers, and the relatively high rates of soil mixing and stirring due to windthrow and rooting of trees and other vegetation.

**Access trail associated with North Kuiu stream restoration project**

3) The Access and travel Management Plan for the Yakutat District restricts OHV use to designated trails except for meat retrieval "if they can do so without causing resource damage". Vegetation and soil disturbance can occur from even the limited ATV use associated with game retrieval, but it also seems likely that better drained areas where sweet gale and willow are dominant can support game retrieval.

**ATV tracks in Yakutat**

## 20. Soil and Water – State Water Quality Standards

### Are the soil and water conservation practices as described through the Best Management Practices and site specific prescriptions implemented and effective in minimizing soil erosion and maintaining the State Water Quality Standards?

The Best Management Practices (BMPs), described in the Soil and Water Conservation Handbook (Alaska Region Supplement to Forest Service Handbook 2509.22, 2006), define practices that protect soil and water resources. The Soil and Water standards and guidelines define site-specific measures to protect the resources. These standards and guidelines were monitored using national forms and protocols. The FY 2014 BMP Monitoring Report provides details on how the monitoring was conducted.

The Forest Plan BMP monitoring program to date has emphasized evaluation of timber harvest units and roads. The National BMP monitoring program places equal emphasis on all resource activities. A regional target of seven resource activities was assigned to the Tongass National Forest and

accomplished in 2014. Five randomly selected activities (timber harvest, facilities, recreation, and aquatic restoration) were monitored. Two other activities (minerals and roads) were not required to be randomly selected.

Generally, the monitoring completed by the interdisciplinary teams showed that the BMPs were mostly or fully implemented during timber harvest, roads, and facilities activities. Some BMP implementation improvements are needed in recreation, roads, aquatic restoration, and minerals activities.

Field observations indicate that BMPs were generally effective in limiting or preventing sediment transport to water bodies during timber harvest and facility activities. Actions were identified to improve BMP effectiveness during roads, minerals, aquatic restoration, and recreation activities.

**Landslide at Starrigavan. Photo by John Reed, Harris Air Pilot**

## 21. Soil and Water – Watershed Health

**What is the ecological condition and trend of watersheds in terms of key characteristics (such as soil productivity, water quality and quantity, invasive species, etc.) of watershed health identified in the desired condition (aquatic ecosystem potential) of the plan area? How effective are management actions in improving watershed health (maintaining or moving watersheds toward Condition Class I)?**

As part of the Forest Service National Watershed Condition Framework watersheds were classified across the Tongass.

Most of the 900 watersheds on the Tongass are in near natural condition. Sixty-eight watersheds were rated “at risk” for maintaining ecological functions and aquatic resources due to management that occurred between 1950 and 1979. Measures are now in place to protect and maintain watershed health.

Eighteen Tongass stream reaches were sampled in 2013 and 17 in 2014.

Data was collected in 2014 as part of the Tongass-wide watershed restoration effectiveness monitoring (WREM) strategy, including stream habitat and fish response.

The Twelvemile Creek watershed smolt investigation continued for a third year.

Project monitoring reports were completed for restoration projects on Harris River and Twelvemile Creek.

**Salmon Creek reference reach.**

## 22. Wetlands

### Were the wetland conservation practices implemented and effective to avoid and/or minimize impacts to wetlands to the extent practicable?

Wetland-road monitoring has been on a two-year cycle, odd years for field work and the even years for report writing.

In FY 2013, a protocol was written to test the magnitude and extent of elevated pH associated with limestone roads across wetlands. In August of 2013, the protocol was implemented and pH and vegetation data was collected in seven wetlands.

Downslope pH was significantly elevated (90 percent confidence) in four of the seven wetlands sampled. Soil samples, from the three transects where field pH was notably different, were sent to Oregon State University's Central Analytic Lab for analysis. The lab analysis included extractable Potassium, Calcium, Magnesium, Sodium and pH. In three of the 4 wetlands, the elevated pH downslope of the road appeared to be due to the chemical reaction of relatively acidic wetland water in contact with and flowing past high pH/basic limestone road fill.

In the three wetlands where elevated pH was found, the effects on wetland vegetation composition and structure appear to be negligible, including areas where elevated pH was identified downslope of limestone road segments.

Maidenhair fern was found on four of our plots in three different wetlands. On the Tongass maidenhair fern appears to be a good indicator of a calcium rich, near neutral pH substrate. Maidenhair fern is often found growing on limestone outcrops and on the edge of limestone shot rock roads.

**Maidenhair fern and redcedar growing on the edge of a limestone shot rock road**

## 23. Karst and Cave Ecosystems

**Are the biological, mineralogical, cultural, paleontological components, and recreational values of the karst and caves maintained?**

Monitoring was completed on projects implemented under Forest Plan direction. Work completed under the Karst and Cave Standards and Guidelines included preliminary inventory, cave inventory and mapping, timber harvest unit and road reconnaissance, timber harvest unit layout, and road layout.

**Thrush Cave moonmilk. Photo by Jim Baichtal**

The Forest Plan was implemented to the fullest extent practicable. The Karst and Cave Standards and Guidelines showed through effectiveness monitoring to ensure a high level of protection for significant caves and karst resources.

In FY2014, a minor amount of logging occurred on karst lands with prescribed mitigation. Monitoring of some of the small sales evaluated the effectiveness of proposed mitigation. Monitoring of these sites found that prescriptions, such as partial suspension and buffer windfirmness, were achieved. Limited subsurface monitoring was accomplished. No substantial changes as a result of management activities were documented within the known cave systems.

**Dall Island epikarst. Photo by Jim Baichtal**

# Human Uses and Land Management

## 24. Timber Resources – Economic Timber Sales, Shelf Volume, and Contract Volume

Is the timber management program meeting the objectives of achieving economic timber sales and rebuilding the volume under contract and shelf volume components of the sale program?

In FY 2014, the Tongass offered 120 million board feet (MMBF) of timber, sold and awarded 100 MMBF and had 449.00 MMBF in no-bid timber sales that remained unsold at the end of the fiscal year. In FY 2014, the purchasers harvested 39 MMBF and had an ending inventory of 152.834 MMBF. The 5 year average annual harvest is 36 MMBF/year.

The Tongass has not been able to establish sufficient shelf volume to maintain flexibility and stability in the sale program.

**Hoonah lumber yard. Photo by Terry Fiske**

**Hoonah lumber yard. Photo by Terry Fiske**

## 25. Timber Resources – Standards and Guidelines

**Are timber harvest activities adhering to applicable timber management standards and guidelines relative to: created openings exceeding the maximum size limit for unit harvest, harvest on slopes greater than 72 percent slope gradient, or within the 1,000 feet beach and estuary buffer?**

### Created openings

There were 2,722 acres fully or partially harvested during FY2014. Of these acres, 1,324 acres were clearcut. The 100-acre size limitation applies to all clearcut harvest units. Of the total harvest acres that created openings from 2000-2014, seven units exceeded the 100-acre limit, but none went over 148 acres. All seven units were analyzed and approved in project-level Records of Decision.

During FY2014, 97 harvest areas (timber stands) were reported as harvested in the Forest Service Tracking Activity System (FACTS) database.

The majority of openings (78 percent) were 40 acres or less in size. Two exceeded 100 acres. Of the 1,324 acres managed via the even-aged system, 29 percent retained a portion of the original stand structure through the retention of leave trees. The remaining 71 percent received a traditional clearcut.

Additionally, 14 stands were harvested using two-aged management totaling 301 acres. Both group selection (2 acre or less openings) and single tree selection prescriptions were used on 49 stands to implement uneven-aged silvicultural systems on 1,398 acres.

**72 percent slope**

In 2014, approximately 30 acres of timber harvest occurred on slopes over 72 percent gradient.

**1,000 feet beach and estuary buffer**

Of the total 2014 harvest, there were 67 acres of windthrow harvest in six units that were salvage harvested within the 1,000-foot beach and estuary buffer. This harvest was authorized under the Zarkof Salvage Sale on Zarembo Island on Wrangell Ranger District.

**Logger harvesting a marked tree. Photo by Chris Budke**

## 26. Timber Resources – Allowable Sale Quantity

### Is the ASQ land base consistent with resource information and programmed harvest?

The allowable sale quantity (ASQ) for the Tongass National Forest as specified in the 2008 Forest Plan is 2.67 billion board feet for the first decade following implementation of the plan.

For FY 2004 through FY 2014, the average annual volume sold was 5,388 million board feet (MMBF) or 20.05 percent of the annual Allowable Sale Quantity. This information is presented to observe the trend in recent allotment of timber sale ASQ. The decline in timber sale volume is based on a variety of factors including economic conditions, harvest costs, and litigation.

**Tonka sort yard, Petersburg Ranger District. Photo by Carol Seitz-Warmuth**

## 27. Timber Resources – Tongass Timber Reform Act

### Is the timber demand being met within limits of the adaptive management strategy and Tongass Timber Reform Act (TTRA)?

Seek to provide an economic timber supply sufficient to meet the annual market demand for Tongass National Forest timber and the market

demand for the planning cycle, up to a ceiling of the Forest Plan's allowable sale quantity, which is 2.67 billion board feet in the first decade. The annual market demand forecast is a methodology used to set the short-term goals for the Tongass Timber Program – volume the Forest plans to offer in the current year, pending sufficient funding and sufficient National Environmental Policy Act (NEPA)-cleared volume. NEPA-cleared volume is defined as NEPA documents with a signed decision.

In FY 2014, all timber harvest offered and harvested was from Phase 1 lands. In FY 2014, the Annual Demand Calculation was 127 MMBF using the expanded lumber scenario. In FY 2014, the Tongass offered 120 MMBF, sold 100 MMBF and had 449 MMBF in no-bid timber sales. Timber harvest for FY 2014 was 39 MMBF.

Since the amount of harvest is less than 100 MMBF, it indicates that the Tongass timber harvest planning efforts should continue in Phase 1 areas on the Forest with the exception of small sale opportunities. At the end of fiscal year 2014, the corrected volume under contract was approximately 119 MMBF. Since the demand calculation estimates that there should be an estimated 127 MMBF under contract, the objectives of TTRA are not being met and efforts to establish shelf volume should continue.

**Front loader at an LTF on Tuxekan Island.**

## 28. Timber Resources – Adaptive Management Strategy Threshold

### Has a Timber Sale Adaptive Management Strategy threshold been reached, so that it is appropriate to move to the next phase?

The timber program will be restricted to Phase 1 areas until harvest levels reach 100 MMBF for 2 consecutive fiscal years. After reaching the harvest level, timber management activities can be planned on Phase 2 areas, which include all Phase 1 areas.

In FY2014, the Tongass offered 120 MMBF, sold 100 MMBF and had 449 MMBF in no-bid timber sales. Timber harvest for FY 2014 was 39 MMBF.

The total volume harvested has not exceeded 100 MMBF in the last decade. Harvest less than 100 MMBF indicates that the Tongass timber sale planning efforts will continue in Phase 1 areas on the Forest.

## 29. Timber Management – Non-Interchangeable Components

Are the non-interchangeable components (NICs) of the allowable sale quantity consistent with actual harvest?

The ASQ consists of two separate non-interchangeable components (NICs) that are established to meet Forest Plan objectives.

NIC I. Normal Operability: This is volume scheduled from suitable lands using existing logging systems (tractor, shovel, standard cable, and some helicopter). Most of these lands are expected to be economic under projected market conditions. On average, sales from these lands have the highest probability of offering a reasonable opportunity for a purchaser to gain a profit from their investment and labor. This is the best operable ground.

NIC II. Difficult and Isolated Operability: This is volume scheduled from suitable lands that are

available for harvest using logging systems not in common use in Southeast Alaska. Most of these lands are presently considered economically and technologically marginal.

NIC evaluation criteria include: 1) Volume harvested by logging system from suitable lands from commercial forest timber stands that are healthy. 2) Volume harvested by logging system from suitable lands from commercial forest timber stands that are unhealthy and currently in a non-productive status, for example yellow-cedar decline and blowdown with heavy sap rot or breakage. 3) Distance from the setting to landing. For helicopter settings, settings over three-fourths of a mile flight distance from landings, either on the land or in the water, is considered NIC II.

In FY2014, there was approximately 39 MMBF harvested from the Tongass. All of the harvest was in NIC I areas.

## 30. Timber Management – Proportional Mix of NIC I and NIC II

Is the proportional mix of volume in NIC I and NIC II as estimated in the Forest Plan accurate?

Under the 2008 Forest Plan Amendment, the ASQ is divided into NIC I and NIC II. The proportional mix in the Forest Plan is set at approximately 89 percent NIC I (238 MMBF) and 11 percent NIC II (29 MMBF) harvested annually.

NIC components are estimates designed to prevent the disproportionate harvest of the most economical portions of the Forest over the long term. Limits on each component are binding on a decadal basis. The components are non-interchangeable because lower sale level in one component may not be compensated by higher sale levels in the other. The NIC I component includes land that can be harvested using “normal operability” logging systems such as shovel and short span cable. The NIC II component includes difficult and isolated operable timber stands requiring special logging equipment requirements due to yarding distances or topography. Unless the annual offer volume approaches the NIC I allowable volume of 238 MMBF, NIC II over-harvest is not likely to occur.

In FY2014, there was approximately 39 MMBF harvested from the Tongass. All of the harvest was in NIC I areas. Timber harvest consisted of 70 percent conventional logging systems and 30 percent helicopter logging systems.

**Active logging operation. Photo by A. Gallo.**

## 31. Transportation System

### Are the standards and guidelines used for forest development roads and log transfer facilities effective in limiting the environmental effects to anticipated levels?

#### Roads

FY2014 monitoring showed that the maintenance program on the road system limited environmental effects. Sediment transport of eroded materials from the road surfaces was minimal. Road surfaces were in excellent condition and showed no ruts or water diversion. The monitored culverts were transporting water across the road and no culvert maintenance issues were noted; no head cutting or bank erosion was noted.

#### Log Transfer Facilities

Each log transfer facility (LTF) is operated by permits in accordance with Alaska Water Quality Standards and requirements from the Environmental Protection Agency (EPA) for storm water discharge. Bark monitoring is required annually for each LTF under the EPA general NPDES permits.

Logging operations did put wood into marine waters in fiscal year 2014. Logging operations were ongoing in the fall, and bark monitoring dives had not yet been completed.

During periods of log transfer operation, receiving waters at the LTF shall be visually monitored daily for the presence of oil sheen. In FY2014, all active LTFs were operated in accordance with their permits. No fuel or hydraulic fluid spills occurred.

The running surface of the Tonka LTF was in good condition; the surface is graded weekly as needed. The sort yard running surface was well graded and clean of bark. The Tonka sort yard settling pond showed some need for clean-out. The system of settling ponds is functioning well to filter out the fine sediment. The settling pond was cleaned out before the end of the 2014 operating season.

**Tonka sort yard; settling pond. Photo by Carol Seitz-Warmuth**

## 32. Transportation System

### Are the roads and trails maintained in accordance with management objectives?

The 2005 travel management rules require the designation of roads, trails, and areas that are open to public use. It prohibits the use of motorized vehicles outside designated areas. Part of these rules included developing motor vehicle use maps (MVUMs) for each district. All roads monitored in FY2014 were shown accurately on the MVUM.

FY2014 monitored roads included road 6351 on the Tonka road system (Kupreanof Island), road 3015 on the North Thorne road system (Prince of Wales Island), road 7576 Harbor Mountain, road 7513 Starrigavan campground (Sitka), Frenchy road 6208 on Mitkof Island, and Kruzof North Beach ATV trail 317591 (closed part of road 7591).

#### Closed Roads Maintenance Level 1

Closed roads (maintenance level 1) do not appear on the MVUM unless designated as a motorized trail, such as the Road 7591 conversion to motorized Trail 317591. The maximum vehicle width on this route is 60 inches.

#### Open Roads Maintenance Levels 2-5

FY2014 monitoring shows that MVUMs consistently make motor vehicle access prohibitions known. However, the map by itself is not completely effective in eliminating access. This was underscored on Trail 317591, where users labored to

modify structures to access the road that had recently been changed to maintenance level 1. Roads where culverts and bridges were removed were effective in eliminating unauthorized motorized use. Unauthorized use by OHVs did not cause any environmental damage or concerns on the routes evaluated. Monitoring of maintenance level 2-5 roads showed that roads are being maintained according to the road maintenance objectives.

**Frenchy Road 6208**

## 33. Mining and Minerals Exploration

### Are Federal regulations (36 CFR 228) to ensure surface resource protection implemented and is the administration of this regulation through the Forest Plan effective in limiting soil and water resource impacts?

A wide range of mineral resources and deposit types occur within the boundaries of the Tongass National Forest. Examples include, but are not limited to, gold, silver, molybdenum, and uranium, also nationally designated “strategic” and “critical” minerals such as lead, zinc, copper, tungsten, and rare earth elements.

The Forest Service recognizes that minerals are fundamental to the Nation and, as policy, encourages the orderly exploration and development of mineral resources. The Secretary of Agriculture has provided regulations to ensure surface resource protection during mineral exploration and development.

The Tongass administered two large locatable mine plans (Greens Creek and Kensington Gold Mine) and processed several dozen exploration-drilling programs and mineral material operations (Herbert Glacier Project, Salt Chuck Exploration Project, Bokan Project, Wowoedski Island Project, Zarembo Island Project, Marx Creek Quarry, and Shoal Cove Quarry).

**Green’s Creek Mine**

The necessity of the operator to obtain approval for their Plan of Operations provides the Forest Service the opportunity and authority to control the effects of the development on the Forest surface resources. Fiscal Year 2014 inspections of mineral sites indicate that the effects of mining activities on surface resources are consistent with Forest Plan expectations.

The Tongass is also engaged in an on-going effort to mitigate the dangers posed by Abandoned Mine Land (AML) features. These features include tunnels, adits, shafts, tailing ponds, rock dumps, mill sites and other associated mining features.

## 34. Subsistence Management

### Are the effects of management activities on subsistence users in rural Southeast Alaska communities consistent with those estimated in the Forest Plan?

Title VIII of the Alaska National Interest Lands Conservation Act provides for customary and traditional uses by rural Alaska residents of wild renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation. Non-wasteful subsistence uses of fish and wildlife and other renewable resources are the priority consumptive resource uses on the public lands of Alaska. If take restrictions are required to maintain resources, restrictions to subsistence uses will be last.

Eleven fisheries assessment projects were conducted in Southeast Alaska in FY 2014. Ten projects assessed sockeye salmon harvests and escapements for stocks that sustain subsistence fisheries. One project surveyed Unuk River eulachon.

**Salmon in fish trap. Photo by Justin Koller**

Aerial moose surveys were conducted near Yakutat in 2014.

A review of project level subsistence analyses will occur in 2017 to determine the effects of the Forest Plan on subsistence uses. 2017 was selected because trends in fish and wildlife populations and subsistence uses generally require long term data sets.

## 35. Wilderness

### Is the wilderness character being maintained?

The Tongass Wilderness Character Monitoring plan was signed by September 2012. While components of the monitoring were identified and the sampling methods refined and tested in 2013, trends cannot be identified until additional monitoring is done. There can be no conclusions regarding the success or the maintenance of the wilderness character on the Tongass until the trends are established.

Progress in 2014 in establishing the baseline needed to respond to the ongoing wilderness character monitoring question was facilitated by grants of $95,100 provided by the Washington Office, integrated projects and through the increased participation of regional non-profit organizations interested in wilderness stewardship. These grants and integrated projects improved the work in wilderness stewardship across the Tongass.

**Admiralty National Monument stewardship project – invasive plant removal.**

Some results for components of the wilderness character are being reported separately by resource (for example, air quality and invasive plants). There has not been enough information collected to determine whether or not the wilderness character of each wilderness is being maintained.

Protocols have been developed, or are being formulated, to address invasive plants, lichen monitoring, wilderness development indexing, preserving outstanding opportunities for solitude, measuring encounters, and campsite inventories.

## 36. Heritage Resources

### Are (1) project clearance/inventory, (2) project implementation, (3) mitigation, and (4) enhancement completed in accordance with the requirements and regulations for heritage resources?

Heritage specialists recorded 105 undertakings on the Tongass in FY 2014. Of those, 27 were reviewed under the Standard 4-part process in Section 106 of the National Historic Preservation Act and involved evaluating sites for National Register eligibility as well as evaluating potential impacts from agency undertakings.

**Student volunteer, Sara Gross, excavates a test pit. Photo by Jeff DeFreest**

Four of the projects were determined to have an Adverse Effect to sites eligible to or listed in the National Register and required mitigation through a Memorandum of Agreement with the State Historic Preservation Officer (SHPO).

The activities within the remaining 78 agency undertakings met the criteria for evaluation under the Programmatic Agreement with the SHPO. Section 110 activities include direct monitoring and condition of sites, as well as partnerships and educational activities that enhance understanding and protection of cultural resources.

In summary, the forest plan's standards and guidelines appear to be complying with the requirements to identify and protect the forest's significant cultural resources. Most of the monitored sites are stable and in good condition, with only a few being actively eroded through natural means, or experiencing adverse effects from visitors.

Decreasing funding challenges the monitoring program to look for alternative methods to carry out the work. In this case, the staffs introduce efficiencies by working cooperatively with other program areas to visit sites.

**Volunteer Tom Metke excavates a stake. Photo by Martin Stanford**

## 37. Recreation

**Are areas of the Forest being managed in accordance with the prescribed Recreation Opportunity Spectrum (ROS) class in Forest-wide Standards and Guidelines? Is the ROS classification consistent with public demand?**

Outfitters and guides provided more than 600,000 recreation visitor days of guide services on the Tongass National Forest in FY 2014. Guides provided nature touring, hiking, flightseeing, rafting, dog-sledding, wilderness adventures, and big game guiding.

The Tongass maintains more than 350 developed recreation sites across the Forest. These include 2 major visitor centers, 4 major wildlife and fish viewing sites, almost 200 shelters and cabins, 12 campgrounds, and more than 40 day use or interpretive sites. The Tongass also manages more than 400 miles of hiking trails, of which almost 92 miles of trail are within congressionally designated wilderness. Another 400 miles of motorized trails are identified on district motor vehicle use maps.

In 2013, the Tongass completed an environmental assessment to determine whether or not to remove 12 cabins. Most of the cabins proposed for removal were available for public use through the National Recreation Reservation System, but had seen little to no use for several years. Some of the cabins were in disrepair and not safe for use. As the manual requires the Forest Service to maintain facilities to a safe standard for the public, removing these cabins will allow funding for the operation and maintenance of these sites to be used in other locations where public demand is higher. In 2014, three of these cabins were removed. Others will be removed or converted to shelters in the coming years.

**Naha Trail**

## 38. Wild, Scenic and Recreational Rivers

**Are Wild, Scenic, and Recreational River Standards effective in maintaining or enhancing the free flowing conditions and outstandingly remarkable values of the classification level for which the river was found suitable for designation as part of the National Wild and Scenic River System?**

The 2008 Forest Plan identifies thirty one rivers (or segments), pending designation by Congress as Wild, Scenic, or Recreational Rivers. Approximately 536 miles of rivers on the Tongass are included in this recommendation to maintain the eligibility of the total miles of river for the Wild, Scenic, or Recreational classification.

**Petersburg Lake morning.**

No projects proposed effects to proposed Wild, Scenic or Recreational River characteristics and no NEPA documents completed that evaluated impacts to these characteristics in FY 2014.

No monitoring was required or completed.

## 39. Scenery

### Are the adopted scenic integrity objectives established in the Plan met?

In FY2014, Tongass National Forest landscape architects completed 14 analyses for compliance with Scenery Standards and Guidelines as part of implementing the Forest Plan. There were also numerous minor scenery resource support efforts for Special Use Permits and small district projects (modifications to cabins, communication sites, a fish pass, and small-scale tree thinning). Some of these projects will be monitored in the future during implementation.

Many projects implemented during 2014 (other than timber sales) were evaluated using the "exception for small areas of non-conforming developments, such as recreation sites, transportation developments, log transfer facilities and mining development... on a case-by-case basis" as allowed by the land use designation (LUD).

In these situations, the scenic integrity objectives (SIO) allowed under the exception often differs from the SIO established by the LUD standards and guidelines because the benefit to the public of the development or management activity has been judged to outweigh the need to strictly conform to the original SIO.

The monitored projects met designer expectations regarding effects to scenery.

**Vegetation plugs near Raven's Roost Trail rest area. Photo by Carol Jensen**

# Economic and Social Environment

## 40. Economics

### Are the effects on employment and income similar to those estimated in the Forest Plan?

The following employment sectors best represent the Tongass contribution to Southeast Alaska's economy.

#### Lumber and Wood Products

Logging and sawmill employment levels have remained fairly stable with minor variations since 2008. The current level of harvest and industry employment is due to a complex array of factors.

#### Recreation and Tourism

The industry sectors, which may include recreation and tourism employment, show a slight decline over the past eight years (2008-2014). We cannot be sure how this relates to Forest Plan implementation. These sectors are complex and depend on many factors including local, state and national economies. The National Visitor Use Monitoring (NVUM) data

provides estimates for economic contributions of the Tongass on the recreation and tourism industry, however, the estimates cannot be compared with employment projections provided in the 2008 FEIS because they use different methods.

### Mining

The mining industry has experienced steady growth in the past five years. It is unlikely that this growth is related to 2008 Forest Plan direction but is likely tied to global market demand and prices.

### Salmon Harvesting and Processing

There has been slight growth in the salmon processing industry over the past five years. While it may be difficult to draw a direct correlation between processing employment and Forest management activities, the 1997 FEIS lists a series of assumption about this relationship that indicates that they may be closely related. The Forest Plan assumes that 80 percent of the commercially caught Southeast Alaska salmon originate on the Tongass. Fish processing employment was derived similarly with the added assumption that salmon represented 60 percent (on volume basis) of the total processed catch. About 48 percent of seafood processing employment is assumed to be dependent upon the Forest (1997 FEIS, page 455). If these assumptions are true, then Tongass activities may have had a positive effect on the salmon seafood processing industry. Though, trends in salmon harvesting and processing are dependent on many factors.

### Federal Government

Although holding steady for the past two years, overall federal government employment has declined since 2008. This may be due to a number of factors including consolidation of positions, lower budgets from Congress, and a decreased number of projects (timber, recreation, and road building). Due to the lower federal government employment, some smaller communities may experience difficulty attracting other services and industries (2008 FEIS, page 3-498).

## 41. Costs and Outputs

### What is the trend in outputs and costs associated with those outputs?

This output information was obtained from the national Performance Accountability System (PAS) Regional Accomplishment by Forest Report for Fiscal Year (FY) 2014. The output tables in some of the previous years followed a different order.

**Table 1. Allocated and expended funds for FY2014 monitoring and evaluation**

| FY 2014 | Description | Allocated | Expended |
|---|---|---|---|
| Subtotal | Appropriated Funds | $47,236,062 | $47,495,570 |
| Subtotal | Permanent & Trust Funds | $ 5,835,391 | $ 5,651,376 |
| TOTAL | | $53,071,453 | $53,146,946 |

**Table 2. A sample of the outputs for FY2014**

| Planning, Inventory and Monitoring | |
|---|---|
| Annual Monitoring Requirements Completed | 31 requirements |
| Acres of Inventoried Data Collected and Acquired | 4,389,240 acres |
| Land Management Plan (LMP) Amendments Underway | 0 amendment |
| Land Management Plan (LMP) Assessments Completed | 0 assessment |

## Program Contact

USDA Forest Service
Ketchikan Supervisor's Office
Inventory Monitoring Program
Federal Building
648 Mission St
Ketchikan, AK 99901

Cathy Tighe
ctighe@fs.fed.us

www.fs.usda.gov/goto/R10/Tongass/Monitoring
https://www.facebook.com/TongassNF
https://twitter.com/TongassNF

Page intentionally left blank.

United States Department of Agriculture

# Fiscal Year 2014 Tongass National Forest

# Annual Monitoring and Evaluation Report

## Monitoring Questions and Technical Evaluation

Forest Service Alaska Region

Tongass National Forest R10-MB-770 September 2015

Page Intentionally blank

# Contents

1. Air Quality ....1
2. Climate Change: Permanent Snowpack ....5
3. Biodiversity: Restocking ....11
4. Biodiversity: Young-Growth Habitat ....13
5a. Biodiversity: Other Habitat Components ....20
5b. Biodiversity: Fungi ....22
6. Insects and Disease ....32
7. Invasive Species: Status ....43
8. Invasive Species: Prevention and Control ....45
9. Biodiversity Ecosystem: Old-Growth Associated Species ....48
10a. Biodiversity Ecosystem: Change in Old-Growth by Biogeographic Province ....52
10b. Biodiversity Ecosystem: Cumulative Change ....56
11. Biodiversity Ecosystem: Matrix ....59
12. Biodiversity Ecosystem: Rare Plants ....64
13. Streams and Fish Habitat: Management Indicator Species ....68
14a. Streams and Fish Habitat: Aquatic Habitat ....84
14b. Streams and Fish Habitat: Fish Passage ....91
15. Streams and Fish Habitat: Riparian ....141
16. Wildlife Terrestrial Habitat: Management Indicator Species ....152
17. Wildlife Terrestrial Habitat: Special Status Species ....166
18. Wildlife Terrestrial Habitat: Endemic Mammals ....177
19. Soil and Water: Productivity and Quality ....183
20a. Soil and Water: BMP Monitoring ....191
20b. Soil and Water: BMPs ....202
21. Soil and Water: Restoration ....205
22. Wetlands ....216
23. Karst and Cave Ecosystems ....223
24. Timber Resources: Economics and Volume ....230
25. Timber Resources: Standards and Guidelines ....232
26. Timber Resources: Allowable Sale Quantity ....235
27. Timber Resources: Tongass Timber Reform Act (TTRA) ....237
28. Timber Resources: Adaptive Management Strategy ....239

29. Timber Resources: Non-Interchangeable Components .....241
30. Timber Resources: Non-Interchangeable Components Proportional Mix.....244
31. Transportation System: Standards and Guidelines .....247
32. Transportation System: Maintenance .....253
33. Mining and Mineral Exploration .....256
34. Subsistence.....257
35. Wilderness.....260
36. Heritage Resources .....265
37. Recreation .....274
38. Wild, Scenic and Recreational Rivers .....276
39. Scenery.....277
40. Economics.....283
41. Cost and Outputs.....297
Appendix A. Tongass-wide Watershed Restoration Effectiveness Monitoring (WREM) .....300
Appendix B. Watershed Restoration Effectiveness Monitoring, FY 2014 Progress Report.....304
Appendix C. Twelvemile Creek Juvenile Salmonid Smolt Investigation Summary Report, FY2014 .....316
Appendix D. Best Management Practice Trip Reports
Corner Bay Facility Maintenance, Sitka Ranger District .....323
Harbor Mountain, Road 7576, Sitka Ranger District .....328
Kensington Gold Mine, Juneau Ranger District.....332
Kruzof North Beach ATV Area, Sitka Ranger District.....347
North Pole Unit 1, Thorne Bay Ranger District .....353
Raven Trail Construction, Petersburg Ranger District.....359
Road 3015, MP 1.773 and 8.743, Thorne Bay Ranger District.....363
Road 6028 (Frenchy), Petersburg Ranger District.....370
Completed Waterbody Crossing Reconstruction, Road B Form, Road 8448, MP 0.380, Ketchikan-Misty Fiords Ranger District.....373
Aquatic Habitat Improvement, Mainstem of Saginaw Creek, Petersburg Ranger District .....376
Completed Construction of Transmission Lines, Facilities C Form, Swan-Tyee Intertie, Shrimp Road System Crossing, Ketchikan-Misty Fiords Ranger District .....380
Single Pit Area 1, Thorne Bay Ranger District.....382
Starrigavan Road 7513, Sitka Ranger District.....388
Tonka Stewardship Contract, Petersburg Ranger District .....393

# 1. Air Quality

**Goal:** Maintain the current air resource condition to protect the Forest's ecosystems from on- and off-Forest air emissions sources.

**Objective:** Attain national and state ambient air quality standards Forest-wide.

## Air Quality Question: *Is air quality being maintained?*

To answer this monitoring question, both annually and every five years, several other factors must first be considered. Ultimately, we want to know how to protect resources from deleterious effects from air contaminants from on- and off-Forest emission sources.

### Evaluation Criteria

- ADEC and EPA data
- Air quality biomonitoring data

### Monitoring Results

**ADEC and EPA review for 2014:** (Is air quality for human health concerns being maintained and if not, how will non- attainment of certain pollutants impact natural resources on adjacent NSF lands?)

**$PM_{10}$:** The City of Juneau was designated non-attainment for National Ambient Air Quality Standard (NAAQS) particulate matter $PM_{10}$ in 1990. Over the years, efforts have been taken to minimize road dust through paving as well as educating the public to limit woodstove use and open burning during certain periods. Within the past few years, the Alaska Department of Environmental Conservation (ADEC) submitted a new maintenance plan to EPA. These efforts have allowed Juneau to be re-designated as a maintenance area with the US Environmental Protection Agency (EPA) in 2009. In July 2013, the EPA approved the maintenance plan and Juneau is considered in maintenance status (http://dec.alaska.gov/air/anpms/SIP/akrevisions1.htm). As of December 2014, nothing has changed in this maintenance status.

**$PM_{2.5}$:** In 2006, the EPA strengthened its air quality standards for fine particulates or $PM_{2.5}$ to 35 g/m$^3$. As federal standards became stricter, the City of Juneau also tightened ordinances that originally dated from the 1980's and increased public education and compliance efforts. Data from 2006-2008 indicate that Juneau has met federal air quality standards for $PM_{2.5}$ (ADEC 2010). No changes to this designation are present in 2014, but the ADEC website states that Juneau is close to nonattainment for $PM_{2.5}$ (ADEC 2014).

**Contaminant thresholds in lichens for 2014:** (How to determine the current air resource condition?)

As part of the Wilderness Challenge six lichen biomonitoring plots were revisited in 2014 within three wilderness areas to determine the air quality condition and gather data for trends in contaminant and nutrient accumulation (Table 1, Figures 1 and 2).

**Air Table 1. Lichen biomonitoring plots revisited in 2014 in wilderness**

| Plot Number | Location | Wilderness Area | First Established | Visit Number |
|---|---|---|---|---|
| 513 | Egg Harbor | Coronation | 2005 | 2 |
| 514 | Windy Pass | Coronation | 2005 | 2 |
| 189 | Gambier Bay | Kootznoowoo | 1989 | 3 |
| 190 | Gambier Bay | Kootznoowoo | 1989 | 3 |

| Plot Number | Location | Wilderness Area | First Established | Visit Number |
|---|---|---|---|---|
| 496 | J-lake ridge | S. Etolin | 2005 | 2 |
| 497 | J-lake shore | S. Etolin | 2005 | 2 |

A total of 14 lichen tissue samples were collected, processed and sent to the University of Minnesota analytical lab for analysis of contaminants including Nitrogen, Sulfur, and heavy metals. Results will be entered into the USDA Forest Service National database (USDA 2006). Results will be compared to the thresholds established for the Tongass National Forest in four target lichen species (Table 2).

**Air Table 2. Contaminant thresholds in lichens from the Tongass National Forest (from Dillman et al. 2007). Species of lichens are: *Alectoria sarmentosa* (Alesar), *Hypogymnia* species (Hypog), *Lobaria oregana* (Lobore) and *Platismatia glauca* (Plagla).**

| Species | S | N | Al | B | Ba | Be |
|---|---|---|---|---|---|---|
| Alesar | 0.06 | 0.56 | 56.78 | 9.33 | 15.84 | 0.04 |
| Hypog | 0.09 | 0.88 | 1126.44 | 9.47 | 76.62 | 0.04 |
| Lobore | 0.13 | NA | 580.03 | 4.06 | 16.46 | 0.04 |
| Plagla | 0.08 | 0.80 | 1063.57 | 6.05 | 53.80 | 0.04 |
| | | | | | | |
| **Species** | **Ca** | **Cd** | **Co** | **Cr** | **Cu** | **Fe** |
| Alesar | 9689.25 | 0.40 | 0.78 | 0.73 | 1.86 | 55.64 |
| Hypog | 24671.17 | 0.61 | 1.25 | 2.38 | 31.31 | 1990.78 |
| Lobore | 1158.10 | 0.55 | 0.83 | 1.51 | 10.18 | 1010.97 |
| Plagla | 4104.48 | 0.32 | 1.14 | 3.29 | 7.55 | 1773.56 |
| | | | | | | |
| **Species** | **K** | **Li** | **Mg** | **Mn** | **Mo** | **Na** |
| Alesar | 2413.25 | 0.40 | 740.83 | 188.24 | 0.54 | 893.16 |
| Hypog | 3284.34 | 0.71 | 2127.70 | 860.85 | 0.54 | 929.13 |
| Lobore | 8001.57 | 0.59 | 735.79 | 168.00 | 0.54 | 394.30 |
| Plagla | 2523.88 | 0.60 | 1717.08 | 483.70 | 0.54 | 693.21 |
| | | | | | | |
| **Species** | **Ni** | **P** | **Pb** | **Rb** | **Si** | **Sr** |
| Alesar | 0.96 | 913.75 | 5.00 | 53.00 | 134.75 | 33.56 |
| Hypog | 4.26 | 1597.23 | 10.13 | 53.00 | 563.82 | 61.26 |
| Lobore | 1.65 | 2532.49 | 3.52 | 53.00 | 681.18 | 6.30 |
| Plagla | 2.65 | 1115.00 | 3.52 | 53.00 | 635.83 | 28.91 |
| | | | | | | |
| **Species** | **Ti** | **V** | **Zn** | | | |
| Alesar | 4.93 | 0.37 | 38.06 | | | |
| Hypog | 62.42 | 2.99 | 70.20 | | | |
| Lobore | 45.30 | 2.42 | 82.93 | | | |
| Plagla | 76.86 | 3.08 | 52.85 | | | |

Elemental analysis takes several months from the time the samples are collected and prepared for the lab. Therefore, elemental analysis results for the six lichen biomonitoring plots revisited in 2014 will be presented in the 2015 annual monitoring report. This report provides the lichen data for those plots above

threshold that were revisited within three wilderness areas in 2013: Stikine-LeConte, Tebenkof and Petersburg Lake-Duncan Salt Chuck (Table 3).

**Air Table 3. Plots revisited in 2013 for air quality biomonitoring in wilderness. Elements or contaminates above Tongass thresholds are reported.**

| Plot Number | Location | Wilderness Area | Elements above threshold/lichen species | Change from last visit |
|---|---|---|---|---|
| 503 | Thunder Mt. | Stikine-LeConte | aluminum, potassium, phosphorus/*Hypogymnia enteromorpha* | Increase in concentration of these elements from 2005 to above thresholds in 2013. |
| 33 | Elena Bay | Tebenkof | copper/*Alectoria sarmentosa* | Cu only element remaining above threshold from 2005 visit, others now below. |
| 116 | Petersburg Lake | Petersburg Lake/Duncan Salt Chuck | manganese and zinc/*Hypogymnia duplicata* | In this lichen, both elements above threshold. This is a new development. Mn was elevated in *Alesar* in 2005. |

## Evaluation of Results

### *Wilderness Areas with Lichens Above Threshold*

In 2013, three wilderness areas were revisited to collect lichen tissue and conduct a lichen community inventory at the plots established during earlier monitoring periods 8 years ago. All three wilderness areas contained some changes in lichen tissue concentrations in elements above thresholds for aluminum, copper, manganese, potassium, phosphorus, and zinc (Table 2). The other plots visited in this monitoring period contained no elements above thresholds during this visit or the previous visit in 2005 (plots 57 from Petersburg Lake and 500 from Tebenkof).

In 2005, lichens from the Thunder Mountain location (plot 503) were not above thresholds for any elements, but were elevated above thresholds in 2013 for aluminum, potassium and phosphorus (Table 2) (Dillman et al 2007). This location is on the mainland, 5 miles from Petersburg, and possibly is influenced periodically from nearby glacial and Stikine River loess, particularly during dry years (such as 2013). Phosphorus and potassium are elements found naturally in the earth's crust, sea water and bird guano. Yet this plot is high elevation and not expected to be high in K or P due to distance from the ocean or sea birds. However, these elements are also emitted with wood burning, and it is possible that burning wood at the Petersburg dump on occasion drifts into the air currents and travels over to the mainland. Smoke from the Petersburg dump has been observed lingering over Frederick Sound during certain time periods over the years. The plot is in a small exposed Mt Hemlock stand, isolated from other stands that birds such as ravens or eagles may find refuge.

*Air Photo 1. Collecting lichen tissue for contaminant analysis in South Etolin Wilderness.*

Lichens from the Tebenkof Bay location (Plot 33) were elevated in copper in 2013, as well as in 2005. Copper is a naturally occurring element in rocks, and may be part of the natural variation in the Tebenkof area. However, only plot 33

*Air Photo 2. Lake in S. Etolin Wilderness near where permanent air quality lichen biomonitoring plots reside.*

had copper elevated in the lichens, the other plot about ¼ mile away did not. Other elements elevated above threshold in 2005 were not above threshold during this round (sulfur, aluminum, potassium, phosphorus) Therefore, this illustrates the importance of monitoring to determine trends in certain elements of concern.

Plot 116 in the muskeg around Petersburg Lake (approximately 10 miles from Petersburg) was above thresholds in manganese and zinc. This site was above thresholds for Mn in 2005, but in a different lichen species. Both of these elements are found naturally in rock and soil. However, this location is also on the flight path from Petersburg for glacier sightseeing tours in the summer months. Manganese is released in the air when fossil fuels are burned.

## Conclusions

In summary, the City of Juneau, Mendenhall Valley area is in maintenance status for PM 10 and is not on the national list for nonattainment for PM 2.5 National Ambient Air Quality Standards (NAAQS). The wilderness plots that were visited in 2014 assisted in achieving a higher score for the air element in the Chief's 10-Year Wilderness Stewardship Challenge. This work was completed through a grant from the WO. The 2014 lichen results will be presented in 2015. The consistent monitoring every ten years allows wilderness managers to gather trend data and to be aware of the environmental conditions that represent the wilderness character for air quality. The plots that contain contaminants of concern elevated above threshold may be monitored in 8 to 10 years to determine the trend in concentrations and any effects to the lichen community at those sites.

## Citations

Alaska Department of Environmental Conservation. 2014. Personal communication with ADEC air quality specialist. November.

Alaska Department of Environmental Conservation. 2014. New data shows Juneau meets federal air quality standards. http://dec.alaska.gov/air/index.htm [Accessed August 13, 2015]

USDA. 2006. National lichens and air quality database and clearinghouse. http://gis.nacse.org/lichenair/ [Accessed August 13, 2015]

# 2. Climate Change: Permanent Snowpack

**Goal:** Identify and evaluate long-term changes to permanent snowpack as a result of climate change.

**Objectives:** Determine whether changes in snowpack are affecting watersheds and associated wildlife species. Support efforts of other agencies and research organizations in assessing climate change.

**Background:** Snowpack plays an important role in aquatic and terrestrial ecosystems throughout Southeast Alaska. Extensive areas of the mainland are covered in glaciers and icefields. Glaciers are also found on the islands of the Alexander Archipelago. Glacial runoff strongly influences the character of freshwater and marine environments in and around the Tongass National Forest. Island ecosystems are also affected by permanent and seasonal snowpack. Long term climate trends and decadal climate cycles influence air temperature and precipitation. Glacier and snowpack changes can indicate climate trends that are relevant to national forest management because they respond directly to these temperature and precipitation changes. Changes in glaciers and snowpack alter streamflow, water quality, and habitats important to fish, wildlife, and people.

## Climate Change Question: *What are the long-term changes to the permanent snowpack and how does it affect the physical and biological environment?*

This question was added to the Forest Plan monitoring plan in 2008. The resource specialists assigned to develop a protocol for this question recommended deferring specific efforts until more information from regional and state climate change assessments was available. Meanwhile, Forest Service support to other agencies' snowpack and streamflow monitoring programs within the Tongass National Forest was recognized as important.

### Evaluation Criteria

The Forest Plan states that the evaluation criteria for this question are "changes to permanent snowpack over the last five, ten, and fifteen years that are sources of water for sensitive watersheds and are important features for wildlife." A monitoring protocol has not yet been developed to address this question.

### Sampling/Reporting Period:

The sampling, reporting and evaluation schedules are on a five-year interval.

### Monitoring Results

Snow course data is summarized below.

### Evaluation of Results

Forest Plan direction is to evaluate key changes and effects on selected resources and assess potential changes to the Forest Plan. This report summarizes new information and ongoing efforts related to:

- climate change
- snowpack changes (glaciers, permanent and seasonal snowpack)
- streamflow

#### *Climate Change*

Long term climate trends and decadal climate cycles have been observed in Southeast Alaska, influencing air temperature and precipitation (Neal et al. 2002). There is a growing body of literature on the topic of

climate change and likely effects on aquatic and terrestrial ecosystems of the Tongass National Forest (e.g., Bryant 2009, Hodgkins 2009, Hood and Berner 2009, Haufler et al 2010, Wolken et al. 2011). The Forest Service collaborates with the University of Alaska Scenarios Network for Alaska Planning (SNAP), the Alaska Climate Science Center, The Nature Conservancy and many other entities on this topic (USDA 2014).

A Tongass Climate Change Team promotes communication and provides information and advice to leadership on relevant issues, activities and programs. Activities include the annual Forest Service Climate Change Scorecard and progress toward vulnerability assessments (ibid). The national Scorecard began in 2011 and consists of ten yes or no questions in four dimensions: organizational capacity, engagement, adaptation, and mitigation. National forests can measure progress by describing accomplishments and/or plans for improvement towards a "yes" answer.

The Tongass National Forest scored seven out of ten on the 2014 Forest Service Climate Change Scorecard (USDA 2014), reflecting improvement from 2013 as two more "yes" answers. Continued negative responses for operational guidelines, adaptive actions, and carbon stock baseline assessments lead to actions in 2015 (ibid). Responses for coordination, sustainable operations, monitoring, partnerships, and science engagement continued as affirmative. New affirmative responses were provided for employee training and vulnerability assessments.

The Tongass National Forest worked with EcoAdapt to complete a climate vulnerability assessment report focused on snow, ice, water, riparian vegetation and fish species (EcoAdapt 2014). This collaboration capitalizes on the work completed by SNAP to characterize likely trends. The Tongass continues to support a climate vulnerability assessment led by the Pacific Northwest Research Station, focused on salmon in Southeast Alaska.

New accomplishments for employee training in 2014 included: 1) a self-directed national training module provided to all employees; 2) weekly Tongass Leadership Team notes and a monthly eNewsletter provide climate change updates, including "keep your green on" elements to all employees; 3) development of one page fact sheets and key messages for Rangers, a forest sustainability video, and friendly District competitions for energy and carbon footprint assessments; 4) eco-literacy provided through a Jeopardy Game Learning Tool; and 5) a new film DVD, "Landscape of Change", which focuses on the Mendenhall Glacier climate studies, was distributed forest-wide.

### *Snowpack Changes - Glaciers*

Glaciers in Southeast Alaska are particularly vulnerable to climate change due to their relatively low elevation (Larsen et al. 2007). On average, Alaskan glaciers are experiencing a trend of accelerating mass loss (Van Beusekom et al. 2010, Arendt 2011). Ice cover in Glacier Bay National Park, adjacent to the Tongass National Forest, has diminished by eleven percent since 1952 (Arendt et al. 2012). The majority of glaciers are retreating; only tidewater glaciers in the park have advanced (ibid). Glaciologists have estimated a loss of roughly 16.7 cubic kilometers of ice from Southeast Alaska between 1948 and 2000: a rate of loss more than twice that previously reported (Larson et al. 2007). Most of the ice losses are occurring at tide or lake terminal glaciers during calving (e.g., LeConte, Dawes, South Sawyer, Mendenhall Glaciers); the tidewater glaciers that are growing or fluctuating (e.g., Taku, Hubbard Glaciers) are doing so in response to factors unrelated to recent climate conditions (ibid). Rapid thinning and retreat at Juneau's Mendenhall Glacier has increased calving (Boyce et al. 2007). Similar accelerated glacial retreat has been observed on Baranof Island (Hughey and Giese 2012). Pollution deposition and accumulation in glaciers as black carbon may also accelerate melt rates.

The US Geological Survey's Alaska Climate Science Center at the University of Alaska (http://www.doi.gov/csc/alaska/index.cfm) has funded interdisciplinary research to quantify glacial runoff from watersheds along the Gulf of Alaska (including the Tongass National Forest) and assess impacts on coastal ecosystems (AK CSC 2013).

Several Tongass National Forest glaciers have active monitoring programs. The US Army Corps of Engineers' Cold Regions Research and Engineering Laboratory leads the Hubbard Glacier monitoring project near Yakutat (http://glacierresearch.com/). Instruments have been installed to continuously track the seasonal advance and retreat of the Hubbard Glacier terminus to determine the potential for closure of Russell Fiord and associated flood risks to the community of Yakutat. The University of Alaska Southeast is monitoring Mendenhall Glacier and others in the Juneau Icefield (http://www.uas.alaska.edu/arts_sciences/naturalsciences/envs/faculty_staff/pubs/mendenhall_glacier_science_july_2010.pdf). Petersburg High School students have conducted an annual survey of the LeConte Glacier terminus on the Wrangell Ranger District since 1983 (http://leconte.webs.com/).

### *Snowpack Changes – Permanent and Seasonal Snowpack*

Permanent and seasonal snowpack in Southeast Alaska is also vulnerable to climate change. Long term and cyclical changes in snow lines and snow depth affect terrestrial and aquatic resources. For example, reduced snow depth during a cyclical warming trend in the 1970s and 1980s is the likely cause of extensive yellow-cedar mortality in Southeast Alaska (Hennon et al. 2012).

Snowpack monitoring in the Tongass National Forest is conducted in cooperation with the Natural Resource Conservation Service (NRCS). Forest Service personnel from Juneau, Wrangell and Petersburg Ranger Districts collect seasonal snowpack data at eight snow courses on the Tongass National Forest following NRCS protocols. The Douglas Island and Petersburg snow courses were established in the late 1970s. Two new Wrangell snow courses were established in 2009. There are three automated SNOTEL sites on the Tongass National Forest operated by NRCS or other entities measuring permanent snowpack associated with hydropower facilities at Snettisham (near Juneau) and Swan Lake (near Ketchikan). Information about snow courses, SNOTEL sites, and data are available at http://www.ak.nrcs.usda.gov/Snow/index.html.

Snowpack observations for the end of winter (April 1, 2014) were at 95 percent of median for the 8 index sites in SE Alaska reported by the NRCS. This compares to 131 percent of median at the same time in 2013.

All of the currently monitored snowpack sites on the Tongass National Forest are either on the mainland or central/northern end of the Alexander Archipelago. Potential impacts to important salmon runs from changing seasonal stream flows and water quality are likely to occur first in the southern, outer coastal area of the Tongass National Forest (EcoAdapt 2014). Low elevation watersheds in this area typically have lower average winter snowpack and duration, more extreme summer low flows and higher water temperatures. Many stream systems in this area depend on relatively thin and variable snow packs to maintain streamflow during rainless periods in the summer. Streams on Prince of Wales Island (e.g., Staney Creek) have experienced die offs of spawning pink salmon during extreme low flow summer periods combined with large returns of adult salmon. Although these events are not common, they are likely to increase in frequency if summer streamflows decrease (Bryant 2009).

### *Streamflow*

The direct relationship between snowpack and streamflow in Southeast Alaska is well known and has implications for salmon life stages (Neal et al. 2002, Taylor 2008, Bryant 2009, Hodgkins 2009, Goode et al 2013), hydropower facilities (Cherry et al. 2010), and effects of timber harvest (Grant et al. 2008).

The US Geological Survey (USGS) has collected and managed streamflow data from over 200 different sites on the Tongass National Forest since the early 1900s; some stream gauges have over forty years of record. The Forest Service has contributed significant funding and logistical support to the USGS streamflow program, though declining budgets have whittled the active stream gauges down to about a dozen. The historical and active stream gauges represent glacial-, snow-, transient snow-, and rain-dominated systems, all of which have relevance to assessing climate trends. Publicly accessible, real-time data are available from some stream gauges. Many include continuous stream temperature and other

water quality parameters in addition to streamflow. Data and site information are available at http://waterdata.usgs.gov/ak/nwis/.

As of 2013, three USGS stream gauges in the Tongass National Forest are at least partially funded by the Forest Service (compared to five in 2008). Staney Creek and Old Tom Creek are the highest priority for the forest due to their length of record and potential for evaluating effects of timber harvest (personal communication with Ed Neal, 2010). The USGS and other partners continue to fund other stream gauges in the Tongass National Forest.

## Action Plan

At this time, no changes to the forest plan are recommended, with one exception which is a recommendation to be considered in the context of the five-year review of the Forest Plan.

- *Consider re-writing this monitoring question to support a more robust, integrated evaluation of climate change relevant to the management of the Tongass National Forest. For example, a more robust question would likely address and inform monitoring strategies for hydropower and municipal water supplies, salmon habitat, and yellow-cedar.*
- Follow through on actions described in the 2014 Forest Service Climate Change Scorecard (USDA 2014), emphasizing renewed strategic collaboration, and development of operational guidelines and adaptive actions focused on resources at risk that are managed by the Tongass National Forest.
- Maintain collaboration with the Alaska Climate Science Center, Alaska Coastal Rainforest Center, Pacific Northwest Research Station and University of Alaska Southeast to learn how best the Tongass National Forest can support relevant climate change research and utilize research findings.
- Support down-scaled regional climate models and use of tools such as NetMap to refine vulnerability and resource impact predictions and provide an improved framework to inform climate change monitoring efforts.

The following recommendations should be considered in the context of relevant snowpack monitoring (and closely related activities) in the Tongass National Forest:

- Maintain current investments in snow course data collection. These are low cost efforts that contribute to long-term records relevant to the islands of the Tongass National Forest. Snow data, though relatively sparse, may provide important field calibration points for downscale climate models or snow models in development.
- Establish additional snowpack monitoring sites in salmon producing watersheds in the southern and outer coastal areas of the Tongass National Forest, including Prince of Wales and possibly Baranof Island.
- Maintain funding and logistical support to USGS stream gage program. The decommissioning of stream gages in the last few years has already compromised the calibration of climate modeling to demonstrated streamflow effects.

## Citations

AK CSC. 2013. Assessing the sensitivity of Alaska's coastal rainforest ecosystems to changes in glacier runoff.

Arendt, A. 2011. Assessing the status of Alaska's Glaciers. Science. 332: 1044-1045.

Arendt, A., C. Larsen, M. Loso, N. Murphy, and J. Rich. 2012. Alaskan National Park glaciers - status

and trends: First progress report. Natural Resource Data Series NPS/AKR/NRDS—2012/403. National Park Service, Fort Collins, CO.

Boyce, E., R. Motyka, M. Truffer. Flotation and retreat of a lake-calving terminus, Mendenhall Glacier, southeast Alaska, USA. Journal of Glaciology. 53(181): 211-224.

Bryant, M. 2009. Global climate change and potential effects on Pacific salmonid in freshwater ecosystems of southeast Alaska. Climate Change. 95: 169-193.

Cherry, J., S. Walker, N. Fresco, S. Trainor, A. Tidwell. 2010. Impacts of climate change and variability on hydropower in Southeast Alaska: Planning for a robust energy future.

EcoAdapt. 2014. A climate change vulnerability assessment for aquatic resources in the Tongass National Forest. EcoAdapt, Bainbridge Island, WA.

Goode, J. R., J Buffington, D. Tonina, D. Isaak, R. Thurow, S. Wenger, D. Nagel, C. Luce, D. Tetzlaff, and C. Soulsby. 2013. Potential effects of climate change on streambed scour and risks to salmonid survival in snow-dominated mountain basins. Hydrological Processes. 27: 750-765.

Grant, G., S. Lewis, F. Swanson, J. Cissel, J. McDonnell. 2008. Effects of forest practices on peak flows and consequent channel response: a state-of-science report for western Oregon and Washington. USDA Forest Service, General Technical Report PNW-GTR-760.

Haufler, J., C. Mehl, and S. Yeats. 2010. Climate change: anticipated effects on ecosystem services and potential actions by the Alaska Region, USDA Forest Service. Ecosystem Management Research Institute, Seeley Lake, MT.

Hennon, P., D. D'Amore, P. Schaberg, D. Wittwer and C. Shanley. 2012. Shifting climate, altered niche, and a dynamic conservation strategy for yellow-cedar in the North Pacific Coastal Rainforest. BioScience. 62(2):147-158.

Hodgkins, G. 2009. Streamflow changes in Alaska between the Cool Phase (1947-1976) and the Warm Phase (1977-2006) of the Pacific decadal oscillation: The influence of glaciers. Water Resources Research. 45.

Hood, E., L. Berner. 2009. Effects of changing glacial coverage on the physical and biogeochemical properties of coastal streams in southeastern Alaska. Journal of Geophysical Research. 114.

Hughey, B. and A. Giese. 2012. A quantification of glacier retreat on Baranof Island, AK through remotely sensed data. Report submitted to the Department of Earth Sciences, Dartmouth College.

Larsen, C., R. Motyka, A. Arendt, K. Echelmeyer, and P. Geissler. 2007. Glacier changes in southeast Alaska and northwest British Columbia and contribution to sea level rise, Journal of Geophysical Research. 112.

Neal, E., M. Walter, and C. Coffeen. 2002. Linking the Pacific decadal oscillation to seasonal stream discharge patterns in southeast Alaska, Journal of Hydrology. 263: 188–197.

Neal, E. 2010. Personal communication to Steve Paustian (USFS) including updated comparative analyses of discharge data from Staney Creek (USGS station no. 15081497) and Old Tom Creek (USGS station no. 15085100) through the 2009 water year. December.

Taylor, S. G. 2008. Climate warming causes phenological shift in pink salmon, *Oncorhynchus gorbuscha*, behavior at Auke Creek, AK. Global Change Biology. 14: 229-235.

Truffer, M., R. Motyka, M. Hekkers, I. Howat, M. King. 2009. Terminus dynamics at an advancing glacier: Taku Glacier, AK. Journal of Glaciology. 55(194): 1052-1060.

USDA. 2014. Forest Service Climate Change Scorecard. Washington, D.C.

Van Beusekom, A., S. O'Neel, R. March, L. Sass, L. Cox. 2010, Re-analysis of Alaskan benchmark glacier mass-balance data using the index method: U.S. Geological Survey Scientific Investigations Report 2010–5247. 16 p.

Wolken, J., T. Hollingsworth, T. Rupp, F. Chapin, III, S. Trainor, T. Barrett, P. Sullivan, A. McGuire, E. Euskirchen, P. Hennon, E. Beever, J. Conn, L. Crone, D. D'Amore, N. Fresco, T. Hanley, K. Kielland, J. Kruse, T. Patterson, E. Schuur, D. Verbyla, J. Yarie. 2011. Evidence and implications of recent and projected climate change in Alaska's forest ecosystems. Ecosphere. 2(11): 124.

# 3. Biodiversity: Restocking

**Goal:** Forest productivity is to be maintained in all harvest areas. Monitor the restocking of all lands that have received a regeneration harvest and determine if restocking has occurred within five years of final harvest.

**Objective:** Areas not adequately restocked with desirable tree cover within a five-year time frame are to be identified and action taken to see that failed areas are reforested. Changes in silvicultural practices may be necessary in these areas.

**Background:** Obtaining regeneration that meets the stocking guidelines and certification standards identified in the Silvicultural Practices Handbook (FSH 2409.17) is rarely a problem on stands receiving a regeneration harvest on the Tongass National Forest. Unpublished research and field observations indicate there are specific site conditions and opportunities that may indicate a need for artificial regeneration (this is usually planting and only rarely artificial seeding). Some situations to be particularly aware of are as follows:

- alluvial sites;
- cutover, open canopy, or sparsely stocked sites with an established ground cover of dense vegetation such as salmonberry, devils club, or grass;
- sites lacking a satisfactory seed source within approximately 660 feet from the center of the cutting unit;
- sites with lower productivity that presently have a plurality of cedar and in which there is a desire to retain a cedar component in the stand;
- stand compositions where change is needed, such as stands planned for harvest or already harvested where the adjacent seed source contains a high incidence of fluted hemlock;
- artificial regeneration is rarely needed and is prescribed on less than 5 percent of the harvested acres; and
- stands needing reforestation for other considerations, such as visually sensitive areas in which immediate regeneration through artificial reforestation would lessen the visual impact; or using genetically improved stock to increase the genetic makeup of the treated stand.

## Biodiversity Question: *Are harvested forested lands restocked within five years following harvest?*

### Evaluation Criteria

All harvested lands are examined following treatment. Artificially seeded or planted areas are examined one and three years after treatment. Examination occurs three growing seasons after treatment in areas where it is anticipated that natural regeneration will be adequate. Stands are certified as stocked if the third growing season survey indicates that the areas meet stocking standards. Artificial regeneration is prescribed if the third-year survey indicates that natural regeneration is highly unlikely. A Forest Service Region 10 certified silviculturist recommends Regeneration Certification for every unit harvested that meets or exceeds the Stocking Guidelines in the Silvicultural Practices Handbook - FSH 2409.17.

Certification records are reported annually through the District Ranger to the Forest Supervisor. Certification records are kept in stand files at the Ranger Districts and in the Forest Service Activity Tracking System (FACTS) electronic database.

All stands harvested in FY2009 were certified as restocked in FY2014 or an earlier fiscal year. All lands harvested prior to FY2009 have also been certified as re-stocked.

## Monitoring Results

**Biodiversity Table 1. Status of Reforestation After Final Harvest FY 2009**

| Tongass Unit | Final Harvest Reported in FY 2009 (acres) | Adequately Stocked (acres) | % Adequately Stocked | Acres Not Adequately Stocked | % Not Adequately Stocked |
|---|---|---|---|---|---|
| Petersburg RD | 0 | 0 | 100 | 0 | 0 |
| Wrangell RD | 246 | 246 | 100 | 0 | 0 |
| Hoonah RD | 24 | 24 | 100 | 0 | 0 |
| Ketchikan-Misty RD | 258 | 258 | 100 | 0 | 0 |
| Craig RD | 231 | 231 | 100 | 0 | 0 |
| Thorne Bay RD | 182 | 182 | 100 | 0 | 0 |
| Total | 941 | 941 | 100 | 0 | 0 |

## Evaluation of Results

The results show that 100 percent of forestland that was harvested in FY2009 and has been surveyed for natural regeneration was adequately restocked within five years.

# 4. Biodiversity: Young-Growth Habitat

**Goals and Objectives:** Manage young-growth to improve habitat for wildlife and for commercial timber products. Review standards and guidelines for applicability to young-growth stands. Maintain habitat capability sufficient to sustain and produce wildlife populations that support the use of wildlife resources for sport, subsistence, and recreational activities. Include a young-growth management program to maintain, prolong, and/or improve understory forage production, and to improve habitat distribution, including future old-growth timber stands for wildlife (e.g., deer, moose, black bear, and other species) on both suitable and unsuitable lands.

**Background:** The Tongass National Forest has over 400,000 acres of young, even-aged stands created through clearcut logging. Stand development following this method of harvest typically includes natural regeneration of western hemlock and Sitka spruce (Alaback 1982a; Deal et al. 1991) and rapid growth of residual shrubs (Alaback 1980). This stage, referred to as the "stand initiation" stage, persists for 15 to 25 years, depending on site quality. Within 10 years of clearcutting, newly established conifers begin to overtop the shrubs, and crown closure may be complete by 25 years. During this "stem exclusion" phase there is a nearly complete elimination of understory vegetation (Alaback 1980, 1982b; Tappeiner and Alaback 1989). Around 100 years after harvest, the understory vegetation begins to re-establish, but does not become well-developed until the stand reaches 120- to 150-years old (Alaback 1982b, 1984; Tappeiner and Alaback 1989).

*Biodiversity Photo 1. Young-growth on the Tongass National Forest*

The stem exclusion stage of forest regeneration after clearcut logging has little value as wildlife habitat (Wallmo and Schoen 1980; Schoen et al. 1981, 1988; Thedinga et al. 1989; Hanley 1993; Dellasala et al. 1996; Brinkman et al. 2010). Therefore, management strategies are needed to minimize the length and severity of this stage. Successful silvicultural treatments will either delay the onset or hasten the end of the stem exclusion phase, or they will reduce its intensity by increasing light transmission through the overstory canopy. Pre-commercial thinning of stands not suitable for commercial thinning may improve wildlife habitat of treated stands, as well as their future timber value. Commercial thinning of older stands may provide these benefits while also increasing the supply of available timber. Some results indicate that understory plants may benefit from pruning, girdling, commercial thinning, and the inclusion of hardwoods such as red alder in the stand (Hanley et al. 2013).

## Biodiversity Question: *Following young-growth treatments, is the change in understory vegetation providing improved habitat for key old-growth associated species?*

Four studies on young-growth management activities are continuing on the Tongass:

1. Tongass-Wide Young-Growth Studies (TWYGS),
2. Prince of Wales Commercial Thinning study,
3. Re-measurement of thinned and pruned young-growth experimental plots, and
4. Work by the University of Wyoming on small mammal responses to young-growth.

### *TWYGS: Tongass-wide Young-Growth Studies*

The Tongass, in cooperation with the Pacific Northwest Research Station Forest Sciences Lab, Juneau (JFSL), has established a large-scale adaptive management study of young-growth management options, the Tongass-Wide Young-Growth Studies (TWYGS). The studies are designed to evaluate the potential benefits of treating precommercial stands to increase wood production and wildlife habitat. The TWYGS includes four adaptive-management experiments:

1. A test of mixed hardwood/conifer stands, created by planting red alder at low (20 trees/acre) and high densities (80 trees/acre) in 0 to 5 year-old stands;
2. A test of moderate (14 by 14 foot) and heavy (18 by 18 foot) precommercial thinning of 15 to 25 year-old stands;
3. A test of moderately heavy precommercial thinning (16 by 16 foot) alone and combined with two pruning treatments (every 1 out of 4 trees and every 1 out of 2 trees), in 25 to 35 year-old stands;
4. A test in stands over 35 years old comparing conventional (chainsaw) precommercial thinning (23 by 23 foot) alone, with slash cut to 15-foot lengths, and with slash cut to 5-foot lengths, and thinning (23 by 23 foot) through tree girdling.

All experiments include a control. Each of the four experiments used a randomized complete block design, with 17 to 23 blocks per experiment. The blocks were established throughout the Tongass (with the exception of the Yakutat Ranger District) from 2002 to 2006 (Hanley et al. 2013). Measurement of the TWYGS experiments is on a 5-year cycle.

### *Prince of Wales Commercial Thinning Study*

The primary objective of this monitoring is to evaluate the feasibility and effects of commercial thinning in even-aged western hemlock-Sitka spruce stands in Southeast Alaska. While this project will focus in the short-term on logging feasibility, harvesting costs, product yields, harvest-related tree damage, and soil disturbance, longer-term monitoring will address effects on understory plant diversity and abundance, deer forage availability, light availability, and forest structure (McClellan 1997).

The thinning treatments will include several methods of individual tree selection and strip thinning. The individual tree selection treatments include thinning from below, crown thinning, and thinning of dominant trees. The treatments are replicated in three blocks: one in the Maybeso Experimental Forest (treatments completed in 2009), one near the Harris River (also treated in 2009), and a third near the community of Naukati (treated in 2010). Each block has four harvest units and one uncut control unit. The total treated area over three blocks is less than 70 acres. To limit costs, the study was established on the Prince of Wales Island road system, on sites with gentle topography that allows ground-based yarding. Pre-treatment data has been collected on all sites and measurement of treatment effect will occur on a 5-year cycle (McClellan 1997).

### *Long-Term Response to Thinning and Pruning Trials*

In FY2012, the JFSL re-measured the understory and overstory response of thinning and pruning treatment study plots established by the JFSL and the University of Washington in the 1990s (thus 20 years post-treatment). The plots include four treatments replicated at four sites, one at Lemon Creek in Juneau and three on Prince of Wales Island: Coffman Cove, Salamander Lake, and Cave Creek. The stands were naturally regenerated following clearcutting 23 to 29 years before the trial began in 1991, and they were operationally thinned at age 15 to 10 by 10 foot spacing. All experimental plots were re-thinned to 16 by 16 foot spacing (170 trees per acre) before pruning. Four treatments were applied in a randomized complete block design:

- Thinning with no pruning
- Thinning with pruning of all trees to 8 feet height
- Thinning with pruning of all trees to 12 feet height
- Thinning with pruning of all trees to 17.4 feet height

*Biodiversity Photo 2. Trees marked for thinning*

The thinning and pruning treatments were applied to 0.5-acre plots and measurements were taken within a 0.2-acre interior permanent plot. Petruncio (1994) studied the time required for pruning and overstory growth, mortality, and quality. No understory plant data were collected prior to or immediately after treatment.

In 1993, Farr established a fifth replicate at Falls Creek near Petersburg that included a fifth treatment: removal of 20 percent of the live crown. The Pacific Northwest periodically measured overstory trees on the pruning plots through the late 1990s, and in 1999, conducted a study of epicormic sprouting on pruned Sitka spruce trees (Deal et al. 2003).

### *Small Mammal Response to Young-Growth Treatment Study*

The Tongass is collaborating with the University of Wyoming to determine the response of small mammals to the young-growth treatments in TWYGS (see above) and evaluate the response of ermines and martens to small mammal response to these treatments. The availability of small mammals has been shown to impact populations of their predators such as old-growth associated American martens (*Martes americana*) (Weckworth and Hawley 1962; Thompson and Colgan 1987; Flynn and Schumacher 2009) and ermine (*Mustela ermine*) (Johnson et al. 2000).

Therefore, it is thought that the value of young-growth stands for these species can be improved through providing habitat for their prey. For example, studies in the Pacific Northwest have shown that small mammal diversity and abundance is lower in young, even-aged stands compared to old-growth habitats (Yahner et al. 1992; Wilson and Carey 2000; Carey and Wilson 2001; Sullivan and Sullivan 2001; Sullivan et al. 2001) and the foods of many small mammals (fungi, invertebrates, vegetation, fruits, and seeds) are rarely found in stem-exclusion stands. It is hypothesized that by increasing understory biodiversity, biomass, and productivity in young-growth stands through thinning, the amount of food for small mammals will increase and lead to increased small mammal abundance. Therefore, the work by University of Wyoming and the Tongass should help the Forest identify: (1) the young-growth treatments that improve habitat for small mammals, and consequently, marten and ermine; and (2) the key young-growth understory features for small mammals for the Forest to monitor.

## Evaluation Criteria

The amount of young-growth due to harvest and treatment of young-growth that improve wildlife habitat and overstory features across the Forest. Sitka black-tailed deer habitat capability of TWYGS and the Prince of Wales commercial thinning study treatments.

## Monitoring Results

### *Young-Growth Stand Improvements*

The Tongass has been working to improve the value of young-growth stands for wildlife and to improve their value for future harvest. This is accomplished using a wide variety of precommercial thinning, and

*Biodiversity Photo 3. Sitka black-tailed deer in tall grass*

sometimes pruning treatments, under the guidance of the Tongass Young-Growth Management Strategy (USDA 2015). Some of the objectives of this strategy include greater integration in meeting multiple resource needs in managing young-growth and continuing to increase our knowledge of young-growth management treatments through programs such as TWYGS.

Based on the Forest Service Activity Tracking System (FACTS) database, 5,814 acres of young-growth forest on the Tongass was precommercial thinned in FY2014. Of this, 303 acres were designed with a wildlife habitat enhancement focus (FACTS Activity Code 6103). An additional 5 acres of openings were created for wildlife (FACTS Activity Code 6130). No slash treatments were done in FY2014. Over the last ten years (2005–2014), a total of 57,798 acres have been precommercially thinned on the Tongass National Forest, including 4,085 acres with a wildlife emphasis. In that same time period, 680 acres of openings were created for wildlife and 392 acres of slash were treated.

### *TWYGS: Tongass-Wide Young-Growth Studies*

TWYGS experiments 1, 2, 3, and 4 have received a five-year measurement while modules 2 and 3 have also received a ten-year post-treatment measurement. In May 2013, a research paper (PNW-RP-593) was published that disclosed and discussed the initial results from the first cycle of re-measurements. Initial results suggest that thinning in older young-growth stands provides a delayed understory response as compared to the TWYGS 2 and 3 modules. It is expected that the 10 year results will be published in the next few years. The typical schedule is for the data to be analyzed in the fiscal year following its collection.

Plant species biomass and percent cover and overstory canopy cover were analyzed in the Forage Resource Evaluation System for Habitat for Deer (Hanley et al. 2012) to determine the deer (adult female) habitat capability of each treatment based on food availability and its nutritional quality, season (summer/winter), reproductive status (female without a fawn (maintenance only) or with one fawn (maintenance plus lactation), and snow depth. The ANOVA statistical test was used to determine if habitat capability differed significantly between treatments within an experiment.

### *POW Commercial Thinning Study*

The 5-year first post-treatment measurement of these commercial thinned stands was completed in 2014 and the data is currently being analyzed.

#### Long-Term Response to Thinning and Pruning Trials

Data was collected in FY2012 and 2013. Data collection included field measurement of understory vascular plant cover and biomass, overstory tree growth and condition, epicormic sprouting on Sitka spruce, overstory canopy cover, and evidence of deer use. Analyses will include: estimation of available deer forage and deer habitat capability with the FRESH-Deer model (Hanley et al. 2012); and use of the Autosaw wood quality model (Todoroki 1990) to estimate the effects of pruning on wood quality and to assess the economics of pruning. In addition, vascular plant cover data collected in 1999 (6 to 9 years post treatment) that has not been published will be analyzed and reported along with the results from 2012. As with the 2012 data, JFSL will use biomass regression equations to convert the cover data collected in

1999 to biomass to estimate deer forage availability with FRESH-Deer. Analysis results have not been received.

### *Small Mammal Response to Young-Growth Treatments*

Surveys were initiated in 2010 by the University of Wyoming, in cooperation with the Tongass, to evaluate small mammal responses to thinning and the response of marten to the resulting small mammal abundance. Data collection continued annually through 2012.

This study assessed vegetation and structural features of young-growth that influence small mammal abundance. This is relevant to marten, which rely on small mammals as prey. Study objectives include:

- Which TWYGS treatments enhance the abundance of small mammals,
- The habitat variables the populations respond to, and
- The response of marten and ermine to small mammal abundance.

Four habitat types were studied: young-growth (control group), thinned young-growth, old-growth, and clearcut. Mark-recapture methods were used to estimate small mammal and marten abundance. Small mammals were live trapped and marten and ermine were trapped using hair-snares. DNA was extracted from the hair samples and used to identify individual marten. Trapped small mammals were weighed, measured, sexed, aged, assessed for reproductive status, and marked with a passive integrated transponder tag for permanent identification. Blood samples were taken from small mammals and, in combination with plant samples, stable isotope analyses was used to identify small mammal diets. Any feces deposited during handling was also collected for diet analysis. In addition, vegetation was sampled to assess food availability (Ben-David et al. 2010).

Mice and shrew densities varied across the years and exhibited no relation to forestry treatments. Ermine captures were correlated with the density of Keen's mice in the same year. Marten captures were correlated with the density of mice the previous year (Ben-David et al. 2014). Samples of mice and shrew tissues, along with diet items, were analysis by the University of Wyoming Stable Isotope Facility. The isotope niches of Keen's mice and dusky shrews are distinct; however, the choice of trophic discrimination factors will influence the interpretation of their diets. Values of carbon and nitrogen for mice varied considerably between habitat types, contributing to their relatively broad isotopic niche. In contrast, the isotopic niche of shrews was constant and relatively narrow. The relatively wide isotopic niche of mice suggests either specialized foraging behavior of individuals within a generalist species or faithfulness to specific foraging habitats (Flaherty and Ben-David 2010). In the future, multi-source dual-isotope mixing models will be used to determine the range of possible contributions of each food source to small mammal diets in each of the 21 trapping grids used in this project. This will be used to explore how diet composition influences population and community dynamics.

Sixteen progress reports and a final report were produced during the course of the study. In addition, a manuscript entitled "Estimating Leaf Area Index in Southeast Alaska: A Comparison of Two Techniques" was published in PLOS One in November 2013. Three educational modules were also designed as part of the cooperative agreement. These modules follow the guidelines of the National Center for Case Study Teaching in Science and include a case study, answer key, and teaching notes. The three case studies are:

- Seeing the Forest for the Trees: Managing for Multiple Use in National Forests;
- Fur Trapping and Management of Old-Growth Forests: Survival, Reproduction and Population Forecasts of Marten; and
- Big Thorne Timber Sale: Managers Stumped Searching for Common Ground.

## Evaluation Criteria

The Tongass continues to improve the value of understory in young-growth stands for wildlife. An average of 5,780 acres per year of precommercial thinning happens across the Tongass, of which an average of 7 percent is designed with a wildlife emphasis. Results of TWYGS from the first 4 to 8 years post-treatment indicate that several thinning prescriptions enhance the value of young-growth stands for deer during this time period. However, information on the long-term understory response to these treatments is still necessary to have an informed thinning program for wildlife. Thus, continued monitoring of this adaptive management study is essential. During FY 2015, two interns have been hired to analyze the extensive data collected from TWYGS 4. Initial results suggest that thinning in older young-growth stands provides a delayed understory response as compared to the TWYGS 2 and 3 modules. It is expected that the 10 year results will be published in the next few years, providing a full comparison of the four experiments.

With the anticipated transition to young-growth harvest on the Tongass, our understanding of the understory response to commercial thinning is equally important. Like the TWYGs, the Prince of Wales Commercial Thinning Study will provide a scientifically credible, replicated, long-term experiment that will greatly inform the Tongass transition to harvesting young-growth, including its effects on the value of the understory for deer.

The availability of small mammals as prey can influence the abundance and distribution of northern goshawk (Salafsky et al. 2005) and marten (Thompson and Colgan 1987; Weckworth and Hawley 1962; Flynn and Schumacher 2009). Small mammals have been shown to respond to forest succession following timber harvest in other parts of the Pacific Northwest with a short-term increase in abundance during the early stages of succession, but declines as the canopy closes (Carey and Wilson 2001; Sullivan and Sullivan 2001; Sullivan et al. 2001; Wilson and Carey 2000; and Yahner et al. 1992). However, with the paucity of information about small mammal dynamics on the Tongass and the response of small mammals to successional forest development in harvested stands, the small mammal response to young-growth study should inform us of the features of the understory in young-growth that small mammal prey respond. This information may inform future habitat monitoring in young-growth, should some of these vegetation features not currently be measured in the TWYGS.

## Action Plan

### *TWYGS: Tongass-wide Young-Growth Studies*

Future work planned for TWYGS is as follows:

- Analysis of 10-year post treatment measurement of TWYGS experiment 4 will be completed.
- Fifteen year re-measurements will begin in 2017 in Modules 2 and 3.

### *POW Commercial Thinning Study*

- Data from the first 5-year post-treatment will be analyzed during FY2015.
- Treatments and the controls will be measured every 5 years.

### *Long-Term Response to Thinning and Pruning Trials*

- Data analyses will be completed and reviewed.

### *Small Mammal and Carnivore Response to Tongass Young-Growth Thinning*

Field sampling is complete and analysis of data continues. Near-term plans are as follows:

- Data analysis of habitat and vegetation characteristics of all sampling stands, including tree height, d.b.h., basal area, plant and fungi biomass was completed. Data summaries will be

included in a Random Forest modeling framework to assess the effects of landscape and local scale factors on population dynamics of mice and shrews.

- Resubmit a proposal to the National Science Foundation Mathematical Biology for the project "Modeling 2 prey - 2 predator cycles in a heterogeneous landscape" in 2015. Modeling work continues. The Tongass will receive any additional papers on the subject.
- Carolyn Eckrich will complete data analyses and her dissertation. She is expected to defend her dissertation in fall 2015 and the Tongass will be provided a copy of the final work.

*Biodiversity Photo 4. Tree thinning in a young-growth unit*

## Citations

Ben-David, M., E.A. Flaherty, and C.A. Eckrich. 2014. Implementation and effectiveness monitoring of small mammal response to biodiversity wildlife thinning: Final report. December 29.

Ben-David, M., E.A. Flaherty, and C.A. Eckrich. 2010. Progress report: implementation and effectiveness monitoring of small mammal response to biodiversity wildlife thinning: September.

Flaherty, E.A. and M. Ben-David. 2010. Overlap and partitioning of the ecological and isotopic niches. Oikos. 119: 1409-1416.

Hanley, T.A., M.H. McClellan, J.C. Barnard, and M.A. Friberg. 2013. Precommercial thinning: Implications of early results from the Tongass-wide young-growth studies experiments for deer habitat in Southeast Alaska. Research Paper. PNW-RP-593, USDA Forest Service, Pacific Northwest Research Station.

Hanley, T.A., D.E. Spalinger, K.J. Mock, O.L. Weaver, and G.M. Harris. 2012. Forage resource evaluation system for habitat – Deer: An Interactive deer habitat model. General Technical Report. PNW-GTR-858, USDA Forest Service, Pacific Northwest Research Station.

# 5a. Biodiversity: Other Habitat Components

**Goals and Objectives:** Manage young-growth to improve habitat for wildlife and for commercial timber products. Review standards and guidelines for applicability to young-growth stands. Maintain habitat capability sufficient to sustain and produce wildlife populations that support the use of wildlife resources for sport, subsistence, and recreational activities. Include a young-growth management program to maintain, prolong, and/or improve understory forage production, and to improve habitat distribution, including future old-growth timber stands for wildlife (e.g., deer, moose, black bear, and other species) on both suitable and unsuitable lands.

**Background:** The Tongass National Forest has over 400,000 acres of young, even-aged stands created through clearcut logging. Stand development following this method of harvest typically includes natural regeneration of western hemlock and Sitka spruce (Alaback 1982a; Deal et al. 1991) and rapid growth of residual shrubs (Alaback 1980). This stage, referred to as the "stand initiation" stage, persists for 15 to 25 years, depending on site quality. Within 10 years of clearcutting, newly established conifers begin to overtop the shrubs, and crown closure may be complete by 25 years. During this "stem exclusion" phase there is a nearly complete elimination of understory vegetation (Alaback 1980, 1982b; Tappeiner and Alaback 1989). Around 100 years after harvest, the understory vegetation begins to re-establish, but does not become well-developed until the stand reaches 120- to 150-years old (Alaback 1982b, 1984; Tappeiner and Alaback 1989).

The stem exclusion stage of forest regeneration after clearcut logging has little value as wildlife habitat (Wallmo and Schoen 1980; Schoen et al. 1981, 1988; Thedinga et al. 1989; Hanley 1993; Dellasala et al. 1996; Brinkman et al. 2010). Therefore, management strategies are needed to minimize the length and severity of this stage. Successful silvicultural treatments will either delay the onset or hasten the end of the stem exclusion phase, or they will reduce its intensity by increasing light transmission through the overstory canopy.

Pre-commercial thinning of stands not suitable for commercial thinning may improve wildlife habitat of treated stands, as well as their future timber value. Commercial thinning of older stands may provide these benefits while also increasing the supply of available timber. Some results indicate that understory plants may benefit from pruning, girdling, commercial thinning, and the inclusion of hardwoods such as red alder in the stand (Hanley et al. 2013).

## Biodiversity Question: *Are young-growth treatments improving other key habitat components for old-growth associated species?*

### Monitoring Objectives

Objectives of this monitoring question included assessment of understory species composition to determine if the change in understory vegetation following young-growth treatments provided improved habitat for key old-growth associated species, and if young-growth treatments improved other key habitat components for old-growth associated species. These objectives provided the basis for developing a habitat monitoring protocol for implementation following silvicultural treatments in young-growth forests on the Tongass National Forest.

## Evaluation Criteria

A suggested habitat monitoring protocol has been proposed for addressing this question, but has not been tested or applied in the field (Suring 2011). Preliminary work to develop Graphical Interface (GI) tools to establish baseline values for the landscape attributes was planned in fiscal year (FY) 2014 but personnel constraints have delayed that work until FY2016. According to the protocol, there will be reports at the start and end of the five-year reporting period.

Suggested metrics are:

- Landscape
    - Total area of productive forest and seral stages calculated from the CoverType and SIZE_DENSITY data bases.
    - Patch size of contiguous habitat, density of edge, and habitat connectivity metrics will be calculated from CoverType and SIZE_DENSITY data bases using FRAGSTATS (McGarigal et al. 2002).
- Site
    - Canopy closure (as defined by Jennings et al. 1999)
    - Amount and quality of forage.

Criteria for changes that would suggest further investigations will be developed based on the outcome of the initial operational testing of the protocol in FY2016.

## Citations

Ben-David, M., E.A. Flaherty, and C.A. Eckrich. 2014. Implementation and effectiveness monitoring of small mammal response to biodiversity wildlife thinning: Final report. December 29.

Ben-David, M., E.A. Flaherty, and C.A. Eckrich. 2010. Progress report: implementation and effectiveness monitoring of small mammal response to biodiversity wildlife thinning: September.

Flaherty, E.A. and M. Ben-David. 2010. Overlap and partitioning of the ecological and isotopic niches. Oikos. 119: 1409-1416.

Hanley, T.A., M.H. McClellan, J.C. Barnard, and M.A. Friberg. 2013. Precommercial thinning: Implications of early results from the Tongass-wide young-growth studies experiments for deer habitat in Southeast Alaska. Research Paper. PNW-RP-593, USDA Forest Service, Pacific Northwest Research Station.

Hanley, T.A., D.E. Spalinger, K.J. Mock, O.L. Weaver, and G.M. Harris. 2012. Forage resource evaluation system for habitat – Deer: An Interactive deer habitat model. General Technical Report. PNW-GTR-858, USDA Forest Service, Pacific Northwest Research Station.

Suring, L. H. 2011. Monitoring Wildlife Habitat Following Silvicultural Treatments of Young-growth Forests on the Tongass National Forest in Southeast Alaska, USA. Northern Ecologic L.L.C. Technical Bulletin 2011–1.

# 5b. Biodiversity: Fungi

**Goals and Objectives:** Manage young-growth to improve habitat for wildlife and for commercial timber products. Review standards and guidelines for applicability to young-growth stands.

Maintain habitat capability sufficient to produce wildlife populations that support the use of wildlife resources for sport, subsistence, and recreational activities.

Include a young-growth management program to maintain, prolong, and/or improve understory forage production, and to improve habitat distribution, including future old-growth timber stands for wildlife (e.g., deer, moose, black bear, and other species) on both suitable and unsuitable lands.

**Background:** Fungi are essential components of all terrestrial ecosystems. They contribute to the function of healthy forest ecosystems by forming mutualistic, symbiotic associations with plants, decomposing organic matter, contributing to nutrient cycling, providing food for animals, and creating habitat diversity for many forest organisms (Castellano et al. 1999). Macro-fungi are the primary focus of this work. This group consists of mushrooms, sequestrate (i.e., truffles), shelf, coral, teeth, club and cup fungi forms (Castellano et al. 1999). Sequestrate fungi depend on animals to disperse their spores and are an important wildlife food (Flaherty et al. 2010).

The following information provides a brief overview concerning terrestrial fungi and their functions in forested ecosystems. Species richness and diversity of fungi contribute directly to the biodiversity of a particular forest and can change as the overstory ages. Fungi may be useful in providing answers to Forest Plan biodiversity questions.

## Biodiversity Question: *Are young-growth treatments improving other key habitat components for old-growth associated species?*

### Evaluation Criteria: Assessment of understory species composition

For the assessment of understory species composition, we asked the question, “Can terrestrial fungi be used to determine if key habitat components exist in young-growth treatments areas, such as old-growth associated species?” This question is not part of the Forest Plan monitoring program. We are using the question here to help look at different ways to determine what monitoring protocols can be used to determine key habitat components.

Fungal inventories in both young- and old-growth forests can help determine the utility of using fungi to identify key old-growth species present in young-growth stands under certain soil conditions. Presently, species presence may be one method of determining this, but also the relative abundance (high or low) of a species in the area surveyed can help determine if the old-growth associated fungi are also found frequently in young-growth forests with the same soil conditions. Presence of a diverse fungal flora and their relative high abundance in young-growth forests may indicate that the fungi species important to the health and productivity of forests are resilient to disturbance or removal of mature trees. The data collected in 2013 and 2014 can also help determine if indicator fungi species can be used for evaluating forest and soil health under certain soil conditions.

#### *Sampling/Reporting Period*

- Sampling Period: 2013 and 2014
- Reporting and Evaluation Period: every 5 years

### *Summary from 2013 Fungal Surveys*

Sporocarp (or mushroom) surveys were conducted by Stone EcoSurveys on Prince of Wales Island (POW) during two time periods: July and September 2013. Mycologists inventoried pre-determined sites to document species present and their relative abundance. They examined how the fungal community (as determined by sporocarp presence and abundance) differed between old-growth forests and adjacent mid-seral (or here after referred to as young-growth) forests on the same soil types which were harvested 45-70 years ago. Some questions explored in this work relating to the biodiversity question were: 1) Are different genera and species present, or is species richness differing with forest age? 2) Are fungal functional (trophic) groups equally represented in both of these forests types? and 3) What roles do the fungi present have in forest growth and health? Also considered were the roles fungi have in supporting wildlife. The aim was to determine which of the species or functional groups provide food or habitat, directly and indirectly, for animal species native to the area. Finally, the inventory provides baseline data to inform future studies.

The locations visited for fungal surveys were paired units in the Deweyville, Winter Harbor and Masada areas that contained one old-growth and one young-growth stand on similar soils (Figure 1). In addition to these three areas, Luck Lake and Naukati were unpaired stands that were surveyed which had different vegetation, disturbance, soil or other aspects that might affect fungal communities (Figure 1).

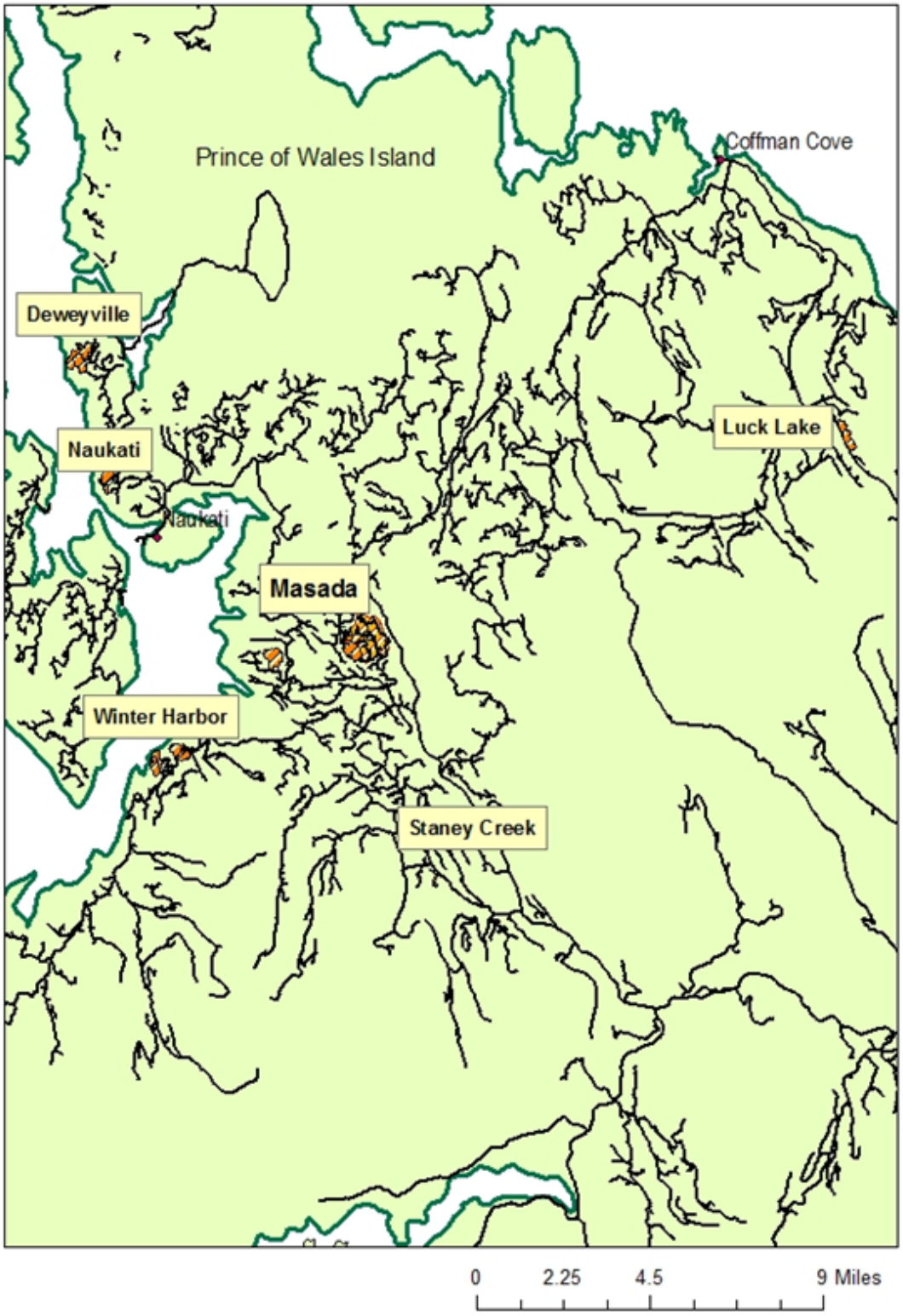
*Are different genera and species present, or is species richness differing with forest age?*

Sporocarps of 306 species were found on the designated units in 2013; 188 species were found in July and 235 species in September. Species richness is greater in all the units during the fall. Combining both visits, old-growth forests had greater species richness (Figure 2) and greater frequency and abundance than young-growth forests (Hamill et al. 2014). Although the unit size varied, roughly the same amount of time was spent surveying each unit.

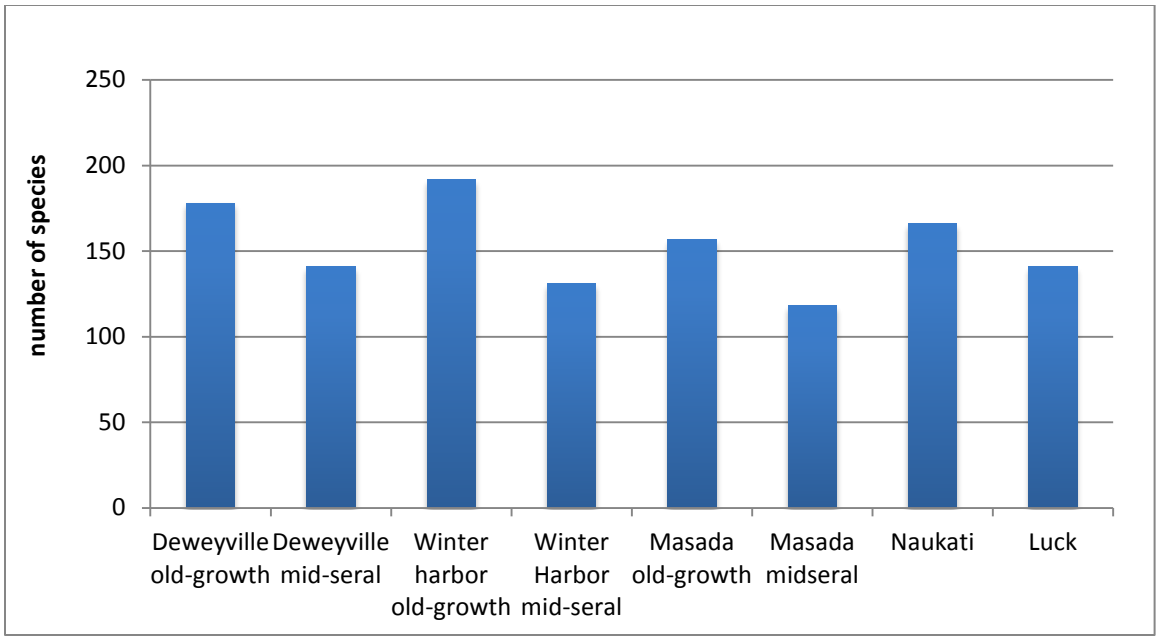
The species encountered in this study indicate that old-growth forests on POW support a different community of macro-fungi than young-growth forests. This finding is also supported by research in British Columbia (Kranabetter et al. 2005). There are 138 species common to both mid-seral and old-growth forests in the POW study area. However, 92 species were unique to old-growth forests, while only 44 species were unique to young-growth forests (Hamill et al. 2014).

The young-growth forests surveyed on POW are *Tsuga heterophylla-Picea sitchensis* dominated, closed canopy forests regenerating after logging between 45-70 years ago. The dense overstory allows little solar radiation from reaching the forest floor, therefore understory species are sparse. Terrestrial mosses occupy most of the forest floor. The overstory trees seem to be in the self- thin stage, resulting in standing poles and much woody debris piled above the forest floor. This is similar to the stand dynamics described by Alaback (1982) as the result of canopy clearing disturbance in southeast Alaska. Tree mortality tends to be in the form of standing dead wood, contributing little towards structural diversity and providing only a slow input of nutrients to the forest floor (Hennon and McClellan 2003). This is the stage in which the young-growth forests lie in the study units.

With a dense, single- age overstory and few large logs or shrubs, the diversity of substrates in young-growth forests equate to low fungal diversity, compared to old-growth. In addition, old slash from thinning in the form of whole young trees lies elevated off the forest floor so that boles are not in contact with the soil, causing the woody debris to lose moisture rapidly.




**Biodiversity Figure 1. Map of units where fungi surveys were conducted on Prince of Wales Island. Staney Creek was added in 2014, replacing the Deweyville site.**

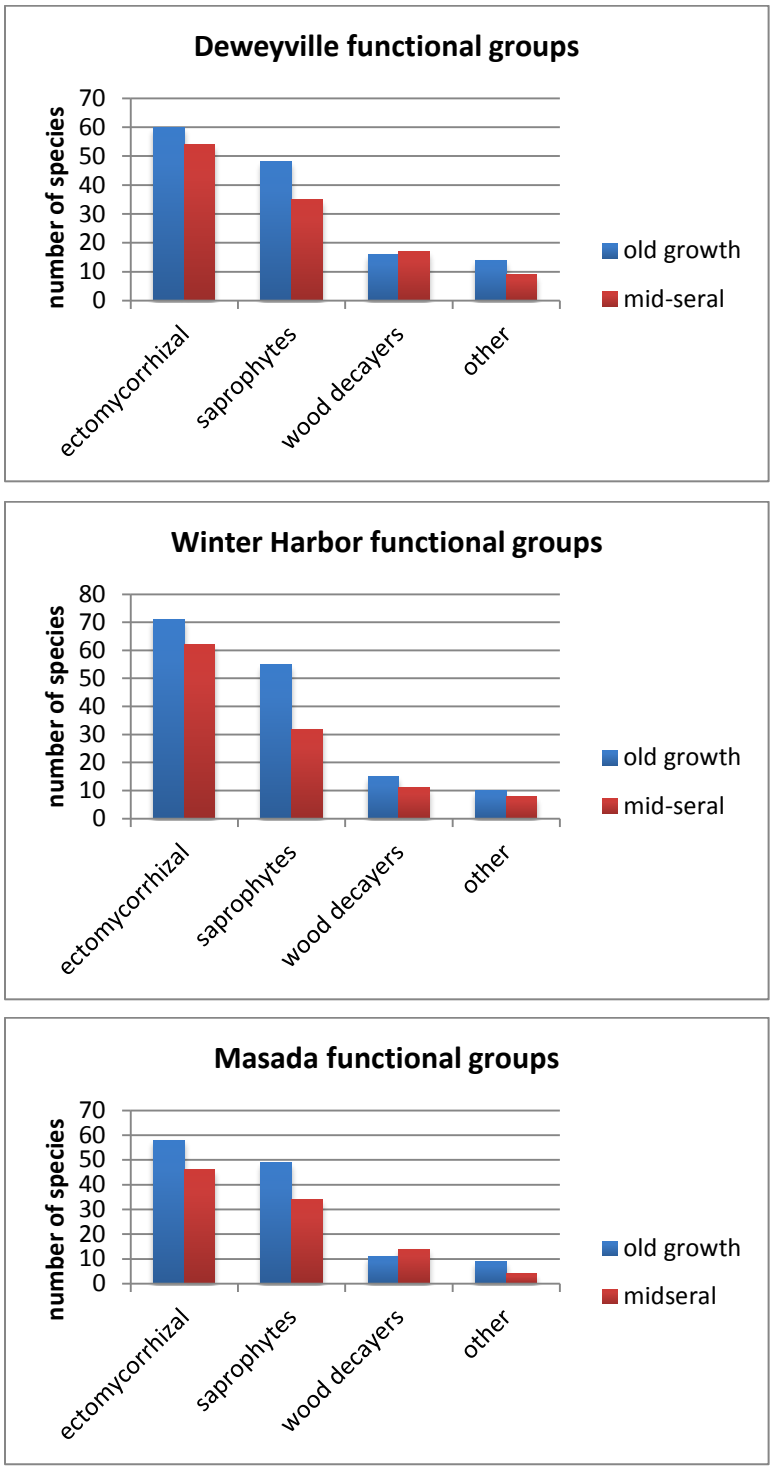



**Biodiversity Figure 2. Display of species richness within the units sampled on Prince of Wales Island for fungal sporocarps. Mid-seral is young-growth. Old-growth units contain greater species richness of fungi due to diversity of microhabitats available (from Hamill et al. 2014).**

As the forest grows beyond 100 years, gaps in the forest canopy open through the action of fungi and wind, allowing patches of shrub and forb communities to develop. Epiphytic lichens become more frequent in the canopy and are noticed as litterfall, which contribute in nutrient cycling (Pike et al. 1975, 1977). The number of large logs on the forest floor also increases markedly during this phase and serve as additional moisture sink, adding structure and substrate. Natural stand replacement relies on gradual fungal decay and windthrow as the principle agents of change to canopy structure over time (Alaback 1982, Hennon and McClellan 2003).This climax stage describes the old-growth forests in the study area. In the old-growth forest sites, the larger trees in the upper canopy, the more developed sub-canopy layers, the large logs on the forest floor and some shrub layer all provide a diversity of habitat for fungal communities to diversify compared to what is available for them in young-growth forests.

*Are fungal functional (trophic) groups equally represented in old and young-growth forests?*

The macro-fungi found in the units include the following functional groups: ectomycorrhizal fungi, litter decayers, wood decayers, pathogens, fungal parasites, insect parasites, dung decomposers and feather decomposers (Figure 3). Across all units there was roughly equal representation of ectomycorrhizal species and nutrient cycling fungi (saprotrophs and wood decay fungi combined). Other species were represented on all units but made up less than 10 percent of the species found. This group included pathogens, fungal parasites, insect parasites, dung decomposers, one bone decomposer and one arbuscular mycorrhizal species. This pattern of functional group representation was similar for each unit except for the Winter Harbor young-growth unit, which had proportionately more ectomycorrhizal species (55 percent in the young-growth to 47 percent in the old-growth of Winter Harbor). Conversely, Luck Lake alder and spruce forest had proportionately more wood decaying fungi than other units (17 percent versus less than 15 percent in the rest of the units) (Hamill et al. 2014).




**Biodiversity Figure 3. Numbers of species in functional groups in paired old-growth and young-growth units (from Hamill et al. 2014).**

Only three species of sequestrate fungi (truffles) were found on POW. *Elaphomyces grannulatus* was frequently encountered. *Macowanites americanus* and *Glomus fragile* were uncommon and restricted to old-growth forests.

Luck Lake contained a higher proportion of saprobes to ectomycorrhizal species than the other units. This unit has less developed soil layers and small, less abundant coarse woody debris than other units. This could magnify the effect of protracted dry weather that occurred in the summer of 2013 on the fungi habitats. Additionally, slumping has created discontinuity of substrate, possibly limiting dispersal/colonization by hyphae or spores of ectomycorrhizal species. Substrate diversity for saprobes is greater here than in the other units because *Alnus rubra* occurs on the numerous slumps mixed among the conifer patches. *Alnus* has a relatively small group of associated ectomycorrhizal species. It does, however, provide a unique substrate for saprotrophs to colonize, some of which are substrate specific to hardwoods. On all other units of both ages, ectomycorrhizal fungi were the dominant functional group, averaging well over 40 percent of the species recorded in the units.

Roads near and within the units often produced sporocarps of very different species from those found in the forested areas. This difference could be attributed to several factors. First, the roads in the study area are mostly constructed with limestone gravel, so the calcareous effect is stronger than it is in the duff of the adjacent forest. Second, the compacted surface of the roads encourages certain species which tolerate compacted soils. Third, solar radiation and precipitation are able to freely reach the ground, allowing for higher density of seedlings and consequently abundant new fine roots for colonization. Furthermore, the roads are pathways used intensely by all sizes of wildlife, likely resulting in relatively higher N input than in the forest (personal observation by Hamill, in Hamill et al. 2014).

*What roles do the fungi present have in forest growth and health, particularly for animals?*

Macro-fungi from the POW units have important roles in forest health, tree growth and wildlife. The ectomycorrhizal fungi present in the units share nutrient transfer with higher plants. This well-known fact is demonstrated with plants sharing an overlapping hyphal network (Horton and Bruns 1999, Simard et al. 1997). However, overstory removal results in reduction of belowground fungal biomass due to the loss of photosynthate provided to ectomycorrhizal hyphae from the vascular plant. Although the hyphae of ectomycorrhizal fungi can persist for up to a year after overstory removal, physical and chemical changes to the site such as solorization, changes in carbon to nitrogen ratios and dispersal limitations of spores and sclerotia, all contribute to a decrease and change in ectomycorrhizal morphotypes present on root tips (Ballard 2000, Horton and Bruns 1999, Lazaruk 2001, Jones et al. 2003, Hoberg et al. 2007). Ectomycorrhizal fungi vary in their abilities to absorb nutrients and to transfer these nutrients to their host plants (Abuzinadah and Read 1986, Bougher et al. 1990, Finlay et al. 1992, Van Tichelen and Colpaert 2000). Maintaining higher species richness in the fungal community may allow facilitation to their plant hosts under a larger range of environmental conditions.

Wildlife such as deer, bear, moose, rodents, and arthropods all utilize fungal sporocarps as an important part of their diet. Since animals rely on fungi, the use of sporocarp diversity and abundance as indicators is a realistic management tool for maintaining wildlife populations. There was frequent evidence of mycophagy in the POW units. Other animals that eat fungi or are fed by the organisms they attract include bears, small mammals, amphibians, birds, insects and cephalopods. Calorically, fungi compare with vegetables and fruits and can be important sources of minerals and protein (Fogel and Trappe 1978). Squirrels, chipmunks and other small mammals often perch their fungi in branch axils and on logs to dry; this concentrates the nutrients and allows for caching. Some of these animals including owls, which are indirect mycophagists, disperse spores over much longer distances than just by release from the sporocarp (Fogel and Trappe 1978).

Fungi comprise up to 70 percent of the cervid diet in the fall (Launchbaugh and Urness 1992), which may be due to fungi having a variety of trace minerals, a high amount of phosphorus, up to 50 percent protein, and an important source of nitrogen, which is essential for protein synthesis. Of the genera collected on POW, *Boletus, Clavaria, Clitocybe, Cortinarius, Lactarius, Lentinus, Polyporus, Russula, Suillus, Ramaria*, as well as some others, are utilized by cervids (Launchbaugh and Urness 1992, Hamill personal communication).

No less important for wildlife is the creation of habitat by fungi. Many animals rely on wood decay fungi to provide the structural changes in both standing and down wood that provides for shelter and food (Laursen et al. 2005). Birds and small mammals rely on wood decay fungi to prepare snags and logs for cavity use. Many rotten trees are inhabited by insects that are important food for birds and mammals. Virtually every fungal fruiting body is utilized by some creature, from springtails (*Collembola*) to the amphibians that position themselves beneath sporocarps to feast on falling springtails and from small rodents to bears (Hamill et al 2014).

Summary from 2014 Fungal Surveys

In 2014, Stone Ecosurveys revisited the same selected sites from 2013, except a Staney Creek site replaced the Deweyville site (Table 1, Figure 1). The riparian area at Staney was chosen because the Forest Service is concentrating restoration efforts in riparian forests. The data collected here will help understand the resiliency and retention of terrestrial fungi communities in riparian habitats after harvest. This 2014 study period will help refine abundance of species and provide a second year of data to capture a more accurate picture of fungal diversity.

**Biodiversity Table 1. Summary of macro-fungi surveys locations on Prince of Wales Island in 2014. OG = Old-growth, YG= Young-growth. Deweyville (site 1) was dropped from additional surveys in 2014 and replaced by Staney Creek (site 6).**

| Local Name | Site | Acres | Stand origin date or age | Soil Series | Forest Type |
|---|---|---|---|---|---|
| **Naukati** | **2** | 89 | 1947 | Ulloa and Sarkar | YG *Tsuga heterophylla*/*Picea sitchensis* and old corduroy road to beach |
| **Winter Harbor** | **3a** | 45 | 1945 | Ulloa, Sarkar, some Karta | YG *Tsuga heterophylla*/*Picea sitchensis,* Some *Vaccinium*. |
| | **3b** | 38 | >200 years old | Ulloa, Sarkar and McGilvery some wetter soils underlain by till in the valley mod-stand. | OG *Tsuga heterophylla*/*Picea sitchensis/Vaccinium*. Some *Thuja plicata* on the shallow soil convex areas. |
| | **3c** | 10 acres below road were treated as wildlife thinning project - 95 acres total. | 1945 | Ulloa and Sarkar, sinkholes and caves in non-treated portion of the stand. | YG*Tsuga heterophylla/Picea sitchensis*. Also has new corduroy road survey. |
| **Masada** | **4a** | 58 | Wind-regenerated stand >200 years old | Ulloa, Sarkar, minor areas of McGilvery. | OG *Tsuga heterophylla*/*Picea sitchensis/Vaccinium*, minor areas of *Thuja plicata* on shallow soils. |
| | **4b** | 100 | 1970 | Ulloa, Sarkar and minor areas of McGilvery | YG *Tsuga heterophylla*/*Picea sitchensis* and *Thuja plicata* on shallow soils. |
| **Luck Lake** | **5** | 99 | 1970 | Tolstoi, Mossman, and Karta, some rock outcrop | YG *Tsuga heterophylla-Alnus rubra*, old landslides |

| Local Name | Site | Acres | Stand origin date or age | Soil Series | Forest Type |
|---|---|---|---|---|---|
| **Staney Creek** | **6a** | <50 | Old-growth riparian forest | Tonowek and Tuxekan | OG *Picea sitchensis* and *Tsuga heterophylla with LYAM and OHPO* |
| | **6b** | <50 | Harvested riparian forest | Tonowek and Tuxekan | YG 50 percent *Alnus rubra*, small amounts *Picea sitchensis* and *Tsuga heterophylla* |

Fungi were sampled from each of the units by lying a transect line to include as much of the structural diversity of the unit as possible. On paired old-growth and young-growth units, the transect placement was laid out on similar aspects. Transects were 2m wide and 200m long, except in the case of Staney Creek young-growth forest. The length of this transect in the young-growth forest was increased to account for several creek bed areas crossed by the transect that had no evidence of vascular plants or fungal fruiting bodies. In the Staney Creek young-growth the transect length was constrained by the unit size so the azimuth direction was changed slightly mid-way to accommodate the entire transect within the unit.

Two mycologists recorded all species encountered along each transect, collecting those species for which field identification was not possible (Photo 1). When two or more sporocarps of the same species are found, the set distance of 2m was used as the definition of a new population of fungus. When one species was found continuously along a several-meter stretch, the species was recorded every 2m so that it was clear how long the population stretched.

*Biodiversity Photo 1. Two mycologists record all sporocarp species along a transect.*

Although this method is not actually individual small plots, the sampling method results in data which can be used as if separate plots were sampled. A transect will capture an accurate representation of the fungal community. It crosses the unit through subtle elevation and microhabitat differences as well as capturing the patchy distribution of shrubs and structural differences in the unit (Photo 2).

Hypogeous fungi (truffles) were sampled at approximately 20m intervals along each transect (Photo 3). At some point within a 20 to 40m interval along each transect, one surveyor walked perpendicular to the transect at least 4m and up to 12m away from the transect, until finding an area that seemed conducive to hypogeous fungi. At that point s/he raked in an area of about 1m$^2$, searching carefully through the surface duff. In this way, hypogeous sampling will not disturb the main transect in case of future sampling. All hypogeous searches were on the right side when progressing forward along a transect. Although the hypogeous plots were not exactly 20m apart, at least 10 areas were searched along each 200m transect. In addition, 4 to 6 additional areas in each unit were raked in places that appeared conducive to hypogeous fungi as the surveyors progressed through the forest.

These data will provide a species list and frequencies of each species found on each unit. Permutation tests in ANOVA using frequency data can test the hypothesis of different species composition in old-

growth versus young-growth units. An ordination with nonmetric multidimensional scaling will be used to detect patterns and relationships in the species distribution data.

Final products of the 2014 fungal sampling period will include dried specimens of species not collected in the 2013 survey, a list of species found in 2014 that were not found in 2013 and a complete combined list from both years. The final report will consist of an ordination of all the plots, showing their relationship to each other in relation to fungal communities. Additionally, comparisons will be made between the paired units addressing whether old-growth forests have significantly different species composition from young-growth forests. Fungi specimens will be submitted to the OSU herbarium.

*Biodiversity Photo 2. Sampling the fungal community through a variety of microhabitats.*

The final report will address this biodiversity question: *Are young-growth treatments improving other key habitat components for old-growth associated species?*

*Biodiversity Photo 3. Hypogeous fungi (truffles)*

## Evaluation of Results

Results from 2013 macro-fungi surveys indicate that POW forests are diverse in macro-fungi. Old- and young-growth forests share some species, as well as possessing unique macro-fungi communities that provide important ecosystem services to many forest organisms and promote nutrient cycling in the soil. The 2014 survey results will provide a better picture of the similarities or differences and provide guidance to silviculturists and wildlife biologists in designing timber management practices that enhance fungal diversity.

## Action Plan

To gather sufficient information about species presence and their relative abundance in a particular habitat, surveys should be conducted for more than one year (Castellano et al. 1999). An individual fungal body can live for many years in one location in the soil, yet produce mushrooms very infrequently. This somewhat cryptic nature poses problems in locating specimens.

Therefore the plan of repeated study years outlined in the 2013 monitoring report has been followed as the second year of surveys was completed in September 2014. The data are currently being analyzed. The FY 2015 report will provide conclusions to this work.

## Citations

Abuzinadah, R.A. and D. J. Read. 1986. The role of proteins in the nitrogen nutrition of ectomycorrhizal plants. Utilization of peptides and proteins by ectomycorrhizal fungi. New Phytologist. 103: 481-493.

Alaback, P.B. 1982. Dynamics of understory biomass in Sitka spruce-Western hemlock forests of southeast Alaska. Ecology. 63(6): 1932-1948.

Ballard, T.M. 2000. Impacts of forest on northern forest soils. Forest Ecology and Management. 133: 37-42.

Bougher, N.L., T.S. Grove, and N. Malajczuk. 1990. Growth and phosphorus acquisition of karri (*Eucalyptus diversicolor* F. Muell) seedlings inoculated with ectomycorrhizal fungi in relation to phosphorus supply. New Phytologist. 114: 77-85.

Castellano, M., J. Smith, T. O'Dell, E. Cazares and S. Nugent. 1999. Handbook to strategy 1 fungal species from the Northwest Forest Plan. General Technical Report. PNW-GTR-476. Portland, OR: USDA, Forest Service, Pacific Northwest Research Station. 195 p.

Finlay, R.D., Ä. Frostegard, and A.-M. Sonnerfeldt. 1992. Utilization of organic and inorganic nitrogen sources by ectomycorrhizal fungi in pure culture and in symbiosis with *Pinus contorta* Dougl. ex Loud. New Phytologist. 120: 105-115.

Flaherty, E.A., M. Ben-David, and W.P. Smith. 2010 Diet and food availability: Implications for foraging and dispersal of Prince of Wales northern flying squirrels across managed landscapes. Journal of Mammalogy. 91(1): 79–91.

Fogel, R. and J.M. Trappe. 1978. Fungus consumption (mycophagy) by small animals. Northwest Science. 52: 1-31.

Hamill, R., D. Stone, J. Villella, J. Scelza and J. Stone. 2014. Macrofungi of Prince of Wales Island, summer and fall 2013. 32 p.

Hennon, P.E. and M.H. McClellan. 2003. Tree mortality and forest structure in the temperate rain forests of southeast Alaska. Canadian Journal of Forest Research. 33: 1621-1634.

Hogberg, M., P. Hogberg and D. Myrold. 2007. Is microbial community composition in boreal forest soils determined by pH, C to N ratios, the trees, or all three? Oecologia. 150: 590-601.

Horton, T.R. and T.D. Bruns. 2001. The molecular revolution in ectomycorrhizal ecology: Peeking into the black-box. Molecular Ecology. 10: 1855-1871.

Jones, M. D., D.M. Durall, and W.G. Cairney. 2003. Ectomycorrhizal fungal communities in young forest stands regenerating after clearcut logging. New Phytologist. 157: 399-422.

Kranabetter, J. M., J. Friesen, S. Gamiet, and P. Kroeger. 2005. Ectomycorrhizal mushroom distribution by stand age in Western hemlock-lodgepole pine forests of northwestern British Columbia. Canadian Journal of Forest Service Research. 35: 1527-1539.

Launchbaugh K. L. and P.J. Urness. 1992. Mushroom consumption (mycophagy) by North American cervids. Great Basin Naturalist 52(4): 321-327.

Laursen, G. A., Burdsall, H. H. and R.D. Seppelt. 2005. Wood inhabiting fungi in Alaska: their diversity, roles, and uses. Alaska Park Science. 4 (1): 18-25.

Lazaruk, L. W. 2001. The impact of harvesting practices on the biodiversity of *Picea glauca* ectomycorrhizae. MSC Thesis, University of Alberta.

Simard, S.W., D.A. Perry, M.D. Jones, D.D. Myrold, D.M. Durall, and R. Molina. 1997. Net transfer of carbon between ectomycorrhizal tree species in the field. Nature. 388: 579-582.

Van Tichelen, K.K. and J.V. Colpaert. 2000. Kinetics of phosphate absorption by mycorrhizal and non-mycorrhizal Scots pine seedlings. Physiologia Plantarum. 110: 96-103.

# 6. Insects and Disease

**Goals:** Part 219 of the National Forest System Land and Resource Management Planning regulations (36 CFR section 219.12) requires monitoring of forest health to determine whether destructive insect and disease organisms increase following various vegetation management treatments. Forest health conditions are monitored, and areas that have experienced an increase in damage are documented.

**Objectives:** Identify areas where destructive insect and disease organisms increase or there are changes in forest health following management. Evaluate the results and modify vegetation management practices if insects and disease agents increase to populations at which they cause significant damage.

**Background:** A key premise of ecosystem management is that native species have evolved with natural disturbance events. Management activities can cause changes to stand structure and composition that impact insect and pathogen population dynamics, and can also affect host tree conditions. Climate change or acute weather events can alter natural disturbances; stimulate changes in insect and pathogen populations, damage levels, or distributions; and influence the vigor or susceptibility of trees and understory plants. Yellow-cedar decline (described below) represents a situation in which the vulnerability of a tree species is revealed by a modest change in climate, particularly warmer winters and reduced snowpack. Along with wind, avalanche, and other disturbance agents, insects and pathogens are important factors in the health of the Tongass National Forest.

The native spruce beetle is the most destructive forest insect in Alaska, killing mature spruce on hundreds of thousands of acres. In Southeast Alaska, notable outbreaks have occurred on Kosciusko Island and in Glacier Bay National Park. Traditionally, outbreaks in Southeast Alaska are usually small in size because beetle development is limited by cool, wet weather. Disturbance events that create an abundance of host material, such as windthrow or improper slash management, coupled with the right climatic conditions can lead to a spruce beetle outbreak. Windthrow and improper slash management can lead to spruce beetle outbreak under some conditions.

Unlike much of North America, few non-native insects and pathogens have become established in Southeast Alaska. The non-native green alder sawfly, which defoliates alder, has been found in Sitka, Juneau, and Ketchikan (confirmed 2013); however, its impact is thought to be minimal because it is in competition with native insect species that also feed on alder. The spruce needle aphid is a European species that feeds on Sitka spruce needles. Aphid populations have been gradually migrating north and outbreaks are correlated with mild winters.

Most insect and disease activity is considered a natural part of our forest ecosystems, contributing to compositional and structural diversity and wildlife habitat. Management intervention to prevent or control insects and pathogens are not usually implemented in Southeast Alaska, but silvicultural practices can be used to fine-tune their impacts. Non-native species are monitored because, if established, they have the potential to cause significant tree mortality. The early detection and rapid response program has been in place since 2001 and the main focus is to detect non-native insect introductions using insect traps near ports and other potential points of entry. Asian gypsy moth egg masses have been detected on vessels approaching Southeast Alaskan port communities in 2008, 2012, and 2014. Preventing establishment of this highly destructive insect is critical in maintaining the health of the forests in Alaska.

## Insects and Disease Question: *Are destructive insect and disease organisms increasing to potentially damaging levels following management activities?*

The Forest Service's State and Private Forestry, Forest Health Protection staff conducts annual aerial detection surveys of Southeast Alaska. The location of insect and disease activity is mapped and entered in a geographic information system (GIS) database. Forest health observations are also made through site visits, monitoring networks, and other fieldwork. In addition, Forest Inventory Analysis (FIA) plots are

used to assess the extent of some diseases (e.g., hemlock dwarf mistletoe) that can be consistently detected and documented by observers with minimal training. Ground observations and FIA plots are used because some agents cannot be detected from the air or by remote sensing. This information is summarized in annual Forest Health Conditions Reports (http://www.fs.usda.gov/detail/r10/forest-grasslandhealth/?cid=fsbdev2_038884).

With a lack of fire activity in Southeast Alaska, insects and pathogens are key disturbance agents, as are wind, landslides, and flooding. In general, clearcut harvests represent larger scale and more frequent disturbance events than would naturally take place in our forests. Overall, current management reduces damage from most insects and diseases by removing older trees, which are more susceptible to some insects (e.g., woodborers) and diseases (e.g., stem decays), or by altering tree species composition to manage the concentration of susceptible hosts. Even-aged vegetation management (clearcutting, seed tree or shelterwood regeneration methods) removes defective trees with stem decay or mistletoe. Timber harvest has created around 730,000 acres of young stands in Southeast Alaska, including approximately 440,000 acres on the Tongass NF. Disease and insect activity in old stands is important to a number of interconnected ecological processes, such as nutrient cycling, carbon storage, and creation of wildlife habitat in trees with stem decay. This is an important consideration for habitat restoration in young stands managed for diverse or non-timber objectives and older stands slated for harvest or other management activities.

Tait et al. (1985) found that insects and disease organisms were present in young-growth stands, but not at populations or intensities at which they caused significant damage (Table 1). *Sirococcus* shoot blight of hemlock, shoot blight of yellow-cedar (causal fungus identified as *Kabatina thuje*), hemlock canker (causal fungus tentatively identified as *Discocainia treleasei*), other foliar pathogens, and spittlebug on spruce (*Aphrophora* sp.) are additional insects and pathogens known to cause damage to conifer saplings in Southeast Alaska that were not detected in the 1985 study. Hemlock canker of western hemlock appears to be most common and severe in unthinned young-growth stands, suggesting that dense stand conditions can exacerbate this disease. More information is needed about the activity of insect and disease agents in thinned and unthinned older young-growth stands.

Management activities also have the potential to mitigate losses of yellow-cedar resulting from yellow-cedar decline root freezing injury. Knowledge of the two key risk factors for yellow-cedar decline, shallow soils and insufficient insulating snowpack, can provide the basis for management decisions to make yellow-cedar stands more resilient to the effects of climate change. Yellow-cedar can be favored through thinning or planted on sites that are expected to be suitable for long-term yellow-cedar survival, including high-elevations, northern portions of the current range, or assisted migration beyond the current range. Deer browsing pressure must be taken into account when selecting planting locations. Salvaging dead yellow-cedar on sites with abundant yellow-cedar snags, gentle slopes, and road access can help to offset yellow-cedar harvests elsewhere. Salvage sales have the potential to financially support restoration efforts. A draft restoration strategy for yellow-cedar is now complete and provides detailed information about current and future suitable habitat for yellow-cedar throughout its range in Alaska.

**Table 1. Pathogens and insects detected on Sitka spruce and western hemlock in the 1985 survey of 16, 12-27 year old thinned and unthinned stands in Southeast Alaska (Tait et al. 1985).**

| | Sitka spruce | Western hemlock | Spruce and hemlock |
|---|---|---|---|
| Pathogens | *Spruce needle cast/blight (Lophodermium picea)*<br>*Spruce needle rust (Chrysomyxa ledicola)*<br>*Cankers (Discocainia treleasii and Heliotium resinicola)*<br>*Armillaria* in 36% of stumps<br>*Annosus* in 2% of stumps | *Hemlock needle rust (Pucciniastrum vaccinia)*<br>Hemlock dwarf mistletoe (*Arceuthobium tsugense)*<br>*Armillaria* in 39% of stumps | Shoot blight (*Sirococcus strobilinus)* |
| Insects | Shoot moth (*Zeiraphera* sp.)<br>Moth (*Dioryctrias* sp.)<br>Green spruce aphid (*Elatobium abietinum)* | Bark beetles (*Pseudohylesinus tsugae)*<br>Woolly aphid/adelgid(*Aldeges tsugae)* | Sawflies (*Neodiprion tsugae)*<br>Geometrid moths (includes *Melanolophia imitate)*<br>Blackheaded budworm (*Acleris gloverana)* |

Note: Information on percentages of stumps with *Armillaria* and *Annosus* root diseases was only recorded in thinned stands.

Harvest and stand entry patterns impact the rate of wounding to residual trees. Wounds are infection courts for decay fungi, so higher rates of wounding translate to greater defect as stands age. The Forest Service is exploring alternatives to clearcutting, in which portions of stands, either single trees or groups of trees, are left as legacy (residual) trees (McClellan et al. 2000). Three research installations across the Tongass (Hanus Bay in the Sitka Ranger District, Portage Bay in the Petersburg Ranger District, and Lancaster Cove in the Craig Ranger District) were used to investigate whether changes to harvest patterns led to greater incidence of windthrow, damage from insects and diseases due to bole wounding of residual trees, or more severe dwarf mistletoe infestations. Logging injury to residual trees varied by both the intensity and spatial arrangement of harvest. A higher rate of residual tree injury was found with greater log removal. Stands with scattered tree harvest suffered higher rates of injury than those where tree removal was concentrated in patches. Wounding residual trees is expected to reduce timber values but provide wildlife habitat.

The Tongass-Wide Young-Growth Study (TWYGS) has installed treatments in young-growth stands (0-45 years old) to examine the effects of various silvicultural treatments on understory development and productivity. Treatments include: planting alder in clearcuts 0 to 5 years post-harvest; pre-commercial thinning in 15 to 25 year-old stands; pre-commercial thinning and pruning in 25 to 35 year-old stands; and pre-commercial thinning of 35 to 45 year-old stands by cutting or girdling, plus slash treatment. In 2008 and 2009, an insect and disease survey was conducted at sites on Prince of Wales that had been thinned by girdling from 2005 to 2006. Proposed benefits of girdling include reduced treatment cost and hazard, lower peak slash loads, and limited damage to residual trees compared to mechanical thinning and stacking treatments. There was some concern that snags might attract spruce bark beetles (*Dendroctonus rufipennis*) and facilitate the spread of *Armillaria* from dead trees to adjacent healthy trees. Although bark beetles and *Armillaria* were detected on a large proportion of girdled trees by 2009, they were not causing damage to retained trees. Girdled trees fell earlier than expected, probably due to wind and snow loads, and many retained green crowns for more than 1 year. It is thought that the cool summers of 2006, 2007 and 2008, combined with the persistent green crowns of snags, slowed the development of bark beetles and woodborers.

## Monitoring Results

### *Pathogens and Yellow-Cedar Decline*

The most important diseases and forest declines in late-seral hemlock-spruce forests on the Tongass NF are stem decays of live trees, hemlock dwarf mistletoe, and yellow-cedar decline. Dwarf mistletoe is present in some stands following partial harvest, but at lower density and severity than pre-harvest. Bole injury from pre-harvest silvicultural activities may increase decay rates in managed stands relative to unmanaged stands when they reach old age, as wounds act as entry points for decay pathogens.

There is now increased emphasis on young-growth stand management. The diseases of greatest importance in young stands detected through monitoring efforts include shoot blights of yellow-cedar and western hemlock, hemlock canker disease, and yellow-cedar decline. The severity of shoot diseases may be greater in young stands because of increased availability of susceptible shoot tissue and greater concentration of susceptible hosts. The cause of hemlock canker is under investigation, but dense stand conditions in unthinned young-growth appear to contribute to outbreaks of this disease. Yellow-cedar decline was documented for the first time in young-growth yellow-cedar on Zarembo Island in 2013.

Stem decays are caused by a number of fungal species in mature forests, and result in enormous annual wood volume loss of Alaska's major tree species (Table 2). Approximately one-third of the old-growth timber in Southeast Alaska is defective, largely due to decay from heart and butt rot fungi (Kimmey 1956, Farr et al. 1976). Conversely, there is very little decay in young-growth stands (Tait et al. 1985) unless there is prevalent wounding from commercial thinning activities, blowdown, or animal feeding. By predisposing large old trees to bole breakage, stem decays serve as important small-scale disturbance agents that create canopy gaps, influence stand structure and succession, increase biodiversity, cycle nutrients, and enhance wildlife habitat for many species. Decay fungi are classified as white rots, which degrade both cellulose and lignin, or brown rots, which primarily degrade cellulose. Wood impacted by brown rot may be more brittle and prone to breakage in high winds, and cannot be used for pulp production. White rots are particularly important for providing decay that leads to the development of cavities for wildlife in live hemlock trees.

**Table 2. Stem decay fungi of live conifer trees in Alaska with decay type, hosts, and common modes of infection. Includes the conifers: western hemlock (*Tsuga heterophylla*), mountain hemlock (*Tsuga mertensiana*), western redcedar (*Thuja plicata*), shore pine (*Pinus contorta* spp. *contorta*), and Sitka, Lutz, white, and black spruce (*Picea sitchensis, P. lutzii [glauca x sitchensis], P.glauca, P. mariana*).**

| Heart and Butt Rot Fungi[1] | Type of Rot/ Decay | Hosts in Alaska | Mode of Infection |
|---|---|---|---|
| *Armillaria spp.* | white | all conifers (& hardwoods) | vegetative spread (or spores) to stressed, dying, or dead trees |
| *Ceriporiopsis rivulosa* | white | western redcedar | likely through root-to-root contact & subsequent spread into butt |
| *Coniophora* spp. | brown | spruce, hemlock (occasionally hardwoods) | through wounds |
| *Echinodontium tinctorium* | brown | mountain hemlock, occasionally western hemlock) | through branch stubs or live branches |
| *Fomitopsis pinicola* | brown | spruce, hemlock, pine; sometimes redcedar & birch | through wounds |

| Heart and Butt Rot Fungi[1] | Type of Rot/ Decay | Hosts in Alaska | Mode of Infection |
|---|---|---|---|
| *Fomitopsis officinalis* | brown | spruce, hemlock | through wounds, broken tops |
| *Ganoderma* spp. | white | hemlock (& hardwoods) | through wounds, broken tops |
| *Heterobasidion annosum* | white | western hemlock, Sitka spruce | through wounds |
| *Laetiporus sulphureus* | brown | spruce, hemlock, shore pine (some hardwoods) | through wounds, basal scars |
| *Onnia tomentosa* | white | white/Lutz spruce (occasionally Sitka spruce & shore pine) | through root-to-root contact |
| *Phaeolus schweinitzii* | brown | spruce, pine, western redcedar, occasionally hemlock | through wounds, basal scars & disturbed roots |
| *Phellinus hartigii* | white | hemlock | through bole wounds, branch stubs, or cracks |
| *Phellinus pini* | white | hemlock, spruce, western redcedar, shore pine | through branch stubs or live branches |
| *Phellinus weirii* | white | western redcedar | likely through root-to-root contact & subsequent spread into butt |

[1] Some root rot fungi are included because they are capable of causing both root and butt rot of conifers.

The incidence of decay is significantly related to tree age; with negligible volume losses to hemlock and spruce less than about 100 years of age (Kimmey 1956). Brown rots are the most important source of cull for Sitka spruce, while white rots are most important for western hemlock and western redcedar. For any given size class, redcedar was the most defective species, followed by western hemlock and Sitka spruce. It is believed that specialized decay fungi are able to overcome the decay resistance of live redcedar trees, even though cedar wood in service is highly decay-resistant. At 151 to 200 years old, defect is estimated to be 5 percent for Sitka spruce and 16 percent for hemlock (Farr et al. 1976). By 300 to 400 years of age, spruce is still relatively rot-free, whereas decay in hemlock averaged 30-40 percent on a board-foot basis (Farr et al. 1976). A project is underway to improve cull estimates for yellow-cedar and western redcedar and to determine what fungi contribute to decay.

### *Annosus/Heterobasidion Root Disease and Armillaria Root Disease*

*Annosus/Heterobasidion* root disease and *Armillaria* root disease are the important root diseases of Southeast Alaska. Although root diseases play an important disturbance role in Alaska's forests, they do not create disease centers and cannot be mapped through aerial survey. *Heterobasidion annosum* causes root and butt rot in old-growth western hemlock and Sitka spruce forests in Alaska. In other regions and countries, cut stumps are frequently treated with fungicidal chemicals or biocontrol during harvest to prevent disease spread, but this is not necessary in Alaska as its incidence and severity is apparently unaffected by timber harvest or management activities. All tree species in Alaska are affected by one or more *Armillaria* species. The *Armillaria* species present in Alaska generally act as secondary pathogens, hastening the death of stressed trees. Tomentosus root disease, caused by *Onnia tomentosa* (*Inonotus*

*tomentosus*), is common in spruce stands of south-central and interior Alaska. The disease was recently documented on Sitka spruce near Skagway and Dyea, but not elsewhere in Southeast Alaska. The cedar form of *Phellinus weirii* is also present, causing butt rot in western redcedar. It is rarely lethal, but contributes to very high defect in Southeast Alaska. The type of *P. weirii* that causes laminated root rot in forests of British Columbia, Washington, and Oregon does not occur in Alaska.

### Hemlock Dwarf Mistletoe

Hemlock dwarf mistletoe is an important disease of western hemlock throughout the Tongass National Forest, causing growth loss, top-kill, and mortality on a conservatively estimated one million acres. The occurrence of dwarf mistletoe is apparently limited by climate, becoming uncommon or absent above 500 feet in elevation and 59°N latitude (Haines, AK) despite the continued distribution of western hemlock from Cross Sound to Prince William Sound. Hemlock dwarf mistletoe brooms (prolific branching) provide wildlife habitat, and suppression or mortality of mistletoe-infected trees plays an important role in gap-creation and succession in coastal rainforest ecosystems. Clearcutting eliminates dwarf mistletoe from second-growth timber stands unless residual trees are infected. The incidence and severity of disease following partial harvest is related to the number, height, and infection severity of residual hemlocks and site productivity. Dwarf mistletoe seeds are able to disperse a greater distance from taller trees. The retention of infected codominant and dominant trees can cause significant infection of nearby trees in the developing young stand; in contrast, small infected trees (less than 8 inches dbh) have a short mistletoe spread distance, and height growth of trees in the young stand outpaces mistletoe spread. On productive sites, small infected residuals may outgrow mistletoe as they gain height and lose infected branches in the lower crown to shading. Managers are able to target some desirable amount of mistletoe in their stands for wildlife benefits without incurring significant growth losses by retaining small, lightly infected trees on moderately productive sites or through green tree retention adjacent to harvest units.

### Shoot Blight

Damage from yellow-cedar shoot blight (*Kabatina thuje*) has been noted in regenerating young-growth stands. Hemlock shoot blight (*Sirococcus tsugae*) was more noticeable in 2014 than in recent years, affecting the new growth of western and mountain hemlock trees near Juneau, Yakutat, and other locations in Southeast Alaska.

### Hemlock Canker

Hemlock canker has been in an outbreak on Prince of Wales Island since 2012 with greatest impacts between Thorne Bay and Coffman Cove and Staney Creek and Whale Pass. This disease kills young western hemlock trees and lower crowns of large trees, primarily in dense young stands along roads and creeks. An inoculation trial is underway near Thorne Bay and Staney Creek in collaboration with the University of Nebraska to determine the causal pathogen. We consider *Discocainia treleasei* the mostly likely pathogen; trees inoculated with this fungus will be evaluated in 2015. Widespread, synchronized mortality from this disease have been documented 1-2 times per decade on Prince of Wales, Kosciusko, Kuiu, and Chichagof islands. Disease symptoms include branch or small tree mortality (less than 14 inches dbh) accompanied by foliage discoloration and shed, bark lesions, and bleeding or resinous cankers. This disease may help dense stands to naturally thin, but long-term impacts on timber quality are unknown.

Damage from hemlock canker appears to be most severe in dense, even-aged stands; although this disease is not widespread and is only periodically in outbreak, stands that regenerate following clearcut harvest are thought to have increased incidence of hemlock canker compared to unmanaged stands.

### Yellow-cedar Decline

Yellow-cedar decline is associated with freezing injury to fine roots that occurs where snowpack in early spring is insufficient to protect roots from late-season cold events. Yellow-cedar trees are protected where

snow is present in spring to insulate tree roots or where better-drained soils allow cedar to root more deeply. Impacted forests tend to have mixtures of old dead, recently dead, dying, and living cedars, indicating the progressive nature of tree death.

In 2014, aerial survey mapped active yellow-cedar decline (dying trees with red crown symptoms) on nearly 20,000 acres. Active decline was most dramatic in the northern panhandle near Slocum and Ford Arms and Klag Bay (Chichagof Island); it continued and increased on other parts of Chichagof, including Hoonah Sound and the area north of Deep Bay and Poison Cove along Peril Strait. Active decline was also scattered throughout Kupreanof, Kuiu, and Northern Prince of Wales islands, with more concentrated decline on the southwestern shore of Etolin Island and to the south near Carroll Inlet (Revillagigedo Island) and Twelvemile Arm (near Hollis on Prince of Wales Island). Cumulatively, about 585,000 acres of yellow-cedar decline have been mapped in Southeast Alaska though Aerial Detection Survey, with extensive mortality occurring in a wide band from western Chichagof and Baranof islands to the Ketchikan area. This cumulative estimate has been refined, but varies depending on the methods used.

Forest Health Protection evaluated dying yellow-cedar trees in portions of two young-growth stands on Zarembo Island (Wrangell Ranger District) in 2013. Affected trees showed signs and symptoms consistent with decline (necrotic root and root collar lesions, and *Armillaria* fungus and *Phloeosinus* beetles as secondary agents). Relatively low site productivity, wet site indicator plants in the understory, and evidence of yellow-cedar decline in adjacent, unmanaged forest suggest that shallow rooting in portions of these stands predisposes yellow-cedar to root-freezing injury. It is not known whether precommercial thinning in 2005 triggered or accelerated symptom development through its influence on snowpack. Forest Health Protection will continue to monitor these stands. This is the first time decline has been documented in a managed young-growth forests. Harvest increased in moderately productive old-growth in the 1990s; wetter portions of moderately productive young-growth stands with yellow-cedar may show decline symptoms in areas with limited late-winter snow.

Yellow-cedar snags accumulate on affected sites and forest composition is altered as yellow-cedar trees die. Yellow-cedar is extraordinarily decay resistant and snags often remain standing a century after tree death. Salvage recovery of dead standing yellow-cedar trees in declining forests can help produce valuable wood products and offset harvests in healthy yellow-cedar forests. A project was initiated this year with the Alaska Coastal Rainforest Center, Forest Service, State of Alaska, and University of Alaska Southeast to evaluate the economic feasibility of salvaging dead yellow-cedar. Study areas include Kupreanof and Mitkof islands. A spatial GIS aspect of the project estimates the acres of yellow-cedar decline that are available for salvage recovery by their proximity to roads, slope, and land use designation.

A draft Yellow-cedar Conservation Strategy is now complete and the final product should be available in 2015. This report was produced as a collaboration between the Pacific Northwest (PNW) Research Station, Region 10, and Forest Health Protection (S&PF). It provides a comprehensive resource on the ecology, silviculture and cultural values of yellow-cedar; describes the risk factors for decline; and uses the two primary risk factors (snow and hydrology) to model locations that are currently unsuitable/suitable for yellow-cedar and then projects this information into the future using General Circulation Models with conservative greenhouse gas emissions estimates. This resource should help managers to prioritize areas for active yellow-cedar management and to identify lands under protected status that can help to meet conservation goals for the species. Appropriate sites to plant and manage yellow-cedar include those with good soil drainage, those at higher elevation, and those in the northeastern portion of the panhandle or in the vicinity of Yakutat. Key management treatments include promoting yellow-cedar through planting and thinning in areas suitable for the long-term yellow-cedar survival in the context of climate change. Deer browse has the potential to negatively impact survival of planted seedlings, as was demonstrated in a recent progeny trial on Prince of Wales Island. On a regional scale, excessive yellow-cedar mortality may lead to diminished populations (but not extinction), especially considering this species' low rate of regeneration and recruitment in some areas.

### *Damage from Abiotic Factors and Animals*

Hemlock fluting is characterized by deeply incised grooves and ridges that extend vertically along boles of western hemlock. Fluting may not be outwardly visible in old trees when fluting patterns have been engulfed within the stem. Affected logs yield less merchantable volume and bark is contained in some of the wood. The cause is not completely understood, but fluting is associated with increased wind-firmness, shallow soils, and may be triggered during growth release by some stand management treatments, disturbance, or genetic predisposition. The economic impacts of bole fluting on National Forest System timber harvest are probably less significant than in the past, since minimal harvest occurs within the 1000-foot beach buffer where fluted trees are most concentrated.

Porcupines represent one of the main biotic disturbance agents in the young-growth forests of Southeast Alaska. In 2014, nearly 1,815 acres of porcupine damage were mapped, up from the preceding four years. The most extensive damage was observed in young-growth stands on Kupreanof Island, with smaller pockets of damage observed near Excursion Inlet, the mouth of the Endicott River, south Mitkof Island, Etolin Island, and the southern Cleveland Peninsula. The variability in mapped acreage can result from differences in survey methods. Porcupine damage must be severe enough to girdle and kill trees to be visible from the air, and is therefore under-mapped during the aerial survey. Porcupines are absent from several islands in Southeast Alaska, including Admiralty, Baranof, Chichagof, and Prince of Wales. Feeding damage reduces timber values but enhances stand structure. This form of tree injury can provide a form of thinning in young forests; however, porcupines feed on groups of trees and usually “thin from above,” targeting the largest, fastest growing trees. Feeding can be locally concentrated in young growth stands that are about 10 to 30 years of age and on trees that are 4 to 10 inches in diameter. As stands age, porcupine feeding typically tapers off, but top-killed trees often survive with forked tops and internal wood decay as a legacy of earlier feeding. Porcupines feed only sparingly on western redcedar or yellow-cedar. Young stands with a cedar component provide more thinning treatment options. For example, where porcupines are problematic, managers can prescribe a lighter thinning treatment and favor tree species that are not as attractive to porcupines.

Less than 400 acres of windthrow were mapped statewide in 2014, with most affected areas less than 25 acres. In Southeast Alaska, the limited wind disturbance was most concentrated between Port Snettisham (Speel Arm) and Endicott Arm. Wind is a common and important small-scale disturbance in Alaskan forests, contributing to bole snap or complete failure of trees (or clumps of trees) with stem, butt or root decay or trees rooted on shallow, saturated soils. Stand-scale windthrow may occur on exposed sites when heavy rain is followed by extreme wind. Stand characteristics (tree height to diameter ratios and tree density) and tree mechanics (height, diameter, crown size and rooting depth) also impact windthrow potential. Topographic conditions and stand management activities influence windthrow potential, because wind accelerates as it moves over and around landscape obstacles. Depending on landscape position, thinned stands or stands adjacent to clearcut harvests may experience increased susceptibility to windthrow.

### *Insects*

Forest insect outbreaks are often linked to weather conditions, but can also be linked to forest management practices and disturbance events (i.e., windthrow). There have been no significant recent introductions of non-native insects and diseases in Southeast Alaska; still, Asian gypsy moth egg masses were intercepted off Juneau in 2014 and Ketchikan in 2008 and 2012. Spruce aphid was introduced from Europe around 1927, but has only caused mortality in 1 to 2 percent of heavily infested trees. The green alder sawfly was found in Sitka, Juneau, and Ketchikan in 2013. However, this non-native insect occurs alongside native defoliators and only partially contributes to alder defoliation damage.

In 2014, spruce aphid (*Elatobium abietinum*) defoliation was only mapped on 425 acres in Southeast Alaska, an increase from 2013, however, still low compared to more than 900 acres in 2012 and 4,000 acres in 2011. Spruce aphid activity mapped during the aerial detection survey was contained entirely

along the western edge of the Chilkat Peninsula. In addition, heavy spruce aphid activity was reported in Petersburg and at the Auke Recreation Area near Juneau. A very short term but intense outbreak began in 2010 on 40,680 acres of Sitka spruce on sites with moderate winter temperatures. This acreage was similar to the largest number of acres of defoliation recorded during the 12-year outbreak from 1995 until 2006. Spruce aphids usually favor the same trees year after year and outbreak after outbreak. Spruce needle aphids feed on older needles of Sitka spruce; after a few years of defoliation, some trees have only the most recent year or two of foliage. Due to temperature controls on aphid populations, this will be an important insect to monitor under changing climate.

Hemlock sawfly (*Neodiprion tsugae*) is a native defoliator of western hemlock found throughout Southeast Alaska. Defoliation attributed to hemlock sawfly was mapped on approximately 4,000 acres in 2014, a third less than the acreage mapped in 2013. Symptom expression after the aerial survey may have led to an underestimate of damaged acreage. The majority of the damage was found on Etolin and Revillagigedo islands, with the heaviest concentration along Behm Canal. There were also small pockets of defoliation along Bradfield Canal. Hemlocks can survive severe defoliation, but radial growth is likely affected. Heavily defoliated stands usually recover within a few years. Hemlock sawfly populations are controlled by parasitoids, predators, and viral and fungal pathogens, and these natural controls agents increase in number during outbreak. Hemlock sawfly has over 20 known species of parasitoids. Sawfly outbreaks can provide net benefits to wildlife. Larvae provide a valuable food source for birds, small mammals, and other insects. Defoliation can promote canopy openings that enhance the growth of understory forbs and shrubs for deer.

Spruce beetle (*Dendroctonus rufipennis*) activity was mapped on 1,600 acres in Southeast Alaska in 2014. The Kupreanof Island outbreak decreased in acreage from 2013 with approximately 220 acres of ongoing spruce beetle activity mapped. The rest of the activity was scattered through the region, from Skagway to Ketchikan, in patches of less than 100 acres. An area of significant spruce beetle activity mapped in 2013 on non-Forest Service lands northwest of Haines along the lower Klehini River and around Chilkat Lake appears to have decreased as well. These two general areas and a few scattered damage polygons nearby comprised 1,400 acres of spruce beetle damage in 2014, compared with 4,700 acres in 2013. These areas were also heavily impacted during the spruce beetle outbreak in the 1990s. Spruce beetle has been a rather minor problem on the Tongass compared to other lands in Alaska, but disturbance such as major windthrow events can lead to increased populations. Ground-checks to verify and monitor mapped spruce beetle activity on the Tongass are planned for 2015.

Defoliating insects eat the leaves or needles of trees and understory plants and are found throughout Alaska on all tree species. When defoliator populations become large enough, vast acreages can be affected. During an outbreak, nearly every tree in a stand can be damaged to varying degrees. In addition to the effects on individual tree physiology, defoliators can also have ecological and socioeconomic impacts on wildlife habitat and forage, aquatic ecosystems dependent on terrestrial inputs, forest aesthetics, and timber, property, and recreation values. Defoliators belong to diverse insect orders and families, including beetles (Coleoptera: Chrysomelidae), sawflies (Hymenoptera: Tenthredinadae), and moths (Lepidoptera: Geometridae, Tortricidae), which contribute the greatest amount of activity. Defoliator outbreaks tend to be cyclic and dramatic. Outbreaks of some species are closely tied to weather conditions that affect insect development, reproduction, and dispersal, as well as host phenology. Understory hardwood defoliators have the potential to significantly reduce browse available to deer.

Tree and shrub species throughout Alaska have been affected by several geometrid (inchworm) defoliators in recent years. Bruce spanworm (*Operophtera bruceata*) is thought to be responsible for widespread blueberry and salmonberry defoliation early in the summer.

Leaf rollers, such as *Epinotia solandriana*, roll leaves into protective shelters to feed within. The damage causes crowns to appear thin. Leaf roller defoliation was mapped on over 800 acres in Southeast Alaska in 2014. The alder along Perseverance Trail in Juneau has been heavily impacted by birch leaf roller in 2013 and 2014 and may result in dieback.

The Sitka spruce weevil (a.k.a. white pine weevil, *Pissodes strobi*), is a damage agent of young Sitka spruce that has yet to be found in Southeast Alaska. However, this native insect is one of the most damaging pests of young Sitka spruce in coastal British Columbia, Washington, and Oregon. Adult weevils lay their eggs in the spring on last year leaders of spruce trees. Resin flows are visible where females have laid their eggs. The larvae hatch in the summer and feed gregariously on phloem, working down the leader. Feeding damage girdles leaders, resulting in multi-topped trees with shrub-like form, crooked stems, and reduced height growth. Attacked leaders turn reddish-brown and droop in late summer or fall. Attacked leaders can be cut vertically and viewed in cross section to reveal last-year's larval feeding tubes and shredded wood fiber beneath the bark. Populations of the Sitka spruce weevil are largely controlled by temperature (degree-days); therefore, this will be a species to watch closely in the future as temperatures increase. Alternatively, the Sitka spruce weevil is more successful on water-stressed trees which could prevent their establishment in the coastal rainforest of Southeast Alaska.

### *Invasive Insect Surveys*

In 2014, several agencies (Alaska Department of Natural Resources, USDA Animal and Plant Health Inspection Service and Forest Service and others) continued detection surveys for European (EGM) and Asian gypsy moths (AGM) (*Lymantria dispar*), rosy gypsy moths (*Lymantria mathura*), nun moths (*Lymantria monacha*), and Siberian silk moths (*Dendrolimus superans sibiricus*). EGM has been intercepted in monitoring traps five times in Anchorage and Fairbanks between 1987 and 2006. The interceptions were single moths found in recreational vehicle (RV) parks demonstrating how the insect is often transported and the effectiveness of this monitoring method. Trapping efforts primarily focus on likely introduction pathways, such as port communities, international borders, shipping and container facilities, and high-use recreational sites. In recent years, AGM egg masses have been detected on marine vessels from Asian ports destined for ports along the west coast, and several of these occurred on vessels headed for ports in southeast Alaska. In 2008, 2012, and 2014 vessels destined for Southeast Alaska that contained AGM egg masses were intercepted by Customs and Border Protection. The AGM poses a more significant risk to Alaska's forested resources than the EGM, as it has a broader host range (over 600 hardwood and conifer species) and female moths are able to fly, allowing for faster dispersal. The relatively recent offshore vessel detections warrant concern for the possibility of overwintering egg masses in or near Alaska's port communities.

A similar trapping program is in effect to survey for invasive bark and wood boring beetles. The Alaska early detection and rapid response (EDRR) non-native bark beetle and wood borer monitoring project goals are to (1) detect, delimit, and monitor newly-introduced non-native bark beetles, ambrosia beetles, and wood boring beetles at selected high-risk forest areas, (2) identify additional pathways and areas for expanding annual monitoring, and (3) quickly assess and respond to newly detected non-native forest insect infestations. Providing early detection of non-native beetles entering Alaska requires a cooperative monitoring network. Key partners assist the Alaska Division of Forestry and the USDA Forest Service Forest Health Protection - Region 10 (R10 FHP) with identification and risk assessment. As of 2014, no tree-killing non-native bark beetles or woodborers have been detected through EDRR monitoring in Alaska, initiated in 2001.

A study was completed in 2014 by entomologists with Forest Health Protection (Juneau) and Xavier University to investigate trapping methods of a specific family of wood boring beetles known as long-horned beetles. Non-native wood boring beetles are easily transported in wood packing materials and can pose a considerable threat to forests. The results of this study will help to improve EDRR monitoring efforts for this family of beetles.

## Evaluation of Results

At this time, management activities do not appear to be exacerbating insect and disease problems in the Tongass National Forest. Hemlock dwarf mistletoe and many stem decay pathogens are less frequent after silvicultural treatment. Yellow-cedar decline in young-growth, hemlock canker, and shoot diseases are issues to watch for in young, managed stands. Stem decays may become prevalent in managed stands as they age due to bole wounding caused by partial harvest or commercial thinning treatments. It is possible to promote or maintain stem decays and mistletoe in stands managed for non-timber objectives in order to enhance habitat, ecological processes, and other old-growth characteristics. Yellow-cedar decline is a leading example of the impacts of changing climate on a tree species. Management can favor yellow-cedar on sites with deeper soils or sufficient snowpack to meet conservation goals for this valuable species. Prospects for the salvage of dead yellow-cedar are promising in some areas with concentrated yellow-cedar snags, road access, and land-use designations that permit harvest or salvage. The completed draft yellow-cedar strategy provides guidance for 33 management zones in Alaska that contain yellow-cedar. The EDRR program monitors several invasive insects that present a threat to Alaskan Forests. The Sitka spruce weevil is another insect species to watch carefully, as it occurs close to our southern border and its populations are influenced by temperature. Damage from already established, non-native spruce aphid may increase under a warming climate scenario.

Although insect and diseases are not currently causing significant problems in managed stands, we must remain vigilant in our monitoring efforts, because this may change with time under altered climate scenarios, or with the accidental introduction of exotic pathogens or insects. The monitoring work conducted annually by the State and Private Forestry branch of the Forest Service, Forest Health Protection group, and Tongass National Forest silvicultural staff is sufficient to assess threats and impacts from insects and disease.

## Citations

Barrett, T.M. and G.A. Christensen, technical editors. 2011. Forests of southeast and south-central Alaska, 2004-2008: Five-year forest inventory and analysis report. General Technical Report. PNW-GTR-835. USDA Forest Service, Pacific Northwest Research Station, Portland, OR. 156 p.

Farr, W.A., V.J. LaBau and T.H. Laurent. Estimation of decay in old-growth western hemlock and Sitka spruce in Southeast Alaska. Research Paper. PNW-RP-204. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR.

Hennon, P.E., D.V. D'Amore, P.G. Schaberg, D.T. Witter, and C.S. Shanley. 2012. Shifting climate, altered niche, and a dynamic conservation strategy for yellow-cedar in the North Pacific coastal rainforest. Bioscience. 62: 147-158.

Kimmey, J.W. 1956. Cull factors for Sitka spruce, western hemlock and western redcedar in southeast Alaska. USDA Forest Service, Alaska Forest Research Center. Station Paper No. 6. Aug. 1956.

McClellan, M.H., D.N Swanston, P.E. Hennon, R.L. Deal, T.L. De Santo, and S.M. Wipfli. 2000. Alternatives to clearcutting in the old-growth forests of southeast Alaska: Study plan and establishment report. General Technical Report. PNW-GTR-494. USDA Forest Service, Pacific Northwest Research Station, Portland, OR. 40 p.

Tait, S.M, C.G Shaw III and A. Eglitis. 1985. Occurrence of insect and disease pests on young-growth Sitka spruce and western hemlock in southeastern Alaska. Research Note. PNW-RN-433. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR.

# 7. Invasive Species: Status

**Goal:** Reduce the potential for introduction, establishment, and spread of invasive species and reduce existing infestations.

**Objective:** Monitor populations of high priority invasive species in cooperation with other agencies. Monitor implementation and effectiveness of specific actions related to control and prevention of invasive species infestations.

**Background:** For policy pertaining to invasive plant management, see FSM 2900 (Invasive Species Management Policy), 2070 (Native Plant Material Policy) and FSM 2150 (Pesticide Use Management and Coordination Policy). The primary forest-wide plan is contained in the 2005 Tongass National Forest Invasive Plant Management Plan. Tiered to this plan are individual district and wilderness area invasive plant plans.

## Invasive Species Question: *What are the status and trends of areas infested by aquatic and terrestrial invasive species relative to the desired condition?*

### Evaluation Criteria

The Tongass has several known infestations of non-native and potentially invasive terrestrial and aquatic animal species. These species include the red legged frog (*Rana aurora*), pacific tree frog *(Pseudacris regilla*) and Atlantic salmon (*Salmo salar)*. The Alaska Department of Fish and Game (ADF&G) is responsible for inventory and monitoring of Atlantic salmon. There are several other species receiving attention throughout the state, including European green crab (*Carcinus maenas*), didemnum tunicate (*Didemnum vexillum*), didymo or 'rock snot'(*Didymosphenia geminata*), black slug (*Arion ater*), Norway rat (*Rattus norvegicus*) and introduced (non-naturally occurring) northern pike (*Esox lucius*). These species are generally being managed by other agencies including the ADF&G and U.S. Fish and Wildlife Service (USFWS). Canadian waterweed (*Elodea canadensis)* is a highly invasive aquatic plant that has been found in the interior of Alaska and is spreading, but it has not yet been found in southeast Alaska.

In 2013, we began implementation of a protocol to monitor sites with a high risk of impacts due to existing or future infestations of invasive plants. Several high-risk sites were identified across the Tongass and were surveyed during the growing season. These sites are identified by ranger district invasive plant management plans (or an equivalent process) as having the highest risk of impacts due to new infestations and/or spread of existing infestations of invasive plants. The location and areal extent of invasive plant infestations was recorded at each site. These sites will be revisited at least once within the 5-year monitoring cycle to assess changes in the number and area of infestations. A new set of sites was visited in 2014, and these sites will also be revisited in 3 to 5 years. The monitoring results will help inform managers about the status and trends of these sites.

### Monitoring Results

In 2014, no monitoring for invasive animal species was conducted on the Tongass. No occurrences of Atlantic salmon were detected in the waters of the Tongass by ADF&G or the Forest Service. According to ADF&G, European green crab have not yet been detected in southeast Alaska waters, but monitoring efforts in 2014 were limited to areas around the cities of Ketchikan, Sitka, and Juneau. ADF&G reports that invasive marine tunicates have been detected in marine harbors in Ketchikan and Sitka.

Seven high-risk invasive plant sites were visited across the Forest in 2014, with infestations covering a total of 2.72 acres (Table 1). High-priority invasive plant species recorded include brittlestem hempnettle (*Galeopsis tetrahit*), field mustard (*Brassica rapa*), oxeye daisy (*Leucanthemum vulgare*), reed canarygrass (*Phalaris arundinacea*), white clover (*Melilotus alba*), black bindweed (*Polygonum*

*convolvulus*), orange hawkweed (*Hieracium aurantiacum*), and field sowthistle (*Sonchus arvensis*). All seven sites had one or more infestations of invasive plant species that are a high priority for control on the Tongass National Forest.

**Invasive Species Table 1. Monitoring results (FY2014) for sites with high risk of impacts from invasive plant infestations**

| Ranger District | Site Name | Species | Infested Area (acres) |
|---|---|---|---|
| Admiralty National Monument | Last Chance Harbor | brittlestem hempnettle | 1.02 |
| | Swan Island | black bindweed | 0.05 |
| | | field mustard | 0.40 |
| Craig Ranger District | Dog Salmon Fishpass | oxeye daisy | < 0.01 |
| | | reed canarygrass | 0.33 |
| | | white clover | 0.18 |
| | Harris River Young Growth Study and Trail | oxeye daisy | < 0.01 |
| Juneau Ranger District | Barlow Cove | field sowthistle | 0.14 |
| Thorne Bay Ranger District | Memorial Beach Parking Area | orange hawkweed | 0.10 |
| | | oxeye daisy | 0.22 |
| | Winter Harbor Boat Launch and Parking | oxeye daisy | 0.01 |
| | | reed canarygrass | 0.27 |

## Evaluation of Results

The high-risk sites visited in 2014 will be revisited at least once during the five-year monitoring cycle, and the new data collected will be compared to the initial monitoring data to determine if infestations have spread or have been reduced or eliminated, or if new infestations have become established.

## Action Plan

In 2015, depending on available resources, a new set of sites with high risk of impacts from invasive plants will be selected using the same criteria as for the previous sets of sites. These sites will be visited, and existing infestations will be recorded at each site. These sites will be revisited at least once during their five-year monitoring cycle, and any new infestations and changes to existing infestations will be recorded. The results will be used to help evaluate the effectiveness of our management activities in preventing new infestations and controlling existing infestations of high-priority invasive plants.

# 8. Invasive Species: Prevention and Control

**Goal:** Reduce the potential for introduction, establishment, and spread of invasive species and reduce existing infestations.

**Objective:** Monitor populations of high priority invasive species in cooperation with other agencies. Monitor implementation and effectiveness of specific actions related to control and prevention of invasive species infestations.

**Background:** For policy pertaining to invasive plant management, see FSM 2900 (Invasive Species Management Policy), 2070 (Native Plant Material Policy) and FSM 2150 (Pesticide Use Management and Coordination Policy). The primary forest-wide plan is contained in the 2005 Tongass National Forest Invasive Plant Management Plan. Tiered to this plan are individual district and wilderness area invasive plant plans.

## Invasive Species Question: *How effective were our management activities, including those done through partnerships, in preventing or controlling targeted invasive species?*

### Monitoring Results

#### *Prevention*

Prevention measures for invasive plants implemented in FY2014 were based on project and site-specific circumstances including overall risk of spread, degree of invasiveness of the non-native plants in the project area, and the likelihood of successfully preventing further spread. Invasive plant prevention measures were implemented on one ranger district in FY2014 as part of projects and other activities.

**Ketchikan-Misty Fiords Ranger District:**

- Weeds were monitored and removed in the Hyder area, including nearby quarries associated with mineral materials special-use permits.
- Monitoring invasive plant infestations at Quartz Hill was implemented during road inspections.
- A previously documented infestation of oxeye daisy was not relocated.

#### *Treatment and Control*

A total of 60.6 acres of invasive plant treatments were completed in FY2014 (Table 1), compared to 67.1 acres in FY2013, 122.8 acres in FY2012, 144.7 acres in FY2011, and 222.5 acres in FY2010.

The Petersburg and Wrangell Ranger Districts recently completed the first district-level invasive plant treatment environmental assessment (EA) on the Forest. This analysis covered all treatment options (manual, chemical, and mechanical) for high priority invasive species and sites within both ranger districts, including wilderness areas. Under this district weed EA, 2.6 acres of infestations were treated using herbicide.

**Invasive Species Table 1. Invasive plant treatments completed on the Tongass National Forest in FY2014**

| | Area Treated (acres) | |
|---|---|---|
| **Ranger District** | **Manual** | **Herbicide** |
| Admiralty National Monument | 2.9 | 0.0 |
| Craig Ranger District | 1.4 | 0.0 |

| Ranger District | Area Treated (acres) | |
|---|---|---|
| | Manual | Herbicide |
| Hoonah Ranger District | 12.5 | 0.0 |
| Juneau Ranger District | 0.7 | 0.0 |
| Ketchikan-Misty Fiords Ranger District | 1.6 | 0.0 |
| Petersburg Ranger District | 3.6 | 0.0 |
| Sitka Ranger District | 7.1 | 0.5 |
| Thorne Bay Ranger District | 28.6 | 0.0 |
| Wrangell Ranger District | 1.7 | 2.6 |
| Yakutat Ranger District | 0.5 | 0.5 |
| **Total** | **60.6** | **3.6** |

### *Education and Partnerships*

Partnerships and educational activities are helpful in prevention and control efforts for invasive plants, both on National Forest System lands and lands outside agency jurisdiction. Invasive plant education/partnership activities were conducted on five ranger districts in 2014.

**Admiralty National Monument:**

- Forest Service staff partnered with groups from Wilderness Volunteers and the Southeast Alaska Conservation Council (SEACC) to control infestations of brittlestem hempnettle (*Galeopsis tetrahit*) at Gambier Bay, and black bindweed (*Polygonum convolvulus*) on Swan Island (Photo 1).

**Hoonah Ranger District:**

- Near the community of Hoonah, Forest Service staff worked with the Hoonah Indian Association to control weed infestations.
- Within the community, the Forest Service, Hoonah Indian Association, and Huna Totem Corporation are in their eighth year of working cooperatively to control field sowthistle (*Sonchus arvensis*).

**Petersburg Ranger District:**

- Forest Service staff completed a Participating Agreement with Southeast Soil and Water Conservation District (SSWCD) to conduct a community demonstration project for treatment of Bohemian knotweed on NFS lands near the community of Kake. The purpose of the agreement is to provide hands-on experience and learning for community members on different treatment methods of this invasive plant.

**Sitka Ranger District:**

- Forest Service staff completed a Participating Agreement with SSWCD to update the invasive species inventory for the community of Sitka and write a management plan, which will be completed in 2015.

**Wrangell Ranger District:**

- Forest Service staff developed a Stikine River Invader Watch pamphlet and identification cards to encourage public reporting of nine invasive plant species of interest. Over 30 sets of identification cards were distributed.
- The district also provided an invasive plant identification/information table at one of the monthly Community Markets, with approximately 50 people contacted.

**Yakutat Ranger District:**

- The district hosted an invasive species workshop in August 2014 in the community of Yakutat. It was attended by representatives of the city, Alaska Department of Transportation, National Park Service, Forest Service, SSWCD, and the Yakutat tribe. The meeting focused on forming a Cooperative Weed Management Area (CWMA) to help stop the introduction and spread of invasive species in Yakutat. The Yakutat tribe now plans to have a Student Conservation Association volunteer work on the formation of a CWMA, with help from the SSWCD and the Forest Service. Another result of the meeting was to organize a weed pull, targeting a small population of fall dandelion (*Leontodon autumnalis*), which has just taken a foothold in the community.

## Action Plan

Prevention, treatment, and control efforts, and education and partnership opportunities will continue to be implemented in FY2015. Successful control of invasive plant infestations often requires continued periodic treatments over several years, along with monitoring to assess the effectiveness of treatments. Continued efforts to develop formal partnership agreements in the form of a Memorandum of Agreement (MOA) are also needed to develop Cooperative Weed Management Areas for communities throughout the Tongass. Currently, the Tongass has one formal MOA with the City of Juneau as a Cooperative Weed Management Area. This work is ongoing. The Wrangell Ranger District is also in discussion with the Southeast Alaska Watershed Coalition to develop a partnership for invasive plant treatment on the district.

*Invasive Species Photo 1. Black bindweed (Polygonum convolvulus), an invasive plant found on the Tongass National Forest.*

# 9. Biodiversity Ecosystem: Old-Growth Associated Species

**Goal:** Maintain healthy forest ecosystems by maintaining a mix of habitats at different spatial scales capable of supporting the full range of naturally occurring flora, fauna, and ecological processes native to Southeast Alaska.

**Objective:** Maintain a Forest-wide system of old-growth forest habitat to sustain old-growth-associated species and resources.

**Background:** An integrated old-growth conservation strategy was developed to protect and maintain old-growth habitat. This strategy was incorporated into the 1997 Tongass National Forest Land and Resource Management Plan (Forest Plan) and was reviewed, revised, and incorporated into the 2008 Forest Plan. The conservation strategy includes two major components. First is the system of large, medium, and small old-growth reserves well distributed throughout the Tongass. This system of reserves is made up of areas allocated to the old-growth habitat land use designation, plus lands in all the rest of the non-development land use designations, which essentially maintain the integrity of the old-growth system. This component provides adequate habitat for old-growth-dependent or associated species, and provides for connectivity between reserves in order to prevent genetic isolation of populations. In response to concerns for small island endemic taxa, the Forest Plan also protects all islands less than 1,000 acres from additional harvest of old-growth forest (USDA Forest Service 2008c, page D-10).

The second major element of the conservation strategy is a series of standards and guidelines applicable to those portions of the Tongass open to consideration for potential timber harvest (referred to as the matrix). The matrix includes lands designated as experimental forest, modified landscape, scenic viewshed and timber production land use designations and sometimes excludes the recreational river land use designation. Within the matrix, components of the old-growth ecosystem are maintained by standards and guidelines to protect important areas and provide old-growth forest habitat connectivity. This component includes beach and estuary fringe, riparian buffers, and other Forest-wide standards and guidelines that preclude or significantly limit timber harvest in areas of high hazard soils, steep slopes, karst terrain, visually sensitive travel routes and use areas, and in timber stands technically not feasible to harvest. It also includes a number of species-specific standards and guidelines such as raptor nest and wolf den protection areas (USDA Forest Service 2008b, page D-10).

During the 2008 Forest Plan amendment process, a comprehensive review and mapping effort was completed for the small old-growth reserves. This review focused primarily on small old-growth reserves because they received differing levels of review during the development of the 1997 Forest Plan. The large and medium old-growth reserves were generally not reviewed because they received a rigorous review and were designed to meet reserve strategy objectives (USDA Forest Service 1997, page 3-82) and few modifications were anticipated. The total acres of old-growth land use designations were increased by 38,749 acres from the 1997 Forest Plan to the 2008 Forest Plan (USDA Forest Service 2008c, page D-29). In addition, old-growth reserve locations were finalized for all but 13 old-growth reserves (identified in Appendix K of the 2008 Forest Plan). Old-growth reserve locations are not expected to change unless they meet the limited circumstances described in Appendix K of the 2008 Forest Plan.

Pursuant to Forest Plan Appendix K, old-growth reserve boundary changes proposed at the project level require an interagency team of USDA Forest Service, U.S. Fish and Wildlife Service (USFWS), and Alaska Department of Fish and Game (ADF&G) biologist to jointly evaluate the location and habitat composition of old-growth reserves. The interagency review team is to develop a biologically preferred location for old-growth reserves that meets Forest Plan criteria and document why other proposals are not recommended. Management prescriptions for the old-growth habitat land use designations (Forest Plan, page 3-62, WILD B.2) indicate that “Reserve location, composition, and size may otherwise also be adjusted. Modified OGRs must provide a comparable achievement of the Old-growth Habitat LUD goals and objectives. Determination as to comparability must consider the criteria in Appendix K.” Thus, the

primary direction for evaluating the capability of a modified old-growth reserve to provide a comparable achievement is contained in the old-growth habitat land use designation goals and objectives and Appendix K of the Forest Plan. Appendix K further references Appendix D of the Forest Plan FEIS.

## Biodiversity Ecosystem Question: *Is the old-growth habitat protected under the Forest Plan being maintained to support viable and well-distributed populations of old-growth-associated species and subspecies?*

### Evaluation Criteria

The maintenance of old-growth habitat and assessment of its support to viable and well-distributed populations of old-growth associated species and subspecies will be determined by assessing changes in the total acres and acres of productive old-growth forest in the system of large, medium, and small habitat reserves (including old-growth habitat and other non-development land use designations). This assessment will be completed by reviewing project-level environmental documents and Forest Plan amendments for their effects on the spatial distribution, size, and composition of old-growth habitat reserves compared to those designated in the 2008 Forest Plan.

The 2008 Forest Plan designates 79 percent of the land use designations as non-development (Table 1). Of this, 1,221,173 acres are old-growth land use designation (USDA Forest Service 2008c, page D-29). National Forest System lands total 16,773,804 acres.

**Biodiversity Ecosystem Table 1. Land use designations for national forest system lands from the 2008 Forest Plan**

| **Non-development land use designations (13,324,832 acres)** | | **Development land use designations (3,448,972)** | |
|---|---|---|---|
| Wilderness/Non Development<br>(5,916,026 acres) | Natural Setting/Non Development<br>(7,408,806 acres) | Development<br>(3,448,972 acres) | Development Overlay Group 3[1]<br>(249,570 acres) |
| Wilderness<br>Wilderness National Monument<br>Non-wilderness National Monument | Land use designations II<br>Remote Recreation<br>Semi-Remote Recreation<br>Old-growth Habitat<br>Enacted Municipal Watershed<br>Research Natural Area<br>Special Interest Area<br>Wild River<br>Scenic River<br>Recreational River | Experimental Forest<br>Modified Landscape<br>Scenic Viewshed<br>Timber Production | Minerals<br>Transportation & Utility Systems |

[1]The two land use designations in this group are always overlay land use designations. Areas allocated to these land use designations are managed according to the underlying land use designations until such time that mineral or transportation/utility development is approved, if at all. The Minerals overlay land use designation has an area (249,570 acres) associated with it; no acreages are calculated for the Transportation and Utility System land use designations because it is defined as a series of corridors of undefined width and imprecise locations.

*Source:* USDA (2008a, page 3-2).

### Monitoring Results

A non-significant Forest Plan Amendment was included in the Big Thorne Project Record of Decision for modification of the small old-growth reserves (OGRs) in the following VCUs: 5790, 5800, 5810, 5820, 5830, 5850, and 5950. The net result of these changes to the spatial distribution, size, and composition of the Old-Growth Habitat Land Use Designation (LUD) in these seven VCUs is an increase of 645 acres to

the OGR system, as well as an increase of 107 acres of POG (USDA Forest Service 2014) (see Table 2). Road miles and young-growth acres within the boundaries of the OGRs were reduced. The amount of POG, including large-tree and low elevation POG, interior forest acres, goshawk and marbled murrelet nesting habitat, and deer and marten winter habitat was reduced in some OGRs. All modified VCUs meet the criteria established by Appendix K of the 2008 Forest Plan and provide comparable achievement of the goals and objectives of the Old-Growth Habitat LUD. Changes were evaluated against factors established in Forest Service Manual and Forest Service Handbook direction to determine if the changes constituted a "significant amendment" (Appendix 3 of the Big Thorne ROD).

**Biodiversity Ecosystem Table 2. Small Old-Growth Habitat LUD changes from the 2008 Forest Plan**

| VCU | Total | Change from existing | POG | Change from existing | Young growth | Change from existing | Total Road Miles | Change from existing |
|---|---|---|---|---|---|---|---|---|
| 5790 | 2,740 ac | - 5 ac | 867 ac | - 5 ac | 128 ac | 0 ac | 3.1 mi | 0 mi |
| 5800 | 3,363 ac | +246 ac | 1,711 ac | +117 ac | 209 ac | -70 ac | 4.1 mi | -1.3 mi |
| 5810 | 3,363 ac | -386 ac | 2,039 ac | -232 ac | 101 ac | -81 ac | 3.2 mi | -3.2 mi |
| 5820 | 1,151 ac | +386 ac | 887 ac | +299 ac | 0 ac | 0 ac | 0 mi | 0 mi |
| 5830 | 2,368 ac | +329 ac | 1,019 ac | +74 ac | 590 ac | -69 ac | 7.2 mi | -0.9 mi |
| 5850 | 1,681 ac | -225 ac | 875 ac | -174 ac | 15 ac | -8 ac | 1.8 mi | -2.3 mi |
| 5950 | 2,593 ac | +300 ac | 1,433 ac | +28 ac | 203 ac | -64 ac | 2.5 mi | -1.1 mi |
| **TOTAL** | **17,259 ac** | **+645 ac** | **8,831 ac** | **+107 ac** | **1,246 ac** | **-292 ac** | **21.9 mi** | **-8.8 mi** |

## Evaluation of Results

Old-growth habitat protected under the Forest Plan has been maintained in the system of small, medium, and large old-growth reserves. According to the analysis in the 2008 Forest Plan FEIS, this along with implementation of the standards and guidelines for protecting old-growth in the matrix continues to support viable and well-distributed populations of old-growth associated species and subspecies. The conservation strategy as implemented in the 2008 Forest Plan provides a sufficient amount and distribution of habitat to maintain viable populations of old-growth associated species after 100 years of plan implementation. Although this does not represent a "no risk" conservation strategy, it represents a balance of wildlife conservation measure that considers the best available scientific information and reflects an acceptable level of risk for continued species viability (USDA Forest Service 2008c, page D-17).

The changes that occurred as a result of the Big Thorne ROD continue to meet the minimum Forest Plan acreage requirements, meet Old-Growth Habitat goals and objectives outlined in the Forest Plan, and are consistent with direction in Appendix K of the Forest Plan. Overall acreage of the reserve system has been increased by 645 acres, a very minor portion of the overall Tongass-wide conservation strategy acreage (change of less than one tenth of one percent of the Tongass National Forest).

## Action Plans

New information does not support any changes to the Forest Plan conservation strategy at this time. Action plan items include:

- Continue to detail descriptions of change in old-growth reserves and associated rationale in project-level National Environmental Policy Act documents.
- When changes in old-growth reserves occur, every 5 years, assess the changes in forest structure (using the size density map) and distribution of the small, medium, and large old-growth reserves

(including non-development land use designations) to monitor reserve function at the biogeographic province or island scale. Focus on landscapes within phase one areas of the Timber Sale Program Adaptive Management Strategy (i.e., Prince of Wales Island, Wrangell Island, etc.).

## Citations

USDA Forest Service. 2014. Big Thorne Project. Record of Decision. Management Bulletin. R10-MB-736e. Thorne Bay, AK: USDA Forest Service, Alaska Region, Tongass National Forest, Thorne Bay Ranger District.

USDA Forest Service. 2008a. Tongass Land and Resource Management Plan, Final Environmental Impact Statement, Plan Amendment, Record of Decision. Management Bulletin. R10-MB-603a. Juneau, AK: USDA Forest Service, Alaska Region, Tongass National Forest.

USDA Forest Service. 2008b. Tongass Land and Resource Management Plan, Final Environmental Impact Statement, Plan Amendment. Management Bulletin. R10-MB-603b. Juneau, AK: USDA Forest Service, Alaska Region, Tongass National Forest.

USDA Forest Service. 2008c. Tongass Land and Resource Management Plan, Final Environmental Impact Statement, Plan Amendment, Volume 1. Management Bulletin. R10- MB-603c. Juneau, AK: USDA Forest Service, Alaska Region, Tongass National Forest.

USDA Forest Service. 1997. Tongass Land and Resource Management Plan. Management Bulletin. R10-MB-338-CD. Juneau, AK: USDA Forest Service, Alaska Region, Tongass National Forest.

# 10a. Biodiversity Ecosystem: Change in Old-Growth by Biogeographic Province

**Goal:** Maintain healthy forest ecosystems by maintaining a mix of habitats at different spatial scales capable of supporting the full range of naturally occurring flora, fauna and ecological processes native to Southeast Alaska.

**Objective:** Maintain a Forest-wide system of old-growth forest habitat to sustain old-growth-associated species and resources.

**Background:** An integrated old-growth conservation strategy was developed to provide a sufficient amount and distribution of habitat to maintain viable populations of old-growth associated species after 100 years and full implementation of the 1997 Tongass Land and Resource Management (1997 Forest Plan) (USDA Forest Service 2008b, page D-17). This strategy was reviewed, revised, and incorporated into the 2008 Forest Plan Amendment (2008 Forest Plan) and includes two major components.

First is the system of large, medium and small old-growth reserves (OGRs) well-distributed throughout the Tongass. This system of reserves is made up of areas allocated to the old-growth habitat land use designations, plus lands in all the rest of the non-development land use designations, which essentially maintain the integrity of the old-growth system. This component provides adequate habitat for old-growth dependent or associated species, and provides for connectivity between reserves in order to prevent genetic isolation of populations. In response to concerns for small island endemic taxa, the 1997 and 2008 Forest Plans both protect all islands less than 1,000 acres from additional harvest of old-growth forest (USDA Forest Service 2008c, page D-10).

The second major element of the conservation strategy is a series of standards and guidelines applicable to those portions of the Tongass open to consideration for timber harvest (referred to as the matrix). The matrix includes lands designated as experimental forest, modified landscape, scenic viewshed and timber production land use designations and sometimes excludes the recreational river land use designation. Within the matrix, components of the old-growth ecosystem are maintained by standards and guidelines to protect important areas and provide old-growth forest habitat connectivity. This component includes the beach and estuary fringe, riparian buffers, and other Forest-wide standards and guidelines that preclude or significantly limit timber harvest in areas of high hazard soils, steep slopes, karst terrain, visually sensitive travel routes and use areas, and in timber stands technically not feasible to harvest. It also includes a number of species-specific standards and guidelines, such as raptor nest and wolf den protection areas (USDA Forest Service 2008b, page D-10).

During the NEPA analysis for the 2008 Forest Plan, a comprehensive review and mapping effort was completed for the small old-growth reserves. This review focused primarily on small old-growth reserves because they received a different level of review during the development of the 1997 Forest Plan. The large and medium old-growth reserves were generally not reviewed because they received a rigorous review during the development of the 1997 Forest Plan and were designed to meet reserve strategy objectives (USDA Forest Service 1997, page 3-82) and few modifications were anticipated. The total acres of old-growth land use designations were increased by 38,749 acres from the 1997 Forest Plan to the 2008 Forest Plan (USDA Forest Service 2008c, page D-29). In addition, old-growth reserve locations were determined for all but 13 old-growth reserves (identified in appendix K of the 2008 Forest Plan Amendment). Old-growth reserve locations may be modified under limited circumstances described in appendix K of the 2008 Forest Plan.

## Biodiversity Ecosystem Question: *Are the effects on biodiversity, shown through the cumulative change in old-growth by biogeographic province, consistent with the estimates of the Forest Plan (change could include effects of timber harvest, land exchanges or conveyance, windthrow, insect and disease, climatic changes, etc.)?*

### Evaluation Criteria

The effects on biodiversity as a result of cumulative change in old-growth habitat by biogeographic province will be determined by assessing changes in the amount of potential old-growth habitat (Biodiversity Evaluation Criteria, USDA Forest Service, 2008b, pages 6-8). Using a vegetation map in a geographic information system (GIS) and the Forest Activities Tracking System (FACTS) database, we will assess the change in acres of productive old-growth (POG), high volume POG (HPOG), and size density 6 & 7 (large-tree POG, SD67) habitat due to timber harvest and land conveyance on National Forest System lands by biogeographic province as compared to those displayed in the 2008 Forest Plan Final Environmental Impact Statement (USDA Forest Service, 2008c, Tables 3.9-14, 3.9-15 and 3.9-16; pages 3-178, 3-180 and 3-181).

POG, HPOG, and SD67 will be identified spatially using the 1954 Size Density cover in the Tongass corporate GIS library joined with harvest data from FACTS. Harvest by all silvicultural systems are included (activity codes 41XX and 42XX) except commercial thinning, which does not harvest POG, HPOG or SD67. The following are definitions of POG, HPOG, and SD67:

- POG: Size density classes 4H, 4S, 4N, 5H, 5S, 5N, and 67. This encompasses the commercial-size timber across the Forest and ranges from:
    - small to medium diameter (quadratic mean diameter [QMD] < 21 inches) trees occurring at various densities and of volume class 4 (8 to 20 MFG/acre) and where tree diameters greater than 40 inches are generally rare, to
    - large diameter (QMD > 21 inches) trees occurring at low density (SDI < 280) of volume class 6 or 7 (> 30 MBF/acre) and where tree diameters greater than 40 inches are common and well -istributed throughout the stand.
- HPOG: Size density classes 5S, 5N, and 67. This is a subcategory of POG that only includes the stands where tree diameters are commonly larger than 40 inches, but may be patchily or uniformly distributed.
- SD67: This includes only the 67 size density class of stands for which tree diameters are commonly larger than 40 inches and are well-distributed throughout.

Large scale changes in forest cover due to windthrow and insect and disease outbreaks at the Forest-wide scale will be tracked as part of the monitoring for 2008 Forest Plan Amendment Monitoring and Evaluation Biodiversity question (Question 6): Are destructive insects and disease organisms increasing to potentially damaging levels following management activities?

## Monitoring Results

There have been no changes in land use designations due to land exchange or conveyance since signing of the 2008 Forest Plan[1]. Based on our analysis in a GIS, 2,488 acres of POG, 1,221 acres of HPOG, and 99 acres of SD67 were harvested (by all silvicultural systems) during FY2014 across five biogeographic provinces (Table 1).

**Biodiversity Table 1. Acres of POG, HPOG and SD67 harvested during FY2014 across five biogeographic provinces**

| | POG Habitats | | |
|---|---|---|---|
| **Biogeographic Province** | **POG** | **HPOG** | **SD67** |
| East Chichagof Island (#3) | 349 | 106 | 11 |
| Kupreanof/Mitkof Islands (#10) | 1,879 | 1,009 | 57 |
| Etolin Island (#13) | 107 | 51 | 6 |
| North Central Prince of Wales (#14) | 138 | 54 | 24 |
| Lynn Canal (#8) | 16 | 1 | 0 |
| **Total** | **2,488** | **1,221** | **99** |

The GIS layer used to estimate the acres of POG, HPOG, and SD67 for this analysis was derived from the 2013 version of the size-density model. The model factors a variety of information including timber type, soil, and aspect for the entire Tongass National Forest.

## Evaluation of Results

The effects of biodiversity shown through the cumulative change in old-growth by biogeographic province are consistent with the estimates of the Forest Plan. There have been no substantial changes in the last year as a result of land exchanges or conveyance, windthrow, insect and disease, climate or other changes that would result in a significant change in biodiversity.

The 2008 Forest Plan assessed the effects of the maximum level of harvest to biodiversity. The allowable sale quantity (ASQ), which is the maximum amount of timber that can be sold in the first decade following the Forest Plan decision, is 2.67 billion board feet. This is equivalent to 267 million board feet (MMBF). This is the upper decadal limit on the amount of timber that may be offered for sale from suitable timber land on the Tongass as part of the regularly scheduled timber sale program. Timber has not been harvested at or near the maximum ASQ level throughout a single planning cycle. Since 2008, total volume harvested has averaged 32 MMBF annually, only 12 percent of the allowable. The 2008 Forest Plan ROD (USDA Forest Service 2008a, page 20) states that there is no expectation that timber will be harvested at a continuous rate of 267 MMBF over the next planning cycle of 15 years.

Even if development occurs at maximum allowable levels for 100 years, the implementation of the Forest Plan would result in a moderate to very high degree of assurance that there would still be sufficient habitat to support long-term viability of wildlife species. This is because the conservation strategy provides a good to very good distribution of high quality old-growth reserves over the long term (USDA Forest Service 2008a, page 47). The conservation strategy provides assurance, subject to an acceptable level of risk inherent in projecting management effects, that even if timber were harvested and roads were constructed consistently for a period of 100 years at the Plan's maximum allowable levels, viable populations of all vertebrate species on the Tongass would remain at the end of that period. This does not

[1] The finalization of the Sealaska land exchange occurred in March 2015, after the period covered by this monitoring report (1 October 2013 through 30 September 2014). This will be included in the FY15 monitoring report.

represent a “no risk” conservation strategy, but a balance of wildlife conservation measures that considered the best available scientific information and reflected an acceptable level of risk for continued species viability, based on conservative assumptions (USDA Forest Service 2008a, page 16).

## Action Plan

- Continue to monitor the amount and distribution, of timber harvest, land exchanges or conveyance, windthrow, insect and disease and climate annually.
- Assess if monitoring question and approach can be better defined as information, or models, are developed to assess climate change.
- Assess the amount, distribution, and intensity of changes to old-growth by change agent at 5-year intervals to assess effects to biodiversity.

## Citations

USDA Forest Service. 2008a. Tongass Land and Resource Management Plan, Final Environmental Impact Statement, Plan Amendment, Record of Decision. Management Bulletin. R10-MB-603a. Juneau, AK: USDA Forest Service, Alaska Region, Tongass National Forest.

USDA Forest Service. 2008b. Tongass Land and Resource Management Plan, Final Environmental Impact Statement, Plan Amendment. Management Bulletin. R10-MB-603b. Juneau, AK: USDA Forest Service, Alaska Region, Tongass National Forest.

USDA Forest Service. 2008c. Tongass Land and Resource Management Plan, Final Environmental Impact Statement, Plan Amendment, Volume 1. Management Bulletin. R10- MB-603c. Juneau, AK: USDA Forest Service, Alaska Region, Tongass National Forest.

USDA Forest Service. 1997. Tongass Land and Resource Management Plan. Management Bulletin. R10-MB-338-CD. Juneau, AK: USDA Forest Service, Alaska Region, Tongass National Forest.

# 10b. Biodiversity Ecosystem: Cumulative Change

**Goal:** Maintain healthy forest ecosystems by maintaining a mix of habitats at different spatial scales capable of supporting the full range of naturally occurring flora, fauna, and ecological processes native to Southeast Alaska.

**Objective:** Maintain a Forest-wide system of old-growth forest habitat to sustain old-growth-associated species and resources.

**Background:** Epiphytic lichen communities are highly sensitive to changes in environmental pollution and climate, making them excellent candidates for long-term monitoring of ecosystem integrity (Root et al. 2014; 2015, Gauslaa 2014, Jovan 2008, Geiser and Neitlich 2007). They lack roots to store water and their physiology is completely dependent on humidity and rainfall occurring at times when temperatures favor photosynthesis (Palmqvist et al. 2008). They are intricately tied to many ecosystem processes such as wildlife food, habitat, and nesting material, nutrient cycling and enhancing biodiversity (Figure 1).

Recently completed models with Forest Inventory and Analysis (FIA) data relate lichen communities to climate gradients in Southeast and Southcentral Alaska (Root et al. 2014). Lichen communities and individual species showed strong differences in composition and abundance within a fairly narrow climatic window from wet areas with warm winters and maximum temperatures to dry places with cold winters and minimum temperatures (or a shift from oceanic to sub-oceanic climate regimes) (Figure 2). This suggests that rapid turnover exists in lichens with relatively small changes within these climate regimes. This work by Root et al. (2014) offers new opportunities to use Forest Service lichen data as indicators of climate and climate change in R10 in collaboration with SE Alaska National Park Network (SEAN), Chugach National Forest, FIA and Oregon State University (OSU). Region 10 has a database of epiphytic lichen community data collected during air quality biomonitoring work from nearly 200 plots from Ketchikan to the Kenai Peninsula. Some Tongass plots in wilderness have had three repeat visits at roughly 10-year intervals since 1989. The data consists of epiphytic lichen communities, elemental content of lichens, and vascular plant community information. To answer the biodiversity question, we hope to explore the lichen data for its utility as a potential indicator of climate and therefore ecological integrity and biodiversity in old growth forested habitats.

*Biodiversity Photo 1. Old man's beard lichen* Usnea longissima *and others of similar morphology are tied to many ecosystem functions such as nesting materials for birds and food for ungulates.*

## Biodiversity Ecosystem Question: *Are the effects on biodiversity, shown through the cumulative change in old-growth by biogeographic province, consistent with the estimates of the Forest Plan (change could include effects of timber harvest, land exchanges or conveyance, windthrow, insect and disease, climatic changes, etc.)?*

## Evaluation Criteria

Currently, this question is being answered by evaluating compositional changes in the biodiversity of old-growth lichen indicator species in relation to climate change (Biodiversity Evaluation Criteria, USDA 2008b, pages 6-8). In 2015, further refinements to help answer this question will be developed by modeling the existing lichen community data from old-growth habitats to identify climate zones and indicator species to climate. The model can be used in the future to score biomonitoring plots based on species' presences and their climatic tolerances. Biodiversity of lichen communities in old-growth forests may be influenced by climate and therefore climate change.

## Sampling/Reporting Period

The sampling period is 2014 and 2015 with a reporting and evaluation period every five years.

## Monitoring Results

The R10 data are housed in the Region 6 Lichen and Air Quality Monitoring database found at http://gis.nacse.org/lichenair/index.php. In 2014, the lichen community and plot databases were substantially edited to catch up on back log of data entry. A small contract was written for a lichenologist to help identify the samples without full identification. These results were also entered into the R10 data base. The National FIA lichen indicator coordinator worked with Tongass staff to develop the Joint Venture Agreement that FIA will have with OSU to do this work in 2015. Modelers from the OSU Plant Biology department will perform most of the model development work.

## Evaluation of Results

Currently the work is in progress. The R10 data are being evaluated for accuracy and refinements are being made for using the data to develop the model. Some of the database work that will be done by the OSU group is nomenclature validation and the addition of vascular plant data from original plot cards. To date, the OSU group has identified climate indicator species and conducted a lichen community analysis in relation to climate gradients using FIA data. Continuing to work the data into the model and score the plots will take about 3 months in 2015 (OSU and FIA researchers). To interpret the results and write a peer reviewed paper including how to use the model in the future would take approximately 5 months including review by the Tongass. Estimated completion of the model is September 2015 and review in 2016.

*Biodiversity Photo 2. Two common lichens of the Tongass, Witch's hair (*Alectoria sarmentosa *on left) and Ticker Tape (*Hypogymnia duplicata *on right). Witch's Hair does not associate strongly with any particular climate variable and is common in many habitats throughout the region. Ticker tape is associated with oceanic climates with cool summer days and low summer precipitation.*

## Action Plan

The use of R10 lichen data will be explored to determine if it can be incorporated into the SE Alaska Lichen-Climate model (using nonparametric multiplicative regression) developed by Root et al. (2014). To further address this Forest Plan question for Biodiversity, the lichen plots are first scored based on the

model so each location receives a climate score. As plot monitoring continues over time, this score will indicate whether a warming or cooling trend exists in regards to lichen species composition.

Future work outside the scope of this current project include:

1. If changes are detected, which suite of species is displaying a decline or increase, and is this change attributed to known climatic changes (temperature and precipitation climate shifts) in the region?
2. If specific species are displaying climatic thresholds in the region, are these species tied to ecological functions such as wildlife forage, nutrient cycling or are rare or sensitive species?
3. If so, what cascading effects are possible with the present or predicted changes in climate?

## Citations

Gauslaa, Y. 2014. Rain, dew, and humid air as drivers of morphology, function, and spatial distribution in epiphytic lichens. Lichenologist. 46: 1-16.

Geiser, L. and P. Neitlich. 2007. Air pollution and climate gradients in western Oregon and Washington indicated by epiphytic macrolichens. Environmental Pollution. 145: 203-218.

Jovan, S. 2008. Lichen bioindication of biodiversity, air quality and climate: Baseline results from monitoring in Washington, Oregon and California.

Palmqvist, K., L. Dahlman, A. Jonsson and T. Nash, III. 2008. The carbon economy of lichens. In: T.H. Nash III (ed.). The Lichen Biology: 182-215. Cambridge University Press, Cambridge, U.K.

Root, H., B. McCune and S. Jovan. 2014. Lichen communities and species indicate climate thresholds in southeast and south-central Alaska, USA. The Bryologist. 117(3): 241-252.

Root, H., L. Geiser, S. Jovan and P. Neitlich. 2015. Epiphytic macrolichen indication of air quality and climate in interior forested mountains of the Pacific Northwest, USA. Ecological Indicators. 53: 95-105.

# 11. Biodiversity Ecosystem: Matrix

**Goal:** Maintain healthy forest ecosystems by maintaining a mix of habitats at different spatial scales capable of supporting the full range of naturally occurring flora, fauna, and ecological processes native to Southeast Alaska.

**Objective:** Maintain a Forest-wide system of old-growth forest habitat to sustain old-growth-associated species and resources.

**Background:** An integrated old-growth conservation strategy was developed to protect and maintain old-growth habitat. This strategy was incorporated into the 1997 Tongass Land and Resource Management Plan (Forest Plan) and was reviewed, revised, and incorporated into the 2008 Forest Plan. The conservation strategy includes two major components. First is the system of large, medium and small old-growth reserves (OGRs) well-distributed throughout the Tongass. This system of reserves is made up of areas allocated to the Old-Growth Habitat land use designations, plus lands in all the rest of the non-development land use designations. These lands provide adequate habitat for old-growth dependent or associated species, and provides for connectivity between reserves in order to prevent genetic isolation of populations. In addition, in response to concerns for small island endemic taxa, the Forest Plan also protects all islands less than 1,000 acres from additional harvest of old-growth forest (USDA Forest Service 2008c, page D-10).

During the 2008 Forest Plan Amendment process, a comprehensive review and mapping effort was completed for the small OGRs. This review focused primarily on small OGRs because they received differing levels of review during the development of the 1997 Forest Plan. The large and medium old-growth reserves were generally not reviewed because they received a rigorous review and were designed to meet reserve strategy objectives (USDA Forest Service 1997, page 3-82) and few modifications were anticipated. The total acres of old-growth land use designations were increased by 38,749 acres from the 1997 Forest Plan to the 2008 Forest Plan (USDA Forest Service 2008c, page D-29). In addition, old-growth reserve locations were determined for all but 13 old-growth reserves (identified in Appendix K of the 2008 Forest Plan). Old-growth reserve locations may be modified under limited circumstances described in Appendix K of the 2008 Forest Plan.

The second major element of the conservation strategy is a series of standards and guidelines applicable to those portions of the Tongass open to consideration for timber harvest (referred to as the matrix). The matrix includes lands designated as experimental forest, modified landscape, scenic viewshed and timber production land use designations and sometimes excludes the recreational river land use designation. Within the matrix, components of the old-growth ecosystem are maintained by standards and guidelines to protect important areas and provide old-growth forest habitat connectivity. This component includes the beach and estuary fringe, riparian buffers, and other Forest-wide standards and guidelines that preclude or significantly limit timber harvest in areas of high hazard soils, steep slopes, karst terrain, visually sensitive travel routes and use areas, and in timber stands technically not feasible to harvest. It also includes a number of species-specific standards and guidelines such as raptor nest and wolf den protection areas (USDA Forest Service 2008b, D-10).

The 2008 Forest Plan replaced the goshawk and marten standards and guidelines with a legacy standard and guideline that requires legacy forest structure be maintained in specific value comparison units (USDA Forest Service 2008b, page 4-90). The intent of this standard and guideline is to maintain the matrix as a functional part of the conservation strategy for wildlife while providing flexibility to address on-the-ground issues while implementing timber sales. The standard and guideline is applied to harvest units located in value comparison units (VCUs) that may be at risk of losing their effective contribution to

the conservation strategy due to past timber harvest. Therefore, it is intended to maintain the effective contribution of these at risk value comparison units by retaining sufficient legacy forest structure in harvest units (USDA Forest Service 2008b, page 4-90).

## Biodiversity Question 3: *Is old-growth structure retained in the matrix adequate and is it representative of old-growth types across value comparison units and across the Forest?*

### Evaluation Criteria

The amount of protected old-growth in the matrix is influenced by the implementation of the legacy standard and guideline. As this is a new standard and guideline as of the 2008 Forest Plan amendment, and replaces the 1997 Forest Plan American marten standards and guidelines for value comparison units in higher risk biogeographic provinces (WILD112 XVI.2), we focus this monitoring on annual implementation of the legacy standards and guidelines.

### Monitoring Results

Table 1 displays acres of timber harvest (all silvicultural systems) and legacy forest structure maintained by district, VCU, and timber sale. Also listed is whether the sale occurred in a VCU in which the legacy standards and guidelines apply (Legacy Value Comparison Units; Yes or No), whether legacy forest structure was retained (Legacy Retained; Yes or No), and the rationale (Legacy Rationale) for why legacy forest structure was, or was not, retained.

The legacy standard and guideline was applicable to only one acre of the 2,707 acres of timber harvest completed in FY2014 for the following reasons, as listed in the 2008 Forest Plan and record of decision:

- The units harvested occurred in value comparison units that were not listed as retention of legacy structure required because less than 33 percent of productive old-growth habitat was harvested (USDA Forest Service 2008b, page 4-90);
- The units harvested were less than 20 acres in size (USDA Forest Service 2008b, page 4-90); or
- The timber sale was under contract before the effective date of the 2008 Forest Plan (ROD Category 1, USDA 2008a, pages 68-69).

Harvesting in FY2014 occurred in one VCU listed in the legacy standard and guideline. Legacy was not retained in the Power Lake timber sale in VCU 5860 (Thorne Bay Ranger District) because the harvest unit was less than 20 acres and the sale was listed as a Category 1 sale in the 2008 Forest Plan ROD. Harvest was just over one acre; one acre of legacy was also retained.

The percentage of original productive old-growth forest in two value comparison units (5770 and 6220) not listed in the legacy standard and guideline has increased from below to above 33 percent since implementation of the 2008 Forest Plan (USDA Forest Service 2013). No harvest occurred in these VCUs in FY2014.

**Biodiversity Ecosystem Table 1. Acres of timber harvest (by all silvicultural systems) and legacy forest structure maintained in FY2014 by value comparison unit (VCU) and district**

| District | VCU | Timber sale | Silvicultural system | Timber harvest acres | Legacy VCU | Legacy retained | Legacy rationale | Legacy retained acres |
|---|---|---|---|---|---|---|---|---|
| Sitka (31) | 2430 | Buckhorn Reoffer | Single Tree Selection Cut (4151) | 5 | No | No | VCU not listed; Less than 20 ac | 0 |
| | 2220 | Midway Reoffer II | Single Tree Selection Cut (4151) | 176 | No | No | VCU not listed; ROD Category 1 | 0 |
| | | Midway Reoffer II | Two-aged Stand Clearcut (4177) | 100 | No | No | VCU not listed; ROD Category 1 | 0 |
| Petersburg (21) | 4250 | 6367 Small Sale #2 Reoffer | Single Tree Selection Cut (4151) | 17 | No | No | VCU not listed; Less than 20 ac | 0 |
| | 4260 | 6367 Small Sale #2 Reoffer | Single Tree Selection Cut (4151) | 2 | No | No | VCU not listed; Less than 20 ac | 0 |
| | 4370 | Tonka Stewardship | Stand Clearcut (4113) | 495 | No | No | VCU not listed | 0 |
| | | Tonka Stewardship | Single Tree Selection Cut (4151) | 516 | No | No | VCU not listed | 0 |
| | 4390 | Tonka Stewardship | Stand Clearcut (4113) | 327 | No | No | VCU not listed | 0 |
| | | | Single Tree Selection Cut (4151) | 302 | No | No | VCU not listed | 0 |
| | | Lindenberg | Stand Clearcut (4113) | 163 | No | No | VCU not listed; ROD Category 1 | 0 |
| | 4470 | Tonka Stewardship | Single Tree Selection Cut (4151) | 255 | No | No | VCU not listed | 0 |
| Thorne Bay (54) | 5730 | Tote Stewardship | Stand Clearcut (4113) | 25 | No | No | VCU not listed | 0 |
| | 5860 | Power Lake | Two-aged stand clearcut w/ Reserve Trees (4177) | 1 | Yes | Yes | Implemented | 1 |
| | | | Two-aged stand clearcut w/ Reserve Trees (4177) | 1 | Yes | No | ROD Category 1; Less than 20 ac | 0 |
| | 5980 | Power Lake | Two-aged stand clearcut w/ Reserve Trees (4177) | 35 | No | No | VCU not listed; ROD Category 1 | 0 |
| | | Setter Lake | Two-aged stand clearcut w/ Reserve Trees (4177) | 75 | No | No | VCU not listed; ROD Category 1 | 0 |
| Hoonah (32) | 2030 | Two Creeks | Single-tree Selection Cut (4151) | 30 | No | No | VCU not listed | 0 |

| District | VCU | Timber sale | Silvicultural system | Timber harvest acres | Legacy VCU | Legacy retained | Legacy rationale | Legacy retained acres |
|---|---|---|---|---|---|---|---|---|
| | 2040 | Above Road | Single-tree Selection Cut (4151) | 12 | No | No | VCU not listed; Less than 20 ac; ROD Category 1 | 0 |
| | 2180 | Fish Ladder | Single-tree Selection Cut (4151) | 30 | No | No | VCU not listed | 0 |
| Juneau (33) | 1190 | Three Moose | Single-tree Selection Cut (4151) | 14 | No | No | VCU not listed; Less than 20 ac; ROD Category 1 | 0 |
| | 1200 | Three Moose | Single-tree Selection Cut (4151) | 10 | No | No | VCU not listed; Less than 20 ac; ROD Category 1 | 0 |
| Wrangell (22) | 4560 | Zarkof Salvage | Two-aged stand clearcut w/ Reserve Trees (4177) | 87 | No | No | VCU not listed | 0 |
| | 4590 | Skipping Cow | Stand Clearcut (4113) | 23 | No | No | VCU not listed; ROD Category 1 | 0 |
| | 4770 | McCormick Microsale #1 | Single-tree Selection Cut (4151) | 6 | No | No | VCU not listed; Less than 20 ac | 0 |
| Total | | | | 2,707 | | | | 1 |

## Evaluation of Results

Much of the timber harvest on the Forest since implementation of the 2008 Forest Plan occurred outside of high risk VCUs. Where harvest did occur in these VCUs, much of it was exempted from application of the legacy standards and guidelines as Category 1 timber sales listed in the 2008 Forest Plan Record of Decision. Much of the harvest of these Category 1 timber sales has been completed. It is likely there will be at least some timber harvested in Category 2 timber sales in high risk VCUs in the future.

The legacy standards and guidelines can be applied to projects previously analyzed using the marten standards and guidelines if a change analysis is completed that analyzes differences in effects and these effects were found be non-significant (FSH 1909.15, section18). Also, the 1997 Forest Plan American Marten Standards and Guidelines (Wildlife Habitat Planning: WILD112.XVI; USDA Forest Service 1997; pages 4-116 and 4-117) are applied to these Category 1 and 2 projects when the legacy standards and guidelines are not applied and the project is located in a Higher Risk Biogeographic Provinces as identified by the 1997 Forest Plan (USDA Forest Service 1997; page 4-116). The effects associated with implementing these pre-existing decisions were considered as part of the baseline and assumed to continue in the environmental analysis of alternatives in the final EIS for the 2008 Forest Plan amendment. Because these earlier decisions were considered in the effects analysis, implementation is not in conflict with the amended Plan (USDA Forest Service 2008a, page 70).

Proposed timber harvest projects are being analyzed through the NEPA processes that are not Category 1 or 2 projects. Where projects occur in high risk VCUs listed under the legacy standards and guidelines, these guidelines will be applied. The full suite of Forest Plan standards and guidelines continues to protect approximately 19 percent of the existing productive old-growth habitat in the matrix. The old-growth structure retained in the matrix is adequate and representative of old-growth types across the Forest. Between the reserve system and the standards and guidelines that apply to the development land use designations, the Forest Plan protects 91 percent of productive old-growth habitat on the Tongass.

## Action Plan

The percent of original productive old-growth harvested in VCUs 5770 and 6220 may have risen to 33 percent or greater since implementation of the 2008 Forest Plan. The Forest Plan review and amendment currently underway will review these VCUs for inclusion in the legacy standard guidelines.

An approach for monitoring the implementation and effectiveness of the legacy standards and guidelines has been developed by Northern Ecologic, LLC and will be assessed for application by the Forest. The protocol includes on-site review of legacy stands and spatial analyses in GIS to assess the representativeness of productive old-growth retained in the matrix at various spatial scales.

## Citations

USDA Forest Service. 2013. 2012 Annual and Five Year Monitoring and Evaluation Report. Management Bulletin. R10-MB-757. Juneau, AK: USDA, Forest Service, Alaska Region, Tongass National Forest.

USDA Forest Service. 2008a. Tongass Land and Resource Management Plan, Final Environmental Impact Statement, Record of Decision. Management Bulletin. R10-MB-603a. Juneau, AK: USDA, Forest Service, Alaska Region, Tongass National Forest.

USDA Forest Service. 2008b. Tongass Land and Resource Management Plan. Management Bulletin. R10-MB-603b. Juneau, AK: USDA, Forest Service, Alaska Region, Tongass National Forest.

USDA Forest Service. 1997. Tongass Land and Resource Management Plan. Management Bulletin. R10-MB-338-CD. Juneau, AK: USDA, Forest Service, Alaska Region, Tongass National Forest.

# 12. Biodiversity Ecosystem: Rare Plants

**Goal:** Maintain ecosystems capable of supporting the full range of native and desired non-native plant species and ecological processes. Maintain a mix of representative habitats at different spatial and temporal scales. Prevent plant species from becoming listed as threatened, endangered, or sensitive.

**Objective:** Determine the status and trends of rare and sensitive plant populations and habitat in order to help inform management decisions.

**Background:** According to the Alaska Natural Heritage Program database of rare plants, the Tongass National Forest is home to ninety-nine rare vascular plant species (generally those with a global rarity rank of G1 to G3 and/or subnational rank of S1 to S3), including fifteen plant and one lichen species listed on the Alaska Regional Forester's 2009 sensitive species list.

## Biodiversity Ecosystem Question: *What are the cumulative effects of changes to habitats that sustain rare plants?*

### Evaluation Criteria

#### *Prince of Wales Island Rare Plant Population Monitoring*

One of the management goals for rare plants on the Tongass National Forest is to maintain the persistence of populations of these species. To help support this monitoring goal, population monitoring has been implemented on Prince of Wales Island, which includes both the Craig and Thorne Bay Ranger Districts. Monitoring is currently focused on two species designated by the US Forest Service Alaska Region as sensitive: lesser round-leaved orchid (*Planthera orbiculata*), and large yellow lady's slipper (*Cypripedium parviflora* var. *pubescens*). Whiteflower rein orchid (*Piperia candida*), which is not listed as sensitive but is considered rare on the Tongass, was also monitored. Monitoring of lung lichen (*Lobaria amplissima*), also a sensitive species, was discontinued in 2014.

For lesser round-leaved orchid and whiteflower rein orchid, one 500m$^2$ permanent sample plot was installed in each of a randomly chosen subset of the populations of each species. Sample plots in 11 lesser round-leaved orchid populations and 5 whiteflower rein orchid populations were measured annually beginning in 2011. Two populations of large yellow lady's slipper were measured annually by full census rather than sampling. Attributes that were monitored in 2014 include presence or absence of the species and density (number of individuals per hectare).

The sampling objective for rare plant population monitoring is to detect a decrease of 20 percent or more in frequency of occurrence or density of populations, by species, with 80 percent confidence. Change in species canopy cover was monitored in previous years but has been discontinued because of the high variance resulting from the difficulty of accurately measuring individual plants of these physically small species. The sampling objective is being evaluated during the current pilot sampling period, and the above parameters may be modified if necessary to achieve objectives within current and projected budget and personnel constraints.

The data collected from the sample plots were summarized to determine the amount of annual change in the above parameters for each species (Table 1). A one-tailed, paired sample t-test was applied to test the null hypothesis of no decrease in density (number of individuals per hectare). The alpha level used to determine significance was 0.20. A McNemar's test for proportions was applied to determine if a change in frequency of occurrence of a species in the sites is statistically significant.

### *Dune Tansy Population Monitoring*

The only known population of dune tansy (*Tanacetum bipinnatum* ssp. *huronense*) on National Forest System lands in the Alaska Region is located on Kruzof Island. It is found in an upper beach meadow in in area used by off-road vehicles (ORVs). Other than on a designated beach access trail, ORV use is prohibited on the beach meadows, and barriers have been set up to prevent ORV access. The churning of vehicle wheels can damage and destroy meadow vegetation, including the dune tansy. Even though ORVs are prohibited on the beach meadows, numerous informal trails now run from the forest across the meadows to the beach. Heavy surf and erosion by a nearby stream have also affected the population by causing progressive erosion of the beach meadow habitat.

The site was revisited in May 2014 to assess the condition of the population and its habitat. The footprint of the remaining population was measured. Habitat loss from beach erosion was also measured, using 8 transects that were established at the back of the beach meadow for this purpose. However, because some transects were mostly in unsuitable habitat, only five were used to estimate habitat loss.

## Monitoring Results

### *Prince of Wales Island Rare Plant Population Monitoring*

**Lesser Round-leaved Orchid.** The average population density of the two sampled sensitive species in 2013 and 2014 are summarized in Table 1. The results for lesser round-leaved orchid indicate a slight decrease in density of one percent from 2013 to 2014 ($t(10) = 1.838$, $p = 0.4289$ ), and an increase of nine percent in frequency of occurrence (chi-squared = 0, df = 1, p = 1). Changes in both parameters were not statistically significant.

**Whiteflower Rein Orchid.** The observed increase in mean density (individuals/ha) in the sample plots was not statistically significant ($t(4) = -0.4436$, $p = 0.6599$). Since there was no change in the frequency of occurrence between 2013 and 2014, a significance test for presence/absence was not performed.

**Biodiversity Ecosystem Table 1. Average density (individuals per hectare) of lesser round-leaved orchid and whiteflower rein orchid populations in 2013 and 2014.**

| | 2013 | | 2014 | |
|---|---|---|---|---|
| **Species** | **Mean** | **Standard Deviation** | **Mean** | **Standard Deviation** |
| Lesser round-leaved orchid | 162 | 324 | 160 | 304 |
| Whiteflower rein orchid | 204 | 169 | 276 | 396 |

**Large Yellow Lady's Slipper.** Large yellow lady's slipper occurs on three sites on the Tongass National Forest, all of which are on Prince of Wales Island. One of the populations is located in a remote area with very difficult access. Due to the low number of known populations, a full census was conducted at the two accessible sites in 2013 and 2014. In 2013, the two populations had a total of 36 individuals. In 2014, the total number of individuals decreased in both populations, with an overall total of 27 individuals recorded. A 25 percent decrease from 2013.

### *Dune Tansy Population Monitoring*

The dune tansy site was revisited in late spring of 2014 to document the effects of ORV traffic and beach erosion on the dune tansy population. The barriers are apparently keeping ORVs away from the population. However, natural erosion is continuing at the site and threatening the prsistence of the population (Photo 1).

*Biodiversity Ecosystem Photo 1. Erosion of beach meadow habitat on North Beach at Kruzof Island. Pin flags mark dune tansy plants in imminent danger of being lost to erosion. Some of these plants were transplanted to other suitable areas along the beach.*

In 2013, the area occupied by the remaining dune tansy population was estimated to be 1,125 square feet. The 2014 estimated population size had decreased to 950 square feet, a loss of 16 percent. This is in addition to an estimated 30 percent of habitat lost between 2012 and 2013. Habitat loss from beach erosion along re-measured transects averaged 9.6 feet, for an average loss of 15 percent.

In 2013, beach erosion had reached the dune tansy population, and plants in imminent danger of loss were salvaged and transplanted to other portions of the beach meadow with less threat from erosion. In 2014, 25 stems of transplanted plants were observed in four locations along the beach. Also, additional threatened plants were salvaged and transplanted in habitat at a neighboring beach.

## Evaluation of Results

### *Prince of Wales Island Rare Plant Population Monitoring*

Results indicate no significant change in lesser round-leaved orchid population density from 2013 to 2014. Monitoring data from two previous years had indicated a significant annual decrease in density. This previous downward trend might have been related to periodic dormancy. Substantial numbers of individuals of this species can become dormant for one or more years, and then continue growth in subsequent years. Although results suggest the decline in population density has stopped, continued monitoring would be necessary to evaluate the long-term trends in population density. Monitoring data for whiteflower rein orchid populations also did not show a significant change in average density from 2013 to 2014.

*Biodiversity Ecosystem Photo 2. Large yellow lady's slipper population located next to an active forest road, northern Prince of Wales Island.*

Census results show a 25 percent decrease from last year in total individuals in the two populations of large yellow lady's slipper. This is in contrast to the 20 percent increase recorded between 2012 and 2013. Fluctuations on annual stem production may be due to natural periodic dormancy of individuals. Continued monitoring is necessary to determine long term trends in these populations. Both

monitored populations are very small, and they may be at risk as they occur adjacent to actively used forest roads (Photo 2). They could potentially be damaged by vehicles and from road maintenance activities, as well as from the spread of invasive plants in the road rights-of-way.

### *Dune Tansy Population Monitoring*

Although the newly erected barriers are apparently helping to keep ORV traffic away from the dune tansy population and habitat, stream and beach erosion is continuing to impact the meadow habitat, and threatening loss of individual plants. Continued stream and beach erosion of habitat is likely unavoidable and could eventually destroy the existing population. Salvage and transplanting threatened plants to adjacent suitable habitat is a strategy to prevent extirpation of this species on the Tongass.

This species, with a conservation status of G5S4 due to its relative common occurrence elsewhere in Alaska and globally, was removed from the Alaska Natural Heritage Program rare plant tracking list in 2012. Consultation amongst professionals both within and outside the Forest Service concludes that as the only known location of this plant in the region, it makes a significant contribution to the biodiversity of the Tongass. While dune tansy has a broad range, its distribution is disjunct. With such large gaps among populations, it is likely that each population is on an independent evolutionary trajectory.

## Action Plan

Work will continue in the revision of the transition of the Forest Plan monitoring to the 2012 Planning Rule, including evaluating the need for this monitoring question relative to the criteria established in the Rule. If needed, a revised rare plant monitoring question will be developed along with revisions to the monitoring protocols.

### *Prince of Wales Island Rare Plant Population Monitoring*

Monitoring of the Prince of Wales rare plant populations will continue in 2015, as personnel and resources allow. After data are collected in 2015, an analysis will be conducted to evaluate the five-year population trends of the monitored species.

During field surveys in 2014, an additional population of large yellow lady’s slipper containing seven individuals was discovered growing along a roadside in northern Prince of Wales Island. This population will be included in the monitoring of this species in 2015.

### *Dune Tansy Population Monitoring*

In 2014, the Sitka Ranger District developed a management strategy for this population. In 2015, the population and its habitat will be re-measured, and the survival of the salvaged plants will be monitored. We will also perform any needed maintenance of ORV barrier fences and beach closure signage.

# 13. Streams and Fish Habitat: Management Indicator Species

**Goal:** Maintain or restore the natural range and frequency of aquatic habitat conditions on the Tongass National Forest to sustain the diversity and production of fish and other freshwater organisms.

**Objectives:** Use baseline fish habitat objectives, identified in the Forest Plan Standards and Guidelines, to evaluate the relative condition of riparian and aquatic habitat. Monitor representative fish populations to determine whether trends attributable to current forest management are evident. This monitoring strives to characterize the ecological condition and trends of watersheds and aquatic ecosystems on the Tongass National Forest.

**Background:** Fish and aquatic resources on the Tongass National Forest provide major subsistence, commercial, and sport fisheries. Abundant rainfall and watersheds with high densities of streams provide a high quantity and diversity of freshwater fish habitats. The Tongass National Forest provides spawning and rearing habitat for the majority of wild fish produced in Southeast Alaska. Maintenance of this habitat and associated waters is a focal point for the public, State and Federal agencies, and Native organizations.

Statistical analyses of an existing 11-year resident fish (Dolly Varden char and cutthroat trout) dataset have been completed in collaboration with the Pacific Northwest Research Station and a manuscript is expected to be finalized by late 2015. Additionally, the forest initiated an alternate monitoring strategy for Dolly Varden, cutthroat trout and coho salmon to provide effective feedback to inform current Forest management. A summarized study plan is included as Appendix A. An interagency aquatics task group convened in 2011 to review the current MIS list and provide feedback and recommendations for improvements or reductions to existing species lists and monitoring protocols. At that time, Dolly Varden, cutthroat trout and coho salmon were recommended to be retained on the MIS list, while pink salmon were recommended for removal.

## Streams and Fish Habitat Question: *Are the trends in abundance of the fish management indicator species (Dolly Varden char, cutthroat trout, coho salmon, and pink salmon) related to changes in habitat associated with forest management, climate change or other factors?*

The 1997 Tongass Land and Resource Management Plan (Forest Plan) identified Dolly Varden char, cutthroat trout, coho salmon and pink salmon as Management Indicator Species (MIS). Dolly Varden char were selected to represent resident fish habitats because of their wide distribution, the availability of data on the species' habitat requirements, and frequent distribution over the full spectrum of resident fish habitats. Dolly Varden char and cutthroat trout were selected because they often reside together in Tongass NF streams and can both be sampled by similar methods. Pink salmon and coho salmon were selected to represent two different periods of salmon life history, spawning/egg incubation and freshwater rearing, respectively.

### Resident Dolly Varden Char and Cutthroat Trout Monitoring

#### *Evaluation Criteria*

Significant downward trend in Dolly Varden char and cutthroat trout densities in monumented stream reaches due to forest management.

#### *Sampling/Reporting Period*

There is an annual sampling period and a 5-year reporting period. Monitoring follows the approach established for the Aquatic and Riparian Effectiveness Monitoring Plan for the Pacific Northwest Forest Plan (AREMP) with some modifications per General Technical Report PNW-GTR-577 (Reeves et al.

2003). The fish habitat effectiveness monitoring framework aims to track watershed condition, in-channel habitat characteristics and abundance of resident populations of Dolly Varden char and cutthroat trout within several stream reaches in each of 14 watersheds on the Tongass National Forest. Watersheds sampled are intended to represent the range and degree of management prescriptions across the Tongass.

Sample protocol follows a rotating panel design in which 14 watersheds will be sampled over an eight year period. Two of the watersheds are sampled annually (fixed watersheds) and 12 watersheds will be grouped into four separate panels (panel watersheds) of 3 watersheds each and sampled on a rotating basis once every four years (Table 1).

One of the annually sampled watersheds is within an unmanaged condition currently and into the perceivable future while the other will be representative of past, present and proposed future active management activities. The annually sampled fixed watersheds will allow for the assessment of trends more rapidly as well as provide information on natural variability.

The watersheds sampled on a rotating panel basis will ideally represent the range of ecological conditions and forest management across the Forest. The relatively small sample size will not allow for extensive stratification.

Selected watersheds have populations of: 1) resident Dolly Varden char and/or cutthroat trout upstream of impassable and permanent barrier(s). Four resident fish populated stream sections of approximately 100 meters in length will be sampled within each of the 14 selected watersheds. Resident Dolly Varden, resident cutthroat trout will be monitored for population trends by repeat population estimates in permanently marked closed reaches of stream. In-channel indicators such as residual pool frequency volume and depth, particle size distribution, and large woody debris count using measurement protocols for stream surveys as outlined in the Alaska Region Aquatic Habitat Management Handbook (USDA Forest Service 2001) will be measured at the reach scale and will coincide with fish sampling.

**Stream and Fish Table 1. Number of sample watersheds and periodicity of sampling**

| Watershed | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|---|---|
| 1 (Managed) | Fixed 1 | Fixed 1 | Fixed 1 | Fixed 1 | Fixed 1 | Fixed 1 | Fixed 1 | Fixed 1 |
| 2 (Unmanaged) | Fixed 2 | Fixed 2 | Fixed 2 | Fixed 2 | Fixed 2 | Fixed 2 | Fixed 2 | Fixed 2 |
| 3 | Panel 1 | | | | Panel 1 | | | |
| 4 | Panel 1 | | | | Panel 1 | | | |
| 5 | Panel 1 | | | | Panel 1 | | | |
| 6 | | Panel 2 | | | | Panel 2 | | |
| 7 | | Panel 2 | | | | Panel 2 | | |
| 8 | | Panel 2 | | | | Panel 2 | | |
| 9 | | | Panel 3 | | | | Panel 3 | |
| 10 | | | Panel 3 | | | | Panel 3 | |
| 11 | | | Panel 3 | | | | Panel 3 | |
| 12 | | | | Panel 4 | | | | Panel 4 |
| 13 | | | | Panel 4 | | | | Panel 4 |
| 14 | | | | Panel 4 | | | | Panel 4 |

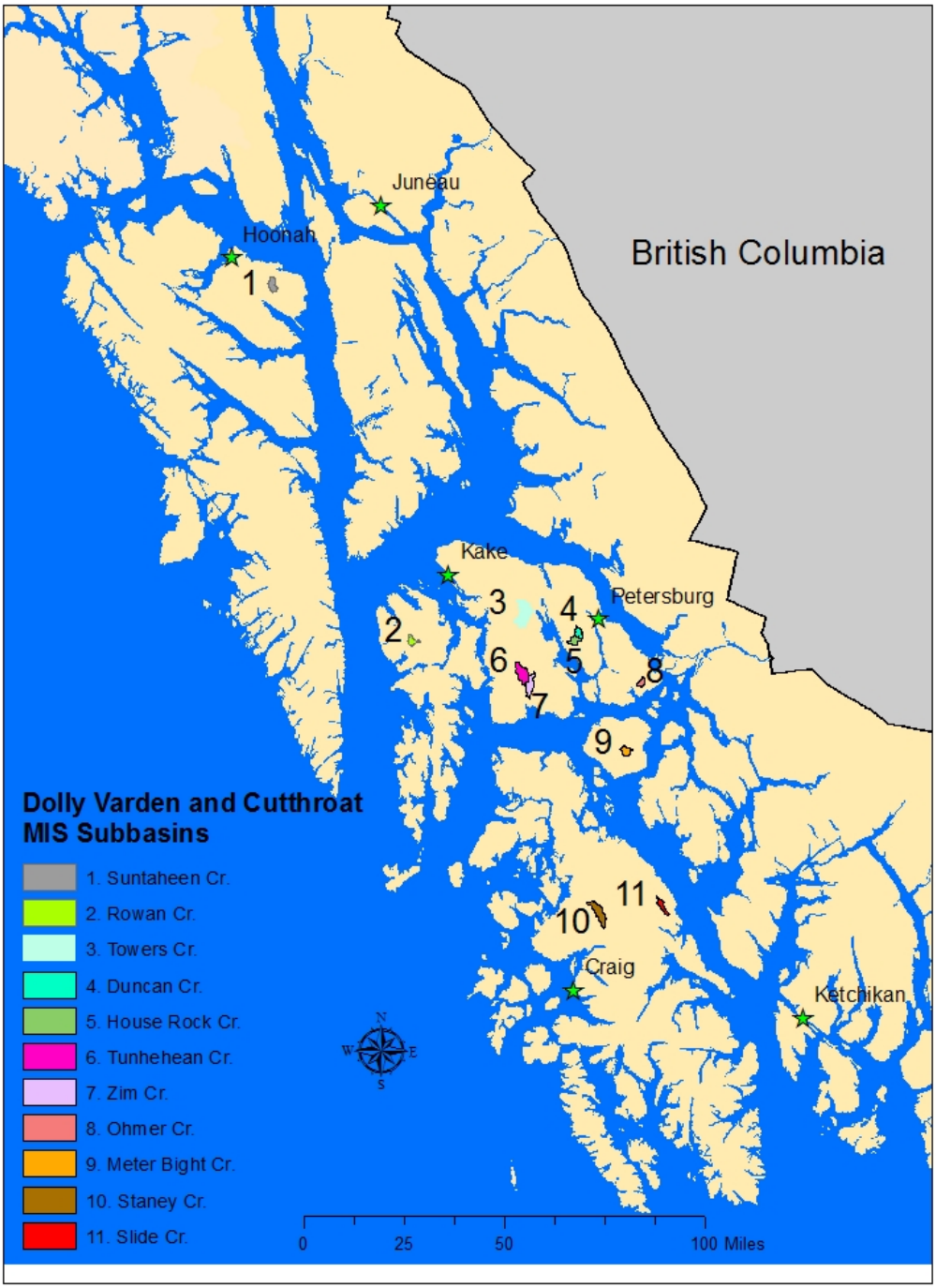
### *Monitoring Results*

An annual monitoring program for resident Dolly Varden and cutthroat and their habitat was established in 1999 with the purpose of determining the effectiveness of the forest management standards and guidelines for fish habitat as outlined in the Tongass Land and Resource Management Plan. A sample design was established and implemented that monitored streams before and after timber harvest to detect differences between resident Dolly Varden and cutthroat trout abundance (Aho 2000; Bryant 2000). The monitoring protocol included a combination of fish population and stream habitat monitoring. However, after 11 years of data collection (1999-2009) an insufficient number of the monitored streams had timber harvest treatments completed due to timber sale economics and social pressures. Harvest activities were completed at only 5 of a total of 26 previously sampled streams and it is unlikely that more than a few of the remaining treatment sites will be harvested any time soon. While these factors do not eliminate the need to monitor watersheds where forest management in the form of timber harvest and road building occurs, they do dictate changes to monitoring protocols and sample design. The Tongass is transitioning from old growth timber harvest with a larger focus on restoration and young growth management with limited harvest of old growth so the current monitoring protocol redesign should reflect this shift in management focus.

During 2011 potential sample watersheds were evaluated against sample design criteria and several watersheds were selected. Sampling began on five watershed subbasins during 2012 which included two fixed, annually monitored, subbasins and three rotating panel subbasins monitored once every four years. During 2013 the two fixed subbasins were resampled and five new rotating panel subbasins were sampled. The study design only requires sampling three rotating panel subbasins annually, however, one of the two extra subbasins sampled in 2013 was resampled in 2014 and the other will be resampled in 2015 to provide between-year variability in fish populations. In 2014, the two fixed subbasins and three rotating panel subbasins were sampled (Figure 1 and Table 2).

Additionally, analysis of the existing 11-year resident fish monitoring dataset in conjunction with the Pacific Northwest Research Station is now complete and a manuscript is being drafted.

*Stream and Fish Photo 2. Cutthroat trout sampling*




**Stream and Fish Figure 1. Dolly Varden and cutthroat trout MIS monitored subbasins – 2012 - 2014**

**Stream and Fish Table 2. Dolly Varden char and cutthroat trout MIS monitored subbasins**

| Watershed | Basin Area (miles$^2$) | Year(s) Sampled | Fish Habitat (miles) | Percent of Basin Harvested 0-10 Years Ago | Percent of Basin Harvested 11-20 Years Ago | Percent of Basin Harvested 21-30 Years Ago | Percent of Basin Harvested >30 Years Ago | Percent of Basin Harvested Total | Miles of Road | Road Density (road mi/mi$^2$ of basin) |
|---|---|---|---|---|---|---|---|---|---|---|
| Staney | 11.9 | 2012 2013 2014 | 25.2 | 0.0 | 6.5 | 1.3 | 32.5 | 40 | 27.8 | 2.34 |
| Towers | 22.9 | 2012 2013 2014 | 41.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0.0 | 0.00 |
| Tunehean | 11.3 | 2012 | 18.5 | 2.2 | 0.0 | 0.0 | 0.0 | 4 | 5.3 | 0.47 |
| Duncan | 4.1 | 2012 | 7.8 | 3.2 | 0.0 | 8.4 | 0 | 12 | 3.3 | 0.82 |
| Meter Bight | 4.6 | 2012 | 5.8 | 4.3 | 0.0 | 2.1 | 10.3 | 17 | 8.7 | 1.88 |
| Zim | 9.2 | 2013 | 12.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0.0 | 0.00 |
| Ohmer South | 2.6 | 2013 2014 | 3.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0.0 | 0.00 |
| House Rock | 4.7 | 2013 | 6.6 | 1.2 | 0.0 | 13.4 | 0.0 | 15 | 3.0 | 0.63 |
| Ohmer North | 2.3 | 2013 | 3.9 | 0.0 | 0.0 | 0.0 | 17.2 | 17 | 2.5 | 1.11 |
| Slide | 5.5 | 2013 | 10.8 | 0.0 | 1.2 | 10.7 | 43.0 | 55 | 36.6 | 6.65 |
| Suntaheen | 5.5 | 2014 | 9.9 | 0.7 | 0.0 | 15.4 | 0.0 | 16 | 4.9 | 0.89 |
| Rowan | 4.0 | 2014 | 6.2 | 0 | 0 | 0 | 16.0 | 16 | 4.8 | 0.77 |

### *Evaluation of Results*

A thorough statistical analysis of an 11-year resident fish dataset is now complete and a manuscript is expected to be finalized and peer reviewed by winter 2015. The focus of the manuscript is landscape drivers of resident Dolly Varden char and Cutthroat trout presence, abundance, and size across the Tongass. We expect results of this analysis to provide insight on future resident fish monitoring efforts.

Because of the short duration of monitoring efforts under the newly revised protocol, no detailed analysis of results is practical at this time. Sampling efforts are planned to continue.

### *Action Plan*

Project work in FY2015 is expected to include:

- Complete a manuscript of the existing 11-year in cooperation with a PNW Research Station statistician. Results will help guide future monitoring and analyses efforts. Results are expected to be published in a professional journal.
- Continue MIS sampling under the new monitoring protocol that includes fish numbers, in-channel habitat measures, and landscape scale measures in five watersheds annually and 14 watersheds total over an 8 year period with an expansion of fish population estimates to additional reaches within these watersheds to better understand the fish/habitat relationship and fish movement. Including watershed scale features in the analysis will provide additional information on the distribution of fish and interpretation of observed trends in fish numbers. A statistician will be consulted to evaluate the study plan and number of reaches per watershed.

*Stream and Fish Photo 2. Minnow trap placement in stream*

No changes to Forest Plan standards and guidelines are recommended at this time.

## Coho Salmon Abundance Monitoring

### *Evaluation Criteria*

Evaluate the trends of the ADF&G annual commercial wild coho salmon harvest statistics and escapement estimates from index streams.

Comparison of population trends of coho fry and parr associated with a total of 14 watersheds representing the range and degree of management prescriptions across the Tongass.

### *Sampling/Reporting Period*

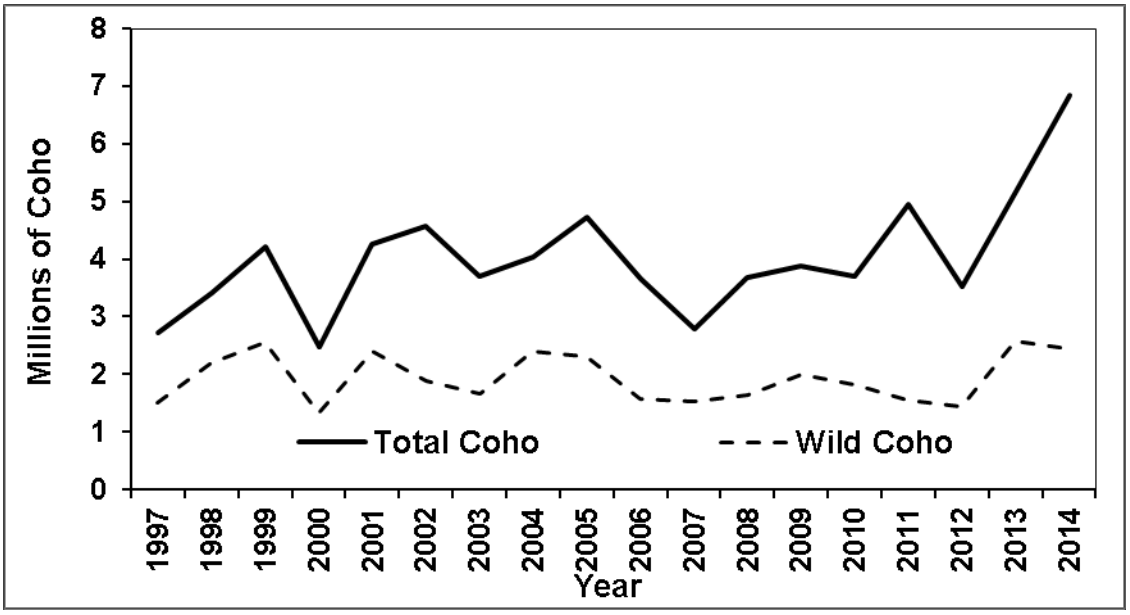
Evaluate ADF&G wild harvest and index stream escapement data annually. Sample fry and parr annually, and report every 5 years. Watershed sampling is done on a rotating panel in which 5 watersheds are sampled annually, and a total of 14 watersheds are sampled over an 8-year period (Table 1). Sampling protocol is similar to that previously described for cutthroat trout and Dolly Varden char MIS monitoring section.

*Stream and Fish Photo 3. Coho salmon*

*Stream and Fish Photo 4. Sampling juvenile coho salmon*

### *Monitoring Results*

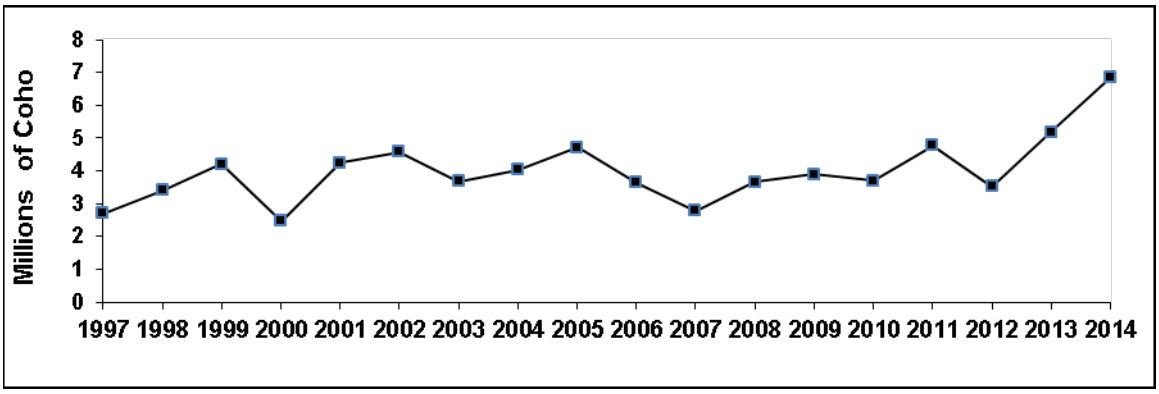
Coho salmon occur in nearly 4,000 streams in Southeast Alaska. Annual wild commercial harvest of coho salmon in Southeast Alaska is reported by the Alaska Department of Fish and Game, and the Forest Service evaluates these estimates for trends (Figure 2). The 2014 wild coho salmon harvest was 2.45 million fish, down from the 2013 catch of 2.57 million fish. Regardless of the 2014 wild coho salmon harvest decline from the previous year, it still ranked the 5th highest harvest since statehood (Skannes et al. 2015). The 2014 average dressed weight of troll-caught coho salmon (6.4 lbs) was higher than 2013, just slightly above the 10-year average weight of 6.2 lbs, and 0.5 lbs heavier than the 5-year average (Skannes et al. 2015).




**Stream and Fish Figure 2. Annual total commercial and wild commercial harvest of coho salmon in Southeast Alaska from 1997 through 2014. Data provided by ADF&G.**

ADF&G calculated an index of total wild coho abundance in Southeast Alaska coastal waters based on the estimated wild troll catch divided by an index of the troll exploitation rate. The 2014 overall wild coho abundance of 6.84 million is the highest on record, surpassing the 1994 record abundance of 6.67 million, and 72 percent above the 20-year average (Skannes et al. 2015).

The abundance estimates (Figure 3) are thought to be a better indicator of actual abundance trend rather than the commercial catch because exploitation rate (all gear types) dropped substantially after 1999, due largely to reduced effort because of economic pressures (Shaul et al. 2011).




**Stream and Fish Figure 3. Index of wild coho salmon abundance in Southeast Alaska from 1997 through 2014. Data provided by ADF&G.**

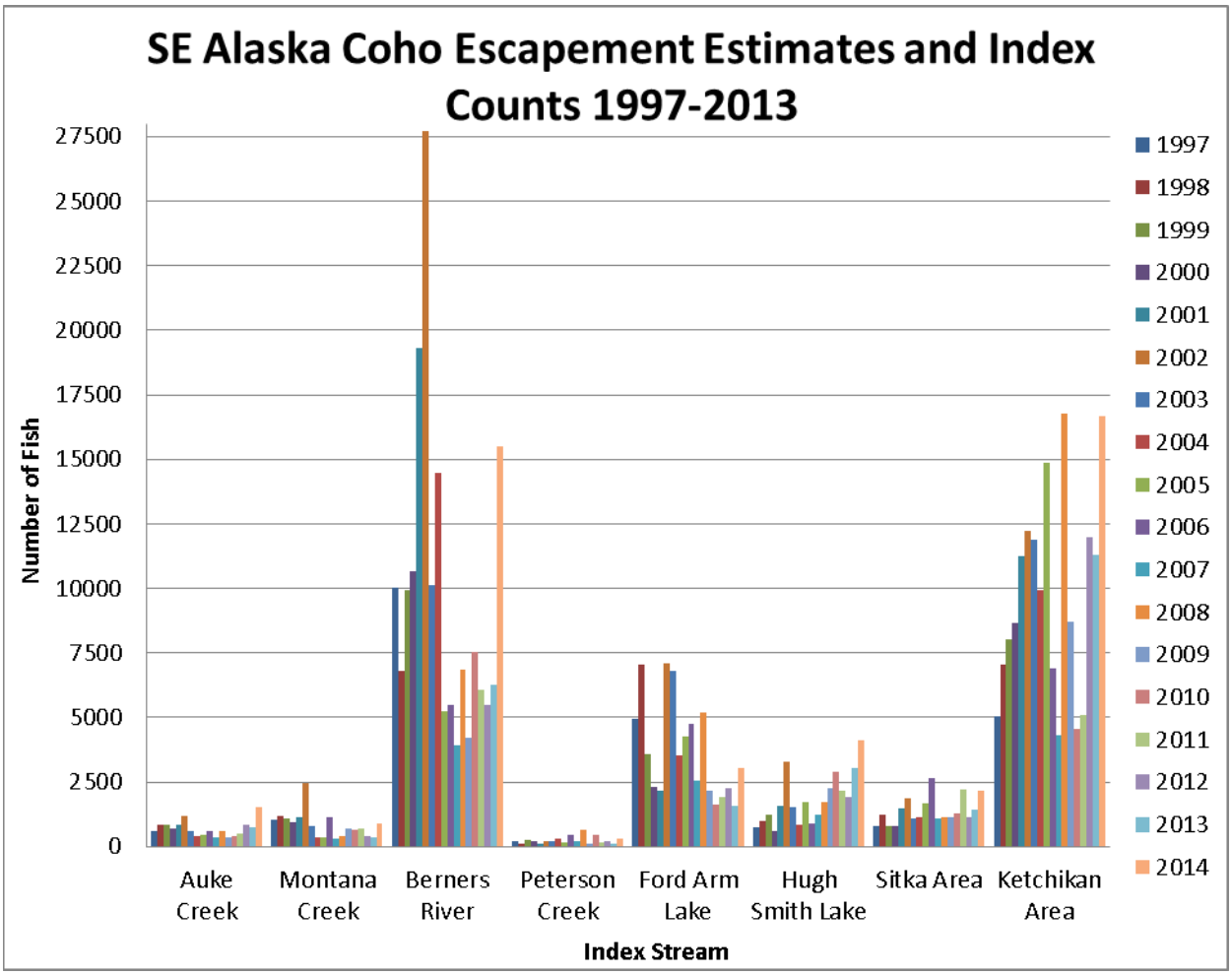
Coho escapements are difficult to estimate since the adults enter spawning streams during the fall when flows are often high and coho routinely distribute throughout the watersheds. The ADF&G has selected a small number of representative streams across

Southeast Alaska to carefully count or estimate escapement, with weirs on three systems and foot or aerial surveys conducted on another 27 streams. An adult tagging and recovery program has been operating since 1987 in the Taku River system to estimate coho escapement. Data from these streams and rivers are available for the Forest Service to review for trends and escapement data from a subset of those systems are displayed in Figure 4. The trend in escapement since the early to mid-1980s has been relatively stable for most stocks, with a peak in the early to mid-1990s (Shaul et al. 2011).

*Stream and Fish Photo 5. Typical sampling stream*

Per ADF&G, 2014 coho salmon escapements for the 13 systems in Southeast Alaska with formal escapement goals met or exceeded the desired escapement objectives (Skannes et al. 2015). Montana Creek, which in the previous two years fell below its Biological Escapement Goal (BEG), was 911 spawners in 2014 and well within the BEG range of 400 - 1,200 spawners (Skannes et al. 2015). Escapement to the Berners River exceeded the BEG goal, as did Auke and Peterson Creeks located on the Juneau road system. The five small streams on Baranof and Kruzof were also well above the spawner goal. And finally, the same pattern was observed for the 15 streams in the Ketchikan area which came in over double the 1987-2013 average (Skannes et al. 2015). Hugh Smith Lake spawner escapement was a record high, and the 7th consecutive year that the BEG was exceeded.

The region-wide commercial harvest estimates, index of total wild coho abundance in Southeast Alaska, and escapement data from index streams are indicators of the annual abundance and potential trends of adult coho returning to Southeast Alaska. Since juvenile coho normally spend one or two years in freshwater, juvenile survival is potentially affected by changes in the quality of stream habitat. Research in the Pacific Northwest and in Southeast Alaska has shown that forest management affects coho salmon on a stream-by-stream basis. Monitoring the abundance of juvenile coho in freshwater appears to be a more direct indicator of potential effects of timber harvest and other management activities as sources of annual variation from marine survival and commercial and sport harvest are largely excluded.




**Stream and Fish Figure 4. Annual escapement of coho salmon in index streams from 1997 through 2014. Data provided by ADF&G.**

A protocol using juvenile coho salmon to monitor Forest Plan Fish and Riparian Standards and Guidelines was completed in 2008 (Bryant et al. 2008) and provided a quantitative method to measure trends in abundance of juvenile coho salmon in streams flowing through forested watersheds that are exposed to timber harvest with 2008 Forest Plan management prescriptions.

A query for potential monitoring sites with subsequent site visits was completed in 2008-2009. During field season 2009, a total of 5 treatment sites and 5 control sites were established and monitored but only 1 or 2 additional potential sites were identified. Primarily, the difficulty in identifying qualifying sample sites is due to the protocol stipulation that the treatment sites be located within sub basins that have no timber harvest before 1997 Forest Plan guidelines were implemented and any harvest that does exist to have occurred no more than 4 years from the start of sampling. Most of the recent timber harvest and proposed timber harvest on the Tongass is located within sub-basins with pre-existing older harvest units. It was determined that sufficient sampling sites as defined in the protocol were not attainable.

Freshwater coho fish population monitoring was placed on hold during 2010-2011 in order to redesign the monitoring protocol to better address current forest management actions with additional emphasis on watershed restoration and young growth management with limited harvest of old growth. The current fish habitat monitoring framework tracks the watershed condition, in-channel habitat characteristics and abundance of populations of juvenile coho salmon within several stream reaches in each of 14 watersheds on the Tongass National Forest. Watersheds sampled represent the range and degree of management

*Stream and Fish Photo 6. Sampling fish with multiple pass deletion*

prescriptions across the Tongass. Sample protocol follows a rotating panel design in which 14 watersheds are planned for sampling over an eight year period. In any one year, five watersheds will be sampled, two of which are re-sampled on a 4 year basis and two sampled every year. One of the annually sampled watersheds is intensively managed while the other is in a natural condition.

In 2012, sampling was completed in four watersheds during July-August. These included two fixed, annually sampled watersheds and two watersheds sampled once every four years. Ideally five watersheds would have been sampled this year but weather and high flows prevented the sampling in one of the watersheds. During 2013, the two annually sampled fixed watersheds were resampled and four new rotating panel watersheds were sampled. In 2014, both annually sampled watersheds and three rotating panel watersheds were sampled (Figure 5).

The sampled watersheds vary in size from 13.1 to 61.7 square miles. Road density between watersheds varies from 0 to 2.32 miles of road per square mile and the percent of the basin harvested ranges from 0 to 65 percent (Table 3).

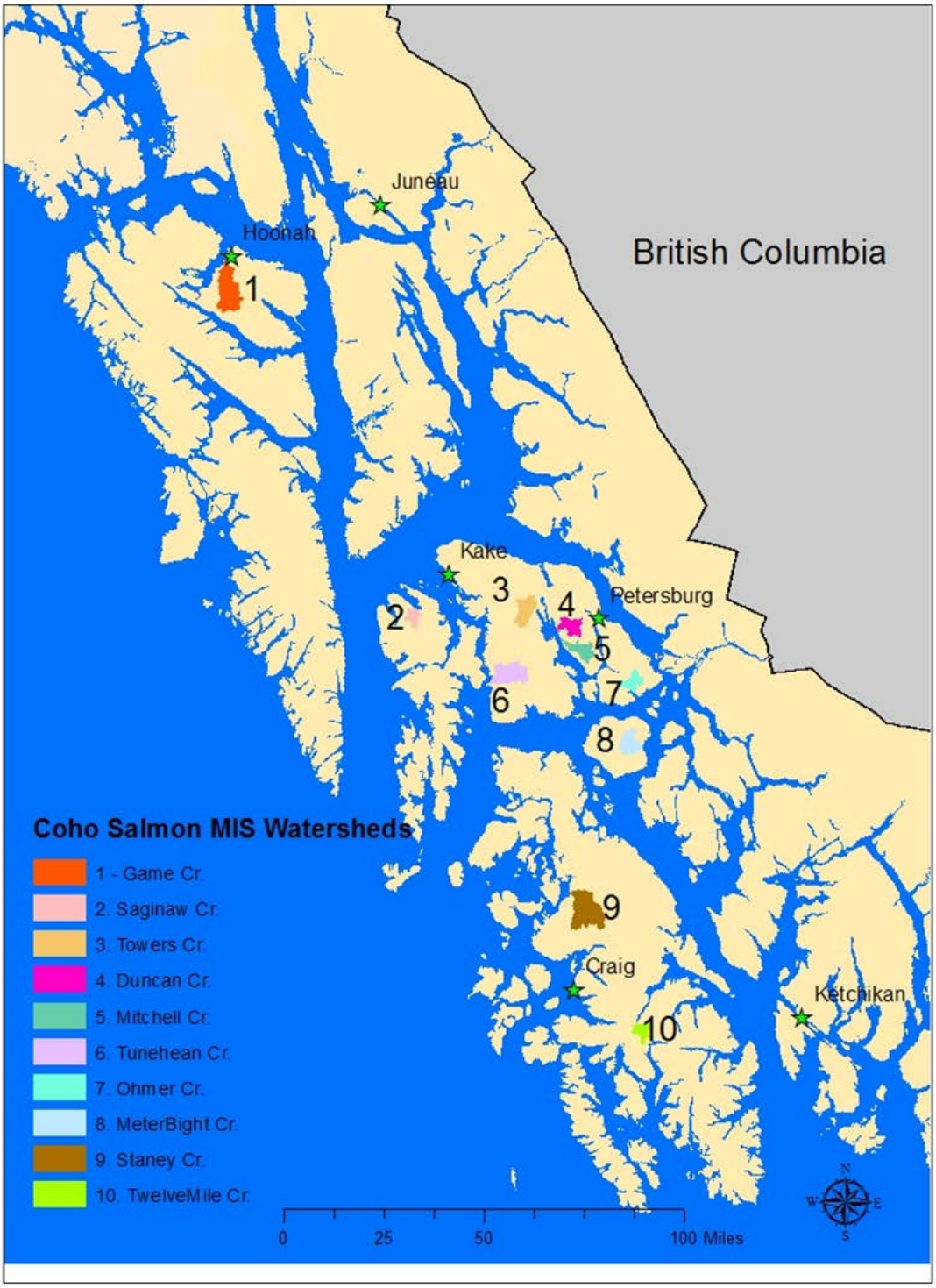
The Watershed Restoration Effectiveness Monitoring (WREM) program also addresses coho salmon population monitoring associated with in-stream restoration projects. Refer to Soil and Water Question 21 –Watershed Health response for further detail. Annual review of ADF&G's commercial harvest and wild stock escapement data will continue to aid analyses.

**Stream and Fish Table 3. Coho salmon MIS watersheds**

| Watershed | Basin Area (miles$^2$) | Year(s) Sampled | Percent of Basin Harvested 0-10 Years Ago | Percent of Basin Harvested 11-20 Years Ago | Percent of Basin Harvested 21-30 Years Ago | Percent of Basin Harvested >30 Years Ago | percent of Basin Harvested Total | Miles of Road | Road Density (road mi/mi$^2$ of basin) |
|---|---|---|---|---|---|---|---|---|---|
| Staney | 61.7 | 2012 2013 2014 | 0.0 | 5.4 | 3.0 | 29.6 | 38 | 143.5 | 2.32 |
| Towers | 37.7 | 2012 2013 2014 | 0.0 | 0.0 | 0.0 | 0.0 | 0 | 0.0 | 0.00 |
| Duncan | 20.7 | 2012 | 3.2 | 0.3 | 2.9 | 0.0 | 6 | 14.4 | 0.70 |
| Meter Bight | 25.0 | 2012 | 0.9 | 2.2 | 0.6 | 8.0 | 12 | 30.1 | 1.20 |
| Tunehean | 39.4 | 2013 | 0.0 | 1.0 | 0.0 | 0.3 | 1 | 5.3 | 0.13 |
| Ohmer | 13.9 | 2013 2014 | 0.2 | 0.0 | 1.5 | 10.1 | 12 | 12.6 | 0.91 |
| Mitchell | 22.5 | 2013 | 4.7 | 1.3 | 5.9 | 5.0 | 17 | 30.4 | 1.35 |
| TwelveMile | 15.5 | 2013 | Not available[2] | Not available[2] | Not available[2] | Not available[2] | 65 | 42.8 | 2.77 |
| Saginaw | 13.1 | 2014 | 0.0 | 0.0 | 6.2 | 21.1 | 27 | 14.0 | 1.07 |
| Game | 52.5 | 2014 | Not available[2] | Not available[2] | Not available[2] | Not available[2] | Not available[2] | 51.6[1] | 0.98[1] |

[1] Does not include Native Land Road

[2] Non-National Forest land timber harvest data currently not available




**Stream and Fish Figure 5. Coho salmon MIS monitored watersheds – 2012-2014**

### *Evaluation of Results*

Because of the short duration of monitoring efforts under the newly revised protocol, no detailed analysis of results is feasible at this time. Sampling efforts are planned to continue.

### *Action Plan*

Continue to evaluate ADF&G's commercial harvest and escapement statistics.

Project work in 2015 is expected to include:

- Continue to implement the current monitoring protocol that includes fish numbers and in-channel habitat measures with an expansion of fish population estimates to reaches within selected watersheds for specified watersheds based on rotating panel approach. A total of five watersheds will be sampled annually for a total of 14 watersheds over an 8-year period (refer back to resident fish monitoring section for rotating panel sampling design).
- Include watershed scale features in the analysis to provide additional information on the distribution of fish and interpretation of observed trends in fish numbers.
- A statistician will be consulted to evaluate the study plan and number of reaches per watershed.

No changes to Forest Plan standards and guidelines are recommended at this time.

## Pink Salmon Abundance Monitoring

### *Evaluation Criteria*

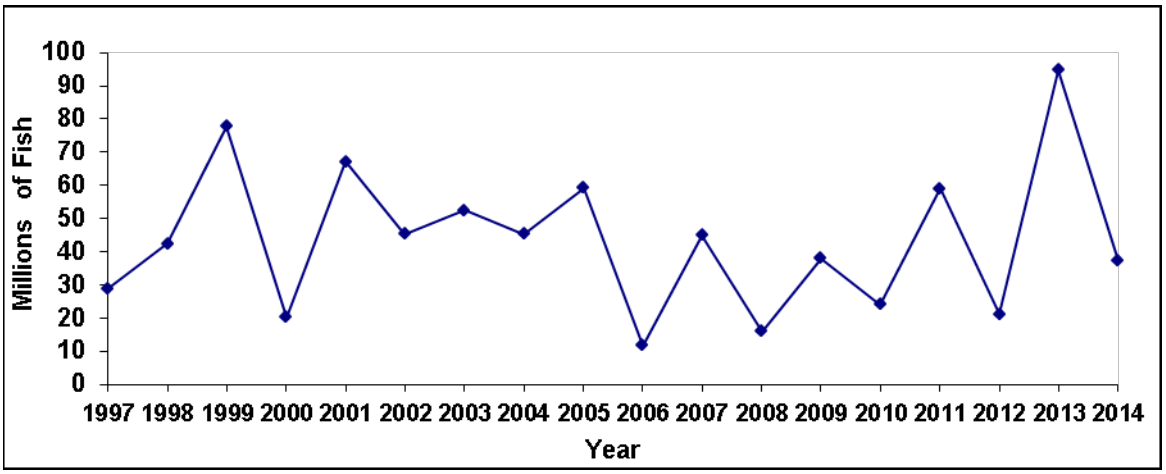
Evaluate the trends of the ADF&G annual Southeast Alaska commercial pink salmon harvest statistics and escapement estimates from index streams.

### *Sampling/Reporting Period*

Evaluate ADF&G harvest and index stream escapement data annually.

### *Monitoring Results*

There are more than 2,500 streams in southeast Alaska in which pink salmon are known to spawn (Piston and Heinl 2011). Annual commercial harvest of pink salmon in Southeast Alaska is reported by the Alaska Department of Fish and Game and the Forest Service evaluates these estimates for trends (Figure 6). Commercial harvest is in part a good indicator of annual abundance and potential trends for pink salmon in Southeast Alaska.




**Stream and Fish Figure 6. Annual commercial harvest of pink salmon in Southeast Alaska from 1997 through 2014. Data provided by ADF&G.**

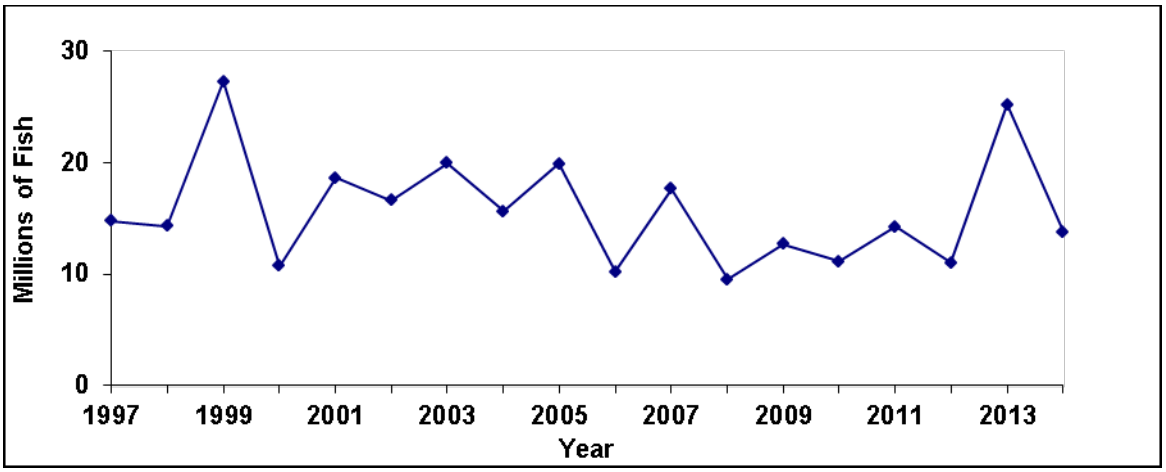
According to ADF&G data, the total 2014 estimated southeast Alaska (not including Yakutat area) pink salmon harvest of 37.2 million fish was below the recent 10-year average (2004-2013) of 41.5 million fish and above the long-term average harvests, ranking the 21st largest harvest since 1962 (Conrad and Gray 2014). The even-year low returns pattern has perpetuated since 2006 and continued in 2014, and was especially evident in Northern Southeast Inside waters. The 2014 pre-season harvest forecast had been predicted to be in the average range at 22 million fish with an 80 percent confidence interval of 8-36 million as BEGs were met in only two of the three subregions in the 2012 parent year (Piston and Heinl 2013). That forecast was calculated using both a forecast from the trend of the harvest through exponential smoothing and an adjusted forecast using the 2012 NOAA Fisheries juvenile pink salmon abundance data (Piston and Heinl 2013).

Another indicator of pink salmon abundance is escapement data based on a series of index streams across Southeast Alaska (Heinl et al. 2008). The reported data is the annual sum of the peak escapement counts for approximately 714 index streams which are surveyed, via small aircraft, throughout the season with data consolidated into 46 active stock groups, representing 12 Management Districts across Southeast Alaska (Figure 7). The highest count observed is used for the index and is considered a relative measure of escapement, useful for tracking trends in escapement and for year-to-year comparisons.

According to ADF&G, the total 2014 pink salmon escapement index of 13.8 million fish ranked 14nd since 1960 and was the highest even-year index since 2004 (ADF&G 2014). During 2014, two of the three sub-regions (demarcated as Southern Southeast Subregion, Northern Southeast Inside Subregion, and the Northern Southeast Outside Subregion) biological escapement goals were exceeded with the exception being in the Northern Southeast Inside subregion where the escapement goal fell below the goal range. Escapement management targets were not met for 7 of the 15 districts with management targets and, at a more refined scale, for 20 of the 46 pink salmon stock groups (ADF&G 2014). The Northern Southeast Inside subregion harvest of 0.9 million pink salmon was a mere 6 percent of the recent 10-year average and of the lowest since 1960. Escapement indices were below management targets for 6 of 7 districts and for 17 of 21 stock groups within this subregion. Management targets in the Freshwater Bay stock group (District 112) have been below BEG since 2011.

The combination of annual harvest and escapement is generally a good indicator of the annual abundance and potential trends for the pink salmon returning to Southeast Alaska. No consistent trends are apparent in the escapement index data from 1997 through 2014. Much of the reduction in recent years was the result of poor even-year pink salmon returns that began in 2006. Those pink salmon out-migrated in 2005, which was an anomalously warm year in the Gulf and likely affected survival for many salmon species. It is apparent that environmental conditions are constantly changing in different ways, in different areas, making it difficult to predict future trends. According to ADF&G, pink salmon abundance is largely driven by early marine survival rates, thus explaining the dramatic annual variation in the size of pink salmon runs.

As defined by the State of Alaska's Policy for Management of Sustainable Salmon Fisheries, no stocks of pink salmon in Southeast Alaska meet the criteria for stocks of concern (Piston and Heinl 2011).




**Stream and Fish Figure 7. Annual escapement of pink salmon in Southeast Alaska from 1997 through 2014. Data provided by ADF&G.**

It is generally believed that pink salmon abundance is controlled by several factors including stream freezing and the cyclical productivity of the marine environment. Quality of the freshwater habitat, mainly the infiltration of fine sediment into pink salmon redds, is also important and may be affected by forest management, but is likely overshadowed by the influence of winter freezing and ocean productivity. Short-term trends in the data, for example the high abundances documented in 1999 and 2013 and extremely poor pink salmon escapement in 2006 and 2008, cannot be attributed to forest management. Commercial harvest of both pink and coho salmon was high in 1999 and 2013. The synchrony of high commercial harvest of both species suggests a strong influence of ocean productivity on the abundance of these species. In 2004, region-wide cold weather and stream freezing when eggs and fry were incubating in the spawning streams is the likely explanation of the reduced 2006 return of pink salmon followed by low 2008 returns. It appears that the even-year lines have been somewhat improving since 2006, however the 2012 return was still considered to be in the weak range primarily because of those particular poor escapement years. The 2014 return was above the prediction but the even-year line is still considered the weaker of the two. Odd year lines appear to be increasing.

### *Evaluation of Results*

There were no pink salmon or pink salmon habitat monitoring efforts conducted during 2014. The forest discontinued attempts at framing a monitoring protocol for this species in 2010. A recommendation has been made to drop this species from the Management Indicator list because of the extreme difficulty in being able to detect meaningful level of change as a result of the Forest's current management practices.

The Forest continues to work with ADF&G to review the annual pink salmon commercial harvest and escapement index data for general trend information. The annual average harvest over the past 10 years has dropped slightly with the exception of 2013 which came in at 177 percent of the 2003-2012 10-year average. With the exception of 2008 in general and the Northern Southeast Inside subregion in 2014, pink salmon escapement indices have been very close to, within or exceeding escapement goals and escapements appear to have been well-distributed throughout Southeast Alaska. As defined by the Alaska sustainable salmon fisheries policy, no Southeast Alaska pink salmon stocks currently meet the criteria for stocks of concern.

### *Action Plan*

Continue to work with ADF&G to review the annual pink salmon commercial harvest and escapement index data.

No changes in the Forest Plan Standards and Guidelines are recommended at this time.

## Citations

Aho, R. 2000. Monitoring plan for determining trends in populations and habitat (for resident Dolly Varden char and cutthroat trout). USDA, Forest Service, Tongass National Forest. 12 p.

Alaska Department of Fish and Game. 2014. 2014 Southeast Alaska salmon escapement summary. Ketchikan, AK. 11 pp.

Bryant, M.D. 2000. Estimating fish populations by removal methods with minnow traps in southeast Alaska streams. North American Journal of Fisheries Management. 20: 923-930.

Bryant, M.D., T. McDonald, R. Aho, B.E. Wright, and M.B. Stahl. 2008. A protocol using coho salmon to monitor Tongass National Forest Land and Resource Management Plan standards and guidelines for fish habitat. General Technical Report. PNW-GTR-743. Portland, OR: USDA, Forest Service, Pacific Northwest Research Station. 80 p.

Conrad, S., and D. Gray. 2014. Overview of the 2014 Southeast Alaska and Yakutat commercial, personal use, and subsistence salmon fisheries. Fishery Management Report No. 14-61. Anchorage, AK: Alaska Department of Fish and Game.

Heinl, S. C., D. M. Eggers, and A.W. Piston. 2008. Pink salmon stock status and escapement goals in Southeast Alaska and Yakutat. Special Publication No. 08-16. Juneau, AK: Alaska Department of Fish and Game. 40 p.

Piston, A.W. and S.C. Heinl, 2013. 2014 Alaska Department of Fish and Game Southeast Alaska salmon harvest forecast. Alaska Department of Fish and Game, Ketchikan. 4 p.

Piston, A.W. and S.C. Heinl. 2011. Pink salmon stock status and escapement goals in Southeast Alaska. Special Publication No. 11-18. Anchorage, AK: Alaska Department of Fish and Game.

Reeves, G.H., D.B. Hohler, D.P. Larsen, D.E. Busch, K. Kratz, K. Reynolds, K.F. Stein, T. Atzet, P. Hays, and M. Tehan. 2003. Aquatic and riparian effectiveness monitoring plan for the Northwest Forest Plan. General Technical Report. PNW-GTR-577. Portland, OR: USDA, Forest Service, Pacific Northwest Research Station.

Shaul L., K. Crabtree, E. Jones, S. McCurdy, and B. Elliot. 2011. Coho salmon stock status and escapement goals in Southeast Alaska. Special Publication No. 11-23. Alaska Department of Fish and Game.

Skannes, P., G. Hagerman, and L. Shaul. 2015. Annual management report for the 2014 Southeast/Yakutat salmon troll fisheries. Fishery Management Report No. 15-06. Anchorage, AK: Alaska Department of Fish and Game.

USDA Forest Service. 2001. Aquatic habitat management handbook. FSH 2090 R10 Amendment 2090-2001-1. Juneau, AK: USDA, Forest Service, Region 10.

# 14a. Streams and Fish Habitat: Aquatic Habitat

**Goal:** Maintain or restore the natural range and frequency of aquatic habitat conditions on the Tongass National Forest to sustain the diversity and production of fish and other freshwater organisms

**Objectives:** Use baseline fish habitat objectives, identified in the Forest Plan Standards and Guidelines, to evaluate the relative condition of riparian and aquatic habitat. Monitor representative fish populations to determine whether trends attributable to current forest management are evident

**Background:** Fish and aquatic resources on the Tongass National Forest provide major subsistence, commercial, and sport fisheries. Abundant rainfall and watersheds with high densities of streams provide a high quantity and diversity of freshwater fish habitats. The Tongass National Forest provides spawning and rearing habitat for the majority of wild fish produced in Southeast Alaska. Maintenance of this habitat and associated waters is a focal point for the public, State and Federal agencies, and Native organizations.

## Streams and Fish Habitat Question: *Is the range and frequency of aquatic habitat conditions maintained?*

In order to answer this question, we have compiled a database of aquatic habitat surveys from reference channels. We define a reference channel as one which has no timber management, road building or other urban effects upstream or adjacent to the stream. We use summary statistics from these channels to define the natural range of variation (NRV) for our baseline fish habitat objectives.

The baseline fish habitat objectives are a suite of descriptive statistics taken from reference stream systems. These statistics, put forth as ranges and quartiles or 10 habitat variables (Table 1) are broken out by geomorphic process group and channel type (Paustian 1992, revised 2010). The original suite of descriptive statistics was published as an evaluation of the effect of sample size on statistical power (Bryant 2004), and two additional metrics were added from the Channel Condition Assessment project (Woodsmith 2005).

In 2008, a re-evaluation of the descriptive statistics identified several channel types where small samples sizes limited their value (Tucker and Caouette 2008). We proposed a 4-year project beginning in 2010 to focus field data collection in reference reaches for the specific purpose of increasing sample size and improving the value of the statistics. The first 3 years of the project were focused on data collection while the fourth year, FY2013 focused on analysis and reporting. In addition, we accepted reference data taken in other channel types to continue to increase sample sizes in all types of channels.

An additional and complicating aspect of this project was that the updated statistics would be run using the national Aquatic Surveys database. This step was included to comply with national direction, provide an additional measure of data validation, and enable further statistical analysis of these data in the future. Data migration to the national database is the current priority for this project.

**Stream and Fish Table 1. Fish habitat objectives**

| Channel Type | | FP | | FPS | | FPM | | FPL | | | | MM | | MMS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Harvest Status | | no | yes | no | yes | no | yes | no | yes | | | no | yes | no | yes |
| | n w/data | 43 | 28 | 16 | 9 | 19 | 12 | 8 | 7 | | n w/data | 49 | 39 | 45 | 27 |
| | 0 | 4.8 | 9.2 | 4.8 | 9.4 | 15.5 | 9.2 | 18.4 | 30.9 | | 0 | 3.48 | 1.56 | 3.5 | 1.6 |
| | 0.25 | 16.5 | 18.5 | 11.6 | 13.7 | 18.7 | 21.3 | 24.2 | 32.0 | | 0.25 | 10.57 | 12.35 | 10.3 | 13.2 |
| | 0.5 | 19.3 | 27.8 | 14.9 | 18.8 | 20.2 | 27.8 | 27.2 | 38.6 | | 0.5 | 15.34 | 17.29 | 14.2 | 16.7 |
| | 0.75 | 26.0 | 38.8 | 18.5 | 22.2 | 30.7 | 33.5 | 41.8 | 52.8 | | 0.75 | 22.27 | 25.15 | 21.8 | 22.5 |
| WD | 1 | 77.8 | 79.1 | 24.7 | 46.1 | 46.0 | 79.1 | 77.8 | 76.7 | | 1 | 52.61 | 44.55 | 52.6 | 37.9 |
| | mean | 23.1 | 31.0 | 15.0 | 20.3 | 24.8 | 30.8 | 15.0 | 20.3 | | mean | 17.83 | 19.54 | 17.4 | 18.2 |
| | stdev | 12.9 | 18.5 | 5.4 | 11.0 | 9.1 | 18.5 | 5.4 | 11.0 | | stdev | 10.98 | 9.48 | 11.4 | 8.3 |
| | cv % | 55.6 | 59.6 | 36.0 | 54.3 | 36.7 | 60.0 | 36.0 | 54.3 | | cv % | 61.6 | 48.5 | 65.6 | 45.6 |
| | n w/data | 44 | 83 | 16 | 27 | 23 | 26 | 5 | 29 | | n w/data | 41 | 35 | 39 | 25 |
| | 0 | 0.10 | 0.00 | 0.19 | 0.00 | 0.13 | 0.09 | 0.10 | 0.00 | | 0 | 0.08 | 0.03 | 0.08 | 0.15 |
| | 0.25 | 0.26 | 0.21 | 0.25 | 0.25 | 0.31 | 0.22 | 0.15 | 0.10 | | 0.25 | 0.27 | 0.29 | 0.28 | 0.36 |
| | 0.5 | 0.36 | 0.39 | 0.39 | 0.45 | 0.37 | 0.48 | 0.17 | 0.32 | | 0.5 | 0.38 | 0.39 | 0.38 | 0.46 |
| | 0.75 | 0.50 | 0.60 | 0.53 | 0.58 | 0.50 | 0.61 | 0.46 | 0.60 | | 0.75 | 0.50 | 0.53 | 0.51 | 0.57 |
| | 0.9 | 0.64 | 0.77 | 0.64 | 0.66 | 0.62 | 0.79 | 0.48 | 0.79 | | 0.9 | 0.71 | 0.78 | 0.73 | 0.98 |
| TLWD/M | 1 | 1.68 | 1.31 | 0.68 | 0.78 | 1.68 | 1.31 | 0.49 | 1.19 | | 1 | 1.03 | 4.74 | 1.03 | 4.74 |
| | mean | 0.41 | 0.41 | 0.41 | 0.41 | 0.45 | 0.46 | 0.41 | 0.41 | | mean | 0.41 | 0.54 | 0.43 | 0.67 |
| | stdev | 0.25 | 0.28 | 0.17 | 0.21 | 0.31 | 0.29 | 0.17 | 0.21 | | stdev | 0.24 | 0.77 | 0.24 | 0.88 |
| | cv % | 61.12 | 67.32 | 42.5 | 51.4 | 67.6 | 62.2 | 42.5 | 51.4 | | cv % | 56.7 | 142.7 | 55.5 | 132.9 |
| | n w/data | 41 | 73 | 17 | 25 | 20 | 21 | 4 | 26 | | n w/data | 42 | 27 | 39 | 20 |
| | 0 | 0.01 | 0.00 | 0.02 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | | 0 | 0.01 | 0.00 | 0.02 | 0.00 |
| TKWD/M | 0.25 | 0.04 | 0.01 | 0.04 | 0.02 | 0.06 | 0.01 | 0.02 | 0.00 | | 0.25 | 0.06 | 0.02 | 0.07 | 0.06 |

| Channel Type | | FP | | FPS | | FPM | | FPL | | | | MM | | MMS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Harvest Status | | no | yes | no | yes | no | yes | no | yes | | | no | yes | no | yes |
| | 0.5 | 0.10 | 0.03 | 0.10 | 0.05 | 0.10 | 0.03 | 0.03 | 0.01 | | 0.5 | 0.11 | 0.07 | 0.12 | 0.10 |
| | 0.75 | 0.15 | 0.08 | 0.17 | 0.11 | 0.15 | 0.09 | 0.06 | 0.03 | | 0.75 | 0.14 | 0.12 | 0.14 | 0.13 |
| | 0.9 | 0.23 | 0.15 | 0.23 | 0.16 | 0.20 | 0.16 | 0.09 | 0.08 | | 0.9 | 0.19 | 0.19 | 0.19 | 0.21 |
| | 1 | 0.25 | 0.30 | 0.25 | 0.30 | 0.25 | 0.27 | 0.12 | 0.26 | | 1 | 0.27 | 0.23 | 0.27 | 0.23 |
| | mean | 0.11 | 0.06 | 0.12 | 0.08 | 0.11 | 0.06 | 0.12 | 0.08 | | mean | 0.11 | 0.08 | 0.11 | 0.10 |
| | stdev | 0.07 | 0.07 | 0.08 | 0.07 | 0.07 | 0.07 | 0.08 | 0.07 | | stdev | 0.06 | 0.07 | 0.06 | 0.07 |
| | cv % | 64.93 | 123.60 | 62.52 | 93.32 | 59.89 | 117.58 | 62.52 | 93.32 | | cv % | 59.93 | 88.41 | 57.03 | 70.75 |
| | n w/data | 52 | 86 | 19 | 27 | 25 | 29 | 8 | 29 | | n w/data | 49 | 38 | 45 | 27 |
| POOLS/ KM | 0 | 7.85 | 0.00 | 23.81 | 0.00 | 8.07 | 8.92 | 7.85 | 0.00 | | 0 | 0.01 | 0.02 | 0.01 | 0.03 |
| | 0.25 | 30.23 | 17.59 | 50.10 | 33.44 | 31.01 | 28.20 | 9.69 | 7.02 | | 0.25 | 0.04 | 0.04 | 0.05 | 0.05 |
| | 0.5 | 44.98 | 32.15 | 66.67 | 50.63 | 41.02 | 38.14 | 18.37 | 16.79 | | 0.5 | 0.06 | 0.06 | 0.06 | 0.07 |
| | 0.75 | 66.38 | 50.47 | 75.47 | 69.13 | 57.48 | 49.18 | 22.59 | 24.61 | | 0.75 | 0.07 | 0.09 | 0.07 | 0.09 |
| | 1 | 118.00 | 171.04 | 118.00 | 171.04 | 76.69 | 113.64 | 49.61 | 130.43 | | 1 | 0.16 | 0.13 | 0.16 | 0.13 |
| | mean | 48 | 39 | 65.41 | 56.67 | 44.13 | 42.10 | 65.41 | 56.67 | | mean | 0.06 | 0.06 | 0.06 | 0.07 |
| | stdev | 25 | 33 | 24.72 | 40.04 | 18.04 | 22.72 | 24.72 | 40.04 | | stdev | 0.03 | 0.03 | 0.03 | 0.03 |
| | cv % | 52.36 | 83.11 | 37.80 | 70.67 | 40.89 | 53.98 | 37.80 | 70.67 | | cv % | 43.03 | 50.51 | 39.73 | 38.11 |
| | n w/data | 52 | 81 | 19 | 25 | 25 | 28 | 8 | 27 | | n w/data | 47 | 36 | 43 | 26 |
| Pool spacing | 0 | 0.88 | 0.25 | 1.17 | 1.30 | 0.88 | 0.61 | 1.07 | 0.25 | | 0 | 0.77 | 1.03 | 1.4 | 1.0 |
| | 0.25 | 1.43 | 1.59 | 2.19 | 2.70 | 1.26 | 1.47 | 1.92 | 1.41 | | 0.25 | 2.87 | 2.67 | 2.9 | 2.7 |
| | 0.5 | 2.20 | 2.46 | 3.22 | 4.36 | 1.78 | 2.01 | 2.67 | 2.16 | | 0.5 | 3.95 | 3.98 | 4.0 | 3.9 |
| | 0.75 | 3.44 | 4.18 | 5.06 | 7.41 | 2.23 | 2.38 | 3.11 | 3.01 | | 0.75 | 5.72 | 5.12 | 5.7 | 5.1 |
| | 1 | 9.56 | 44.68 | 7.32 | 44.68 | 9.56 | 6.12 | 6.32 | 10.74 | | 1 | 15.16 | 12.33 | 15.2 | 12.3 |
| | mean | 2.82 | 4.15 | 3.60 | 7.52 | 2.22 | 2.19 | 3.60 | 7.52 | | mean | 5.00 | 4.19 | 5.10 | 4.19 |

| Channel Type | | FP | | FPS | | FPM | | FPL | | | | MM | | MMS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Harvest Status | | no | yes | no | yes | no | yes | no | yes | | | no | yes | no | yes |
| | stdev | 1.86 | 5.91 | 1.74 | 9.31 | 1.85 | 1.17 | 1.74 | 9.31 | | stdev | 3.57 | 2.17 | 3.66 | 2.40 |
| | cv % | 65.86 | 142.27 | 48.46 | 123.87 | 83.03 | 53.55 | 48.46 | 123.87 | | cv % | 71.33 | 51.86 | 71.78 | 57.40 |
| | n w/data | 52 | 32 | 19 | 9 | 25 | 13 | 8 | 10 | | n w/data | 46 | 29 | 42 | 23 |
| RPD/CBW | 0 | 0.00 | 0.03 | 0.00 | 0.05 | 0.00 | 0.03 | 0.00 | 0.03 | | 0 | 0.00 | 0.00 | 0.00 | 0.02 |
| | 0.25 | 0.03 | 0.03 | 0.05 | 0.06 | 0.04 | 0.04 | 0.02 | 0.03 | | 0.25 | 0.06 | 0.05 | 0.06 | 0.05 |
| | 0.5 | 0.04 | 0.04 | 0.06 | 0.07 | 0.04 | 0.04 | 0.03 | 0.03 | | 0.5 | 0.07 | 0.06 | 0.08 | 0.08 |
| | 0.75 | 0.06 | 0.05 | 0.09 | 0.08 | 0.05 | 0.04 | 0.03 | 0.03 | | 0.75 | 0.10 | 0.10 | 0.10 | 0.11 |
| | 1 | 0.13 | 0.11 | 0.13 | 0.11 | 0.08 | 0.05 | 0.04 | 0.04 | | 1 | 0.17 | 0.18 | 0.17 | 0.18 |
| | mean | 0.05 | 0.05 | 0.07 | 0.07 | 0.04 | 0.04 | 0.07 | 0.07 | | mean | 0.08 | 0.08 | 0.08 | 0.09 |
| | stdev | 0.03 | 0.02 | 0.04 | 0.02 | 0.01 | 0.00 | 0.04 | 0.02 | | stdev | 0.04 | 0.04 | 0.04 | 0.04 |
| | cv % | 60.64 | 42.57 | 55.27 | 27.08 | 34.30 | 11.19 | 55.27 | 27.08 | | cv % | 53.01 | 56.10 | 46.57 | 49.83 |
| | n w/data | 43 | 32 | 18 | 10 | 19 | 13 | 6 | 9 | | n w/data | 44 | 28 | 40 | 22 |
| D50 | 0 | 1.04 | 2.23 | 5.21 | 14.00 | 6.00 | 2.23 | 1.04 | 5.95 | | 0 | 7.76 | 7.07 | 7.8 | 7.1 |
| | 0.25 | 16.68 | 17.35 | 22.77 | 17.52 | 14.93 | 21.73 | 17.29 | 17.80 | | 0.25 | 26.98 | 24.81 | 26.5 | 23.8 |
| | 0.5 | 24.00 | 26.56 | 27.16 | 26.59 | 19.10 | 25.47 | 19.69 | 27.11 | | 0.5 | 34.83 | 33.50 | 34.8 | 30.5 |
| | 0.75 | 36.24 | 38.84 | 36.89 | 35.48 | 31.62 | 38.00 | 44.79 | 50.00 | | 0.75 | 55.31 | 50.21 | 52.0 | 46.0 |
| | 1 | 109.00 | 86.00 | 56.00 | 86.00 | 109.00 | 68.00 | 109.00 | 59.00 | | 1 | 122.00 | 210.00 | 103.0 | 178.0 |
| | mean | 31.39 | 31.33 | 28.81 | 31.55 | 32.20 | 31.66 | 28.81 | 31.55 | | mean | 44.15 | 52.14 | 42.19 | 40.52 |
| | stdev | 25.63 | 19.53 | 12.53 | 21.23 | 30.63 | 20.20 | 12.53 | 21.23 | | stdev | 26.83 | 51.13 | 24.72 | 36.45 |
| | cv % | 81.66 | 62.33 | 43.48 | 67.27 | 95.11 | 63.78 | 43.48 | 67.27 | | cv % | 60.78 | 98.08 | 58.59 | 89.95 |
| | n w/data | 32 | 24 | 15 | 9 | 12 | 8 | 5 | 7 | | n w/data | 41 | 29 | 39 | 24 |
| POOL | 0 | 0.11 | 0.02 | 0.20 | 0.35 | 0.11 | 0.02 | 0.12 | 0.10 | | 0 | 0.07 | 0.15 | 0.1 | 0.2 |

| Channel Type | | FP | | FPS | | FPM | | FPL | | | | MM | | MMS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Harvest Status | | no | yes | no | yes | no | yes | no | yes | | | no | yes | no | yes |
| LENGTH/M | 0.25 | 0.34 | 0.39 | 0.36 | 0.39 | 0.43 | 0.52 | 0.18 | 0.39 | | 0.25 | 0.28 | 0.29 | 0.3 | 0.3 |
| | 0.5 | 0.51 | 0.54 | 0.58 | 0.50 | 0.54 | 0.60 | 0.42 | 0.51 | | 0.5 | 0.42 | 0.35 | 0.4 | 0.3 |
| | 0.75 | 0.69 | 0.59 | 0.66 | 0.55 | 0.70 | 0.84 | 0.44 | 0.55 | | 0.75 | 0.47 | 0.45 | 0.5 | 0.5 |
| | 1 | 0.84 | 1.21 | 0.84 | 0.70 | 0.75 | 1.21 | 0.69 | 0.64 | | 1 | 0.80 | 0.67 | 0.8 | 0.7 |
| | mean | 0.50 | 0.53 | 0.53 | 0.50 | 0.52 | 0.64 | 0.53 | 0.50 | | mean | 0.41 | 0.38 | 0.41 | 0.38 |
| | stdev | 0.21 | 0.24 | 0.20 | 0.11 | 0.21 | 0.36 | 0.20 | 0.11 | | stdev | 0.19 | 0.14 | 0.19 | 0.14 |
| | cv % | 41.17 | 45.52 | 37.17 | 22.01 | 39.75 | 56.20 | 37.17 | 22.01 | | cv % | 46.08 | 36.28 | 46.49 | 36.54 |

Definitions of Habitat Management Objectives (see Tucker and Caouette, unpublished, for complete definitions)

WD = channel width-to-depth ratio (Bankfull width / mean bankfull depth)

TLWD/M = Total Large Wood pieces / meter (Total Pieces / meters surveyed)

TKWD/M = Total Key pieces Large Wood/meter (Total Key pieces / meters surveyed)

POOL/KM = Pools/Km (Total number of Pools / meters surveyed * 1000)

POOL SPACE = Pool Spacing (Length of stream surveyed / channel bed width / total number of pools)

RPD/CBW = Residual Pool Depth/Channel Bed width (Average of all pool residual depth / average channel bed width)

D50 = median particle size of streambed

PLNGTH/M = Pool Length/meter (Total pool length / total length of stream surveyed)

REL_SUBMRG = Relative Submergence (Mean bankfull depth / D50)

POOL_SIZE = Pool Size (Average residual pool depth / average bankfull depth)

Definitions of channel types (see Paustian 1992 for complete definitions)

FP = floodplain process group MM: moderate grade mixed control process group

FPS = small floodplain channel MMS: small moderate grade mixed control channel

FPM = medium floodplain channel

MM = moderate grade mixed control process group

MMS = small moderate grade mixed control channel

FPL = large floodplain channel

Note: This table is an update of the original publication of quartiles to include the sample sizes, full ranges of the data, mean, standard deviation, and the coefficient of variation expressed as a percentage of the mean. It also shows both harvested and unharvested channels – the source data for t-test analysis comparisons.

## Evaluation Criteria

During the 2014 field season, we continued to add channels to the reference database, sampling 18 sites (Table 2). These sites come from the Watershed Restoration Effectiveness Monitoring (WREM) and Management Indicator Species (MIS) projects. The data from these sites were entered to the corporate Natural Resources Information System (NRIS) Aquatic Surveys database in preparation for analysis and reporting.

**Stream and Fish Table 2. Sites sampled in 2014**

| Site Name | Location | Drainage | Channel Type |
|---|---|---|---|
| 11 Mile | Prince of Wales Island | 11 mile | FPM |
| Salmon Creek | Baranof Island | Salmon Lake | FPM |
| Rising Stream | Kupreanof Island | Towers | FPS |
| Newlunberry | Prince of Wales Island | Thorne River | FPS |
| ZZ Top | Kupreanof Island | Towers | MCS |
| Dehydration | Kupreanof Island | Towers | FPM |
| Upper East | Kupreanof Island | Towers | MMM |
| Thirty Trap | Kupreanof Island | Towers | MMS |
| Easy Street | Kupreanof Island | Towers | FPS |
| Camelot | Kupreanof Island | Towers | MMM |
| Football Field | Kupreanof Island | Towers | MMS |
| Old Ohmer | Mitkof Island | Ohmer | MMS |
| Super Trap | Mitkof Island | Ohmer | MMS |
| Bit Of Bedrock | Mitkof Island | Ohmer | MMS |
| Porcupine | Mitkof Island | Ohmer | MMS |
| Fairyland | Kupreanof Island | Big John Bay | MMS |
| Last Ditch | Chichagof Island | Peril Strait | MMS |
| Indian Tributary | Baranof Island | Indian River | FPS |

Definitions of channel types (see Paustian [1992] for complete definitions):

FPS: small floodplain channel
FPM: medium floodplain channel
FPL: large floodplain channel
MCS: small moderate gradient contained channel
MMS: small moderate gradient mixed control channel
MMM: medium moderate gradient mixed control channel

## Sampling/Reporting Period

The sampling period is annual and the reporting period is five years.

## Monitoring Results

The 2014 field season focused on adding reference sites from other projects and collation and organization of the data. We were able to add data from 12 MIS monitoring project sites and 6 WREM sites that were sampled in 2014. While those channel types were not targeted specifically in the reference reach project, increases in sample size – especially when they improve our geographic distribution of

reference reach sites – improve the strength of the overall data set.

## Evaluation of Results

This project set aside FY2014 to focus on data entry and analysis. The data were first entered into the NRIS database. This step standardizes and validates the data, enabling queries to extract the summary metrics. Currently, we are working to incorporate legacy habitat data into the NRIS environment. We are also developing the reporting tools to extract summary statistics from each survey.

## Action Plan

In FY2015, we will continue to focus on data entry and analysis creating a useful and available analytical product. The goal for this project is to produce an interactive suite of statistics generated from data relevant to project needs. As any new site is surveyed, it will be compared to the existing suite of statistics and added to the overall dataset. The complete dataset summary, currently a static product, will be a user-generated output.

## Citations

Paustian, S.J., 1992. A channel type user's guide for the Tongass National Forest, southeast Alaska. Technical Paper 26. Juneau, AK: USDA, Forest Service, Alaska Region. Revised 2010.

Byrant, Mason D., J. Caouette, and B. Wright. 2004. Evaluating stream habitat survey data and statistical power using an example from Southeast Alaska. North American Journal of Fisheries Management. 24: 1353-1362.

Tucker, E., and J. Caouette, 2008. Unpublished report. Statistical analyses of aquatic habitat variables in the Tongass National Forest. On file at USDA Forest Service, Tongass National Forest, Petersburg, Alaska.

Woodsmith, R.D., J.R. Noel, and M.L. Dilger. 2005. An approach to effectiveness monitoring of floodplain channel aquatic habitat: channel condition assessment. Landscape and Urban Planning. 72: 177-204.

# 14b. Streams and Fish Habitat: Fish Passage

**Goal:** Maintain or restore the natural range and frequency of aquatic habitat conditions on the Tongass National Forest to sustain the diversity and production of fish and other freshwater organisms.

**Objectives:** Use baseline fish habitat objectives, identified in the Forest Plan Standards and Guidelines, to evaluate the relative condition of riparian and aquatic habitat.

**Background:** Fish and aquatic resources on the Tongass National Forest provide major subsistence, commercial, and sport fisheries. Abundant rainfall and watersheds with high densities of streams provide a high quantity and diversity of freshwater fish habitats. The Tongass National Forest provides spawning and rearing habitat for the majority of fish produced in Southeast Alaska. Past riparian harvest altered aquatic habitat by reducing the supply of large wood available to streams. Maintenance of this habitat and associated waters is a focal point for the public, State and Federal agencies, and Native organizations.

## Streams and Fish Habitat Question*: Is the natural range and frequency of aquatic habitat conditions maintained?*

### Fish Passage at Road Crossings

Upstream migration is essential for many fish species in the Tongass National Forest. Anadromous fish (fish that migrate from the ocean to freshwater to spawn) require access to spawning habitat. Juvenile anadromous fish migrate during their freshwater life stage, seeking seasonal habitats. Resident fish (fish that spend their entire life in freshwater) also may migrate seasonally in response to food, shelter and spawning needs.

Providing for fish passage at stream and road intersections to ensure fish migration is an important consideration when constructing or reconstructing forest roads. Improperly located, installed or maintained stream crossing structures can restrict these migrations, thereby adversely affecting fish populations. These structures can present a variety of potential obstacles to fish migration. The most common obstacles are excessive vertical barriers, debris blockages, and extreme water velocities that can inhibit fish passage, especially smaller or juvenile fish.

The Tongass National Forest strives to incorporate an adaptive management process to achieve the desired management goals and objectives for the fish passage at road crossings program. The adaptive management approach includes a continuous process of using, or developing, state-of-the-art assessment and restoration techniques followed by monitoring and adjustment of the techniques, accordingly.

Designing the crossing structure to fit the stream is the key for attaining fish passage objectives and avoiding many unintended and undesirable impacts. Culverts that constrict the stream channel may cause excessive water velocity, excessive bedload deposition or rapid change in water surface profile at the inlet. Culverts installed at a gradient significantly different than the natural stream grade can induce stream head cutting upstream or excessive deposition of bedload at the culvert inlet. Culverts that do not retain adequately sized bedload may lead to excessive water velocities within the culvert. Culverts with excessive water velocities within them may release energy by eroding the outlet control, leaving the outlet perched.

Design techniques to provide fish passage across roads include:

**Natural Stream Bottom Design:** Maintaining the natural streambed using bridges and bottomless arch culverts;

**Stream Simulation Design:** Installing culverts that mimic and retain the natural stream characteristics of stream width, gradient, substrate and pool depth and spacing. Stream simulation assumes that if a culvert is installed in a manner that mimics that of the stream channel the ability for fish movement will be no

less or greater at the road crossing than in the natural channel (Photo 1).

**Minimally Engineered Aquatic Organism Passage (MEAOP) Design:** An experimental, potentially cost effective method of installing culverts in a manner that over time are expected to provide conditions in the culvert that closely mimic and retain natural stream characteristics of stream width, gradient and substrate. This is achieved by sufficiently sizing and countersinking the culvert and then staging bedload material directly upstream. Over time, as the result of high flows, the staged and native bedload material becomes deposited within the culvert and fish passage conditions are achieved.

**No Slope Design:** Installing culverts that are countersunk and at a flat gradient. This technique has limited application and is only effective where the natural stream grade is also flat and the water is pooled and backwatered, as is found in palustrine, estuarine and occasionally floodplain channels.

**Hydraulic Design:** Culverts designed to result in predetermined water velocities or depths at predetermined flows. This design often includes installing culverts equipped with a system of weirs or baffles. The complex hydraulics and poor bedload transport associated with baffled culverts require very careful design considerations if fish passage is to be retained over time. This hydraulic design technique must match estimated fish swimming performance to calculated hydraulic conditions at a range of flows.

**Removal:** Removing culverts and restoring the natural stream channel.

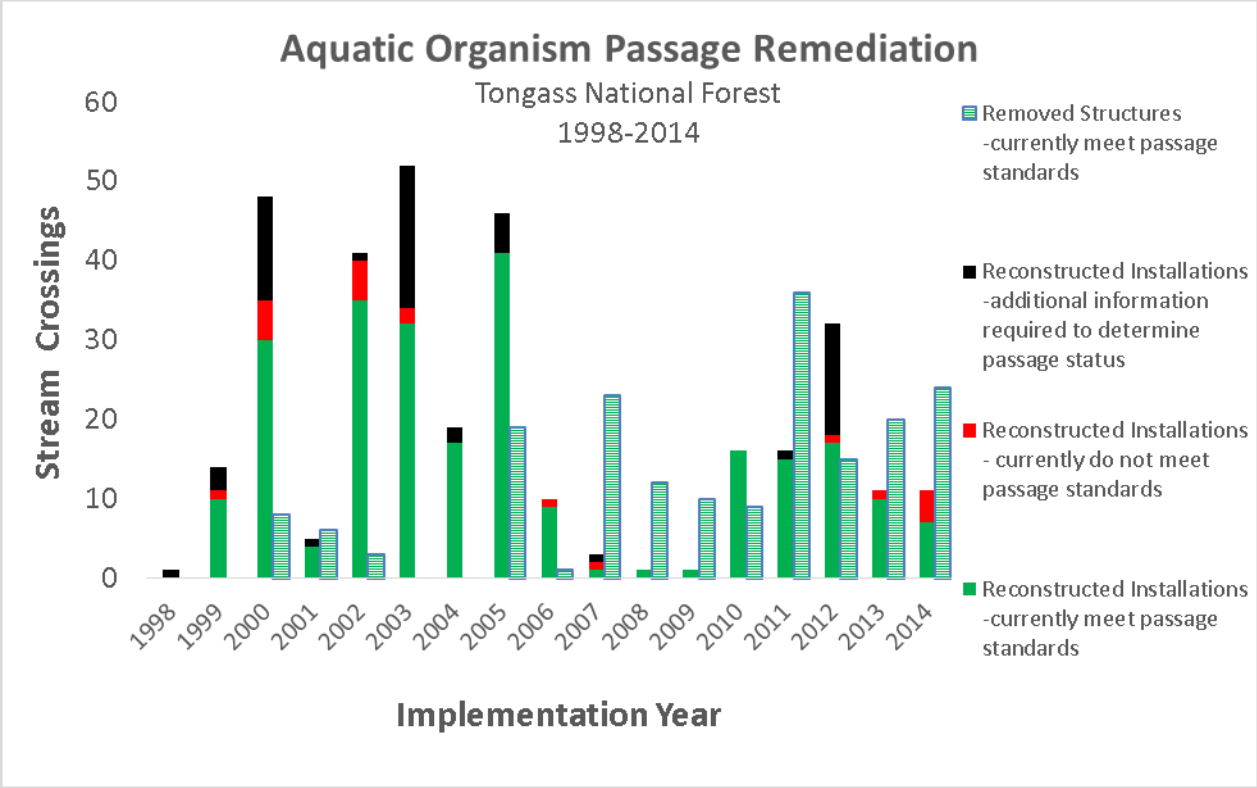
### *Evaluation Criteria*

The Tongass National Forest has identified and surveyed 3,650 fish stream road crossings along approximately 5,000 miles of forest roads. Thirty-six percent of these are anadromous crossings, while the remaining 64 percent are resident fish streams. Approximately 55 percent of the crossings are culverts and 45 percent are bridges or removed structures. Approximately 90 percent of the crossings have had fish passage determinations completed and 34 percent of those have been determined not to meet State of Alaska fish passage standards. There is an average of 0.33 miles and a median of 0.18 miles of fish habitat stream length upstream of the anadromous crossings and an average of 0.20 miles and a median of 0.11 miles upstream of the resident crossings not meeting passage standards.

Fish Passage Standards and Guidelines including drainage-structure-design-criteria have evolved over time and are still evolving as information on fish swimming performance, fish movement patterns and culvert hydraulics is improved. Therefore, the assessment of the effectiveness of the Standards and Guidelines contained in the Forest Plan can only be meaningfully conducted on drainage structures more recently designed and installed.

Between 1998 and 2014, the Tongass has re-installed, retrofitted or removed approximately 513 crossings that were not previously meeting passage standards in fish streams and potentially impeding fish passage. One-hundred and eighty-six of those were remediated by being removed and 327 of them were reinstallations (Figure 1). The estimated cost of this remediation is 18.5 million dollars, indexed to 2015 dollars. Approximately 76 percent of the reinstallations were replaced with culverts and 24 percent were replaced with bridges. The monitoring provided in this report excludes bridges, removed structures and bottomless culverts since they routinely do not impede fish passage. Only non-bottomless culvert installations were evaluated since they are more problematic for fish passage.

*Stream and Fish Photo 1.Time series of culvert replacement for fish passage remediation using a stream simulation design*




**Stream and Fish Figure 1. Aquatic organism passage remediation on the Tongass National Forest 1998 - 2014**

The culverts were primarily assessed using criteria established in the USFS Alaska Region juvenile fish passage criteria matrix (Table 1). The matrix separates out culverts that have conditions that can be assumed to meet standards from those that do not. The evaluation matrix stratifies culverts by type and establishes criteria thresholds for culvert gradient, stream constriction, debris blockage, and vertical barrier at the culvert outlet (perch) specific to each culvert type. Each culvert is placed into one of the five juvenile fish-passage capability categories.

- **GREEN category**: conditions are assumed to be adequate for fish passage and to meet State of Alaska juvenile fish passage flow standards.
- **RED category**: conditions are assumed not to be adequate for fish passage and not to meet State of Alaska juvenile fish passage flow standards.
- **GRAY category**: conditions are such that additional and more detailed analysis is required to determine their juvenile fish passage ability. This additional analysis includes use of the FishXing analytical software.
- **YELLOW category**: Conditions are assumed to be adequate for fish passage and to meet State of Alaska juvenile fish passage flow standards. However, the potentially insufficient depth of bedload material in the bottom of the culvert elevates concerns about the ability of the bedload to be retained. These culverts are on a more frequent inspection schedule to assure that bedload is retained
- **BLACK category**: The fish passage condition is unknown because critical survey measurements are not currently available.

**Stream and Fish Table 1. USFS Alaska Region juvenile salmonid fish passage criteria matrix**

| Structure Group # | Structure Group | Green<br>Conditions assumed adequate to pass juvenile fish | Gray<br>Conditions require additional analysis | Red<br>Conditions assumed inadequate to pass juvenile fish |
|---|---|---|---|---|
| 1 | Bottomless pipe arch or embedded[1][1] pipe arch or embedded CMP[2]. | Culvert span to bed width ratio >= 0.75 and no blockage or backwatered[3] and no blockage. | Culvert span to bed width ratio of 0.5 to 0.75 OR blockage >0 percent but <=10 percent. | Culvert span to bed width ratio <0.5 or blockage >10 percent |
| 2 | Non-embedded pipe arches and culvert span <= 144 inches or non-embedded CMP and culvert span > 48 inches and <=144 inches. | Culvert gradient <0.5 percent and no perch[4] and no blockage and culvert span to bed width ratio > 0.75 or backwatered and no blockage. | Culvert gradient between 0.5 percent - 2.0 percent or perch >0.0 feet but <=4 inches or blockage >0 percent but <=10 percent or culvert span to bed width ratio between 0.5 to 0.75. | Culvert gradient >2.0 percent or >4 inches perch or blockage >10 percent or culvert span to bed width ratio <0.5. |
| 3 | Non-embedded CMP and <= 48 inch span. | Culvert gradient <0.5 percent and no perch and no blockage and culvert span to bed width ratio > 0.75 or backwatered and no blockage | Culvert gradient between 0.5 percent - 1.0 percent or perch >0.0 feet but <=4 inches or blockage >0 percent but <=10 percent or culvert span to bed width ratio between 0.5 to 0.75. | Culvert gradient >1.0 percent or >4 inch perch or blockage >10 percent or culvert span to bed width ratio <0.5. |
| 4 | Non-embedded culvert and culvert span >144 inches | Culvert gradient <1.0 percent and no perch and no blockage and culvert span to bank full ratio > 0.75 or backwatered and no blockage. | Culvert gradient between 1.0 percent - 2.0 percent or perch >0.0 feet but <=4 inches or blockage >0 percent but <=10 percent or culvert span to bed width ratio between 0.5 to 0.75. | Culvert gradient >2.0 percent or >4 inch perch or blockage >10 percent or culvert span to bed width ratio <0.5. |
| 5 | Box culverts, tidally influenced culverts, culverts with non-standard configurations or materials or baffled culverts. | Fully backwatered | All | Perch >4 inches |
| 6 | Bridges or fords or removed structures | No road fill caused blockage | Not Applicable | Road fill causing blockage. Water piping through road fill |
| 7 | Multiple structure installations | Multiple structures are assessed as other similar structures with the exception that constriction is calculated by dividing the stream bedwidth by the sum of all the structure widths. The structure with the best passage performance is used to determine the passage capability of the entire array. | | |

*Note:* These criteria are not design criteria, but rather indicate whether the structure is likely to provide fish passage for juvenile salmonids at a particular point in time.

[1] Culverts are considered embedded if they have 100 percent bedload cover and average substrate depth >=20 percent of culvert rise. If culverts have 100 percent bedload cover and the average substrate depth is < 20 percent but > 5 percent of the culvert rise at both the inlet and outlet of the culvert and meet other criteria for a Green culvert than it will be identified as a Yellow crossing and requires more frequent re-inspections to assure bedload depth is retained.

[2] CMP – corrugated metal pipe

[3] The culvert is considered backwatered if the elevation of the top-of-water at the downstream control is greater than the elevation of the upstream invert of the culvert. Culvert gradient, constriction, and perch criteria are not considered in the assessment of fish passage in backwatered culvert.

[4] Perch is calculated as a flow dependent value. Perch is the defined as the difference in height between the downstream invert of the culvert (or top of bedload at downstream end of culvert if bedload is present) and top-of-water at the downstream control.

Annually, a subsample of the culverts that are evaluated using the USFS Alaska Region juvenile fish passage criteria matrix are also assessed more comprehensively by comparing physical conditions within the culvert against those in reference reaches in the vicinity of the culvert.

Mimicking site specific natural channel conditions within a culvert is the strategy of a stream simulated culvert design. Stream simulation assumes that if a culvert is installed in a manner that mimics that of the stream channel the ability for fish movement will be no less or greater at the road crossing than in the natural channel. Channel characteristics such as stream width, gradient, substrate and pool depth and spacing is measured and compared. In addition, a comparison of stream velocities within the culvert to the reference reach was completed using a sodium chloride salt tracer and measuring changes of conductivity over time. This method provides a simple means of obtaining a velocity profile in a stream reach with high variability of channel geometry and roughness characteristics.

### *Sampling/Reporting Period*

The sampling period is annual. A subsample of culverts installed from 1998 - 2014 in fish streams are monitored annually. The reporting and evaluation period is a 5-year interval.

### ***Monitoring Results***

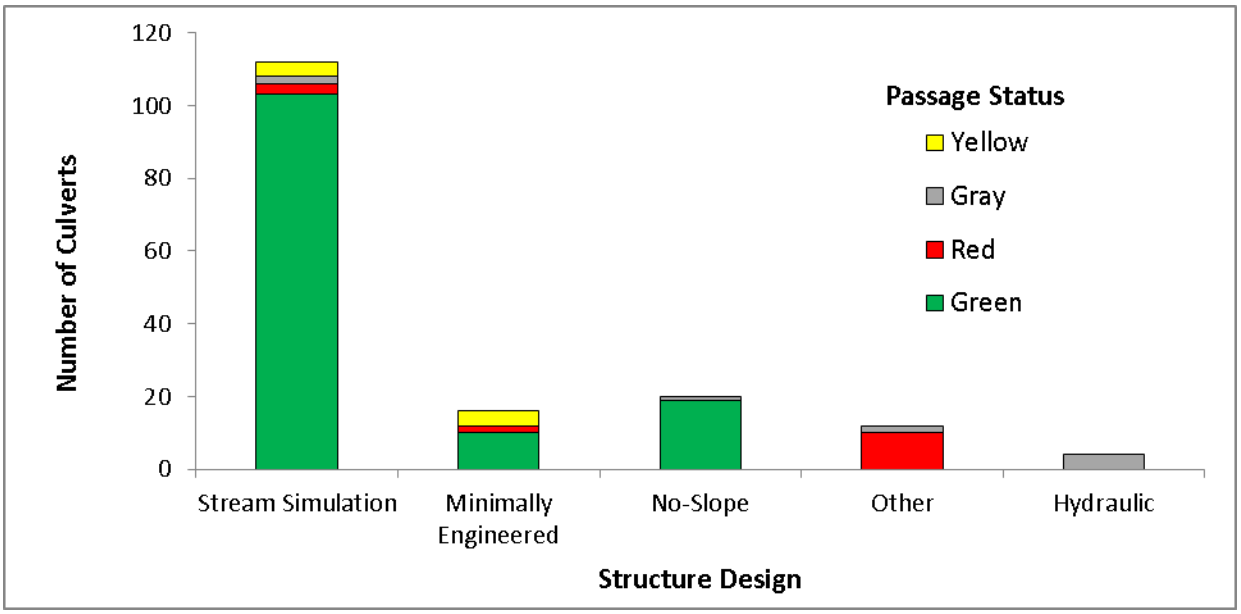
As part of a multi-year monitoring project, 40 culverts spanning fish streams were monitored in fiscal year 2014 to assess their ability to provide fish passage (Photo 2). These culverts were chosen from 246 culverts which have been installed, reinstalled or retrofitted in fish streams from 1998 through 2014. The culverts monitored in 2014 are located on Chichagof, Wrangell, Zarembo and Prince of Wales Islands. From 2009 through 2013, 138 similar culverts were monitored on Kupreanof, Kuiu, Wrangell, Mitkof, Zarembo, Revillagigedo and Prince of Wales Islands. Nine culverts that were installed in 2012 and 2013, using a minimally engineered aquatic organism passage (MEAOP) design, are monitored annually and were resurveyed in 2014. The 164 unique stream crossings monitored to date as part of this assessment constitute approximately 67 percent of the culverts (excluding bottom-less culverts) recently installed, reinstalled or retrofitted in fish streams on the Tongass National Forest.

Eighty-six percent of the culverts monitored are green or yellow and have met the acceptable passage criteria established in the juvenile fish passage criteria matrix (Figure 2). They are consistent with State of Alaska juvenile fish passage standards and are assumed to provide unimpeded juvenile and adult fish passage. Five percent of the culverts are Gray and require more comprehensive analysis to determine passage status. The remaining 9 percent are red and are assumed not to provide adequate passage at all desired stream flows. The majority (68 percent) of the 164 stream crossings monitored were installed between 2000 and 2005 (Table 2).

Sixty-nine percent of the monitored culverts used stream simulation designs, 10 percent were installed using a MEAOP design, 2 percent are hydraulic designed baffled culverts, 12 percent utilized a no-slope design and 7 percent were incorrectly designed without adequate fish passage considerations. Two percent of the stream simulated designed culverts are red. Of the three red stream simulated designed culverts, two have had a segment of their length completely scoured free of bedload and one was blocked by woody debris. Thirteen percent of the MEAOP designed culverts are red due to insufficient bedload accumulation within the culverts. None of the 20 installed no-slope designed culverts were red. All of the

*Stream and Fish Photo 2.Survey of culvert conditions*

hydraulic designed culverts require additional more comprehensive analysis to determine passage status. Twelve culverts were installed without discernable fish passage design considerations and as a result 83 percent of them are red. Six of those most likely were not identified as crossings requiring passage at time of installation and therefore were not designed appropriately (Figure 2). It is undetermined why the other four culverts were installed without adequate design considerations.




**Stream and Fish Figure 2. Design type and juvenile fish passage status of monitored culverts.**

Of the culverts that were determined to be consistent with passage standards, most were ideal installations. They contained appropriate bedload depth and material, were not blocked with debris, were not perched at the outlet and did not constrict the channel or cause any undesirable channel modifications.

However, some of the crossings determined to be consistent with passage with standards had some issues associated with them that required or may require some action. Four of the culverts had woody debris blockages in them but were subsequently cleared. Several of the culverts which have bedload retaining weirs installed in them are not retaining bedload to the desirable amount. This causes slight vertical drops at the weirs and may provide a less than an ideal amount of channel roughness within the culvert. One culvert had a section of subsurface flow within the culvert which was most likely due to an insufficient amount of finer bedload material. However, this stream channel also had a section of naturally occurring interrupted flow directly downstream of the culvert.

**Stream and Fish Table 2. Culvert Measurements**

| District | Road | M.P. | Culvert Type | Design | Year Install-ed | Year Monitor-ed | Culvert Outlet Perch | Percent Culvert Bedload Cover | Ratio Bedload Depth to Culvert Rise | Ratio Stream Bedwidth to Culvert Width | Percent Culvert Gradient to Percent Channel Gradient | Percent Debris Block-age | Juvenile Passage Status |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Petersburg | 40000 | 2.492 | round | simulation | 2002 | 2009 | No perch | 100 | 0.32 | 1.41 | 2.8 : 8 | 0 | Green |
| Petersburg | 40000 | 3.129 | round | simulation | 2002 | 2010 | No perch | 100 | 0.40 | 1.00 | 4.6 : 7 | 0 | Green |
| Petersburg | 40000 | 3.194 | arch | simulation | 2002 | 2010 | No perch | 100 | 0.23 | 1.31 | 6.3 : 7 | 0 | Green |
| Petersburg | 40000 | 3.292 | round | simulation | 2002 | 2009 | No perch | 100 | 0.38 | 1.28 | 4.1 : 6 | 0 | Green |
| Petersburg | 40000 | 3.337 | arch | simulation | 2002 | 2009 | No perch | 100 | 0.26 | 0.97 | 6.7 : 9 | 0 | Green |
| Petersburg | 40000 | 3.356 | round | simulation | 2002 | 2009 | No perch | 100 | 0.35 | 0.93 | 5.2 : 7 | 0 | Green |
| Petersburg | 40000 | 3.552 | arch | simulation | 2002 | 2010 | No perch | 100 | 0.23 | 1.62 | 7.1 : 8 | 0 | Green |
| Petersburg | 40000 | 3.739 | round | simulation | 2003 | 2011 | No perch | 100 | 0.47 | 0.94 | 6.7 : 12 | 0 | Green |
| Petersburg | 40000 | 5.001 | round | hydraulic | 2002 | 2009 | No perch | n/a | n/a | n/a [4] | 6.9 : 0 | 0 [1] | Gray |
| Petersburg | 6235 | 12.361 | round | simulation | 2002 | 2009 | No perch | 100 | 0.35 | 1.22 | 5.1 : 7 | 0 | Green |
| Petersburg | 6235 | 12.932 | round | simulation | 2002 | 2009 | No perch | 100 | 0.41 | 1.50 | 4.7 : 5 | 0 | Green |
| Petersburg | 6235 | 15.450 | round | simulation | 2003 | 2009 | No perch | 100 | 0.35 | 1.27 | 0.1 : 3 | 0 | Green |
| Petersburg | 6235 | 15.846 | round | simulation | 2002 | 2009 | No perch | 100 | 0.42 | 1.01 | 1.0 : 2 | 0 | Green |
| Petersburg | 6235 | 17.071 | round | simulation | 2002 | 2009 | No perch | 100 | 0.36 | 1.25 | 1.4 : 1 | 0 | Green |
| Petersburg | 6235 | 17.579 | arch | simulation | 2002 | 2009 | No perch | 100 | 0.41 | 2.00 | 2.7 : 1 | 0 | Green |
| Petersburg | 6245 | 0.940 | arch | simulation | 1998 | 2009 | No perch | 100 | 0.28 | 0.95 | 1.6 : 4 | 0 | Green |
| Petersburg | 6245 | 1.256 | arch | simulation | 2003 | 2009 | No perch | 100 | 0.50 | 1.15 | 8.8 :16 | 0 | Green |
| Petersburg | 6245 | 1.503 | round | simulation | 2003 | 2009 | No perch | 100 | 0.23 | 1.00 | 5.0 : 7 | 0 | Green |
| Petersburg | 6245 | 4.690 | round | simulation | 2003 | 2009 | No perch | 100 | 0.43 | 1.21 | 1.7 : 5 | 0 | Green |
| Petersburg | 6245 | 4.962 | round | simulation | 2003 | 2009 | No perch | 100 | 0.51 | 1.21 | 4.8 : 8 | 0 | Green |
| Petersburg | 6245 | 8.562 | round | simulation | 2003 | 2009 | No perch | 100 | 0.31 | 1.14 | 6.4 :7 | 0 | Green |
| Petersburg | 40010 | 0.146 | arch | simulation | 2001 | 2009 | No perch | 100 | 0.20 | 0.76 | 1.6 : 6 | 0 | Green |
| Petersburg | 6204 | 0.318 | round | no slope [2] | 2009 | 2009 | No perch | 38 | 0.04 | 1.18 | 1.4 : 4 | 0 | Green |
| Petersburg | 6204 | 1.997 | round | simulation | 2003 | 2009 | No perch | 100 | 0.49 | 1.00 | 2.0 : 9 | 0 | Green |
| Petersburg | 6204 | 8.002 | round | simulation | 2003 | 2009 | No perch | 100 | 0.34 | 1.33 | 2.0 :3 | 0 [1] | Green |

| District | Road | M.P. | Culvert Type | Design | Year Install-ed | Year Monitor-ed | Culvert Outlet Perch | Percent Culvert Bedload Cover | Ratio Bedload Depth to Culvert Rise | Ratio Stream Bedwidth to Culvert Width | Percent Culvert Gradient to Percent Channel Gradient | Percent Debris Block-age | Juvenile Passage Status |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Petersburg | 6350 | 4.612 | round | no slope [2] | 2002 | 2010 | No perch | 100 | 0.04 | 1.45 | -0.7 : 5 | 0 | Green |
| Petersburg | 6350 | 4.693 | round | no slope [2] | 2002 | 2010 | No perch | 0 | 0.00 | 1.30 | 0 : 2 | 0 | Green |
| Petersburg | 6350 | 17.465 | plastic | other[7] | 2013 | 2014 | 0.7 feet | 0 | 0.00 | 0.69 | 1 : 3 | 0 | Red |
| Petersburg | 6402 | 7.872 | arch | simulation | 2005 | 2010 | No perch | 100 | 0.27 | 1.00 | 0.9 : 3 | 0 | Green |
| Petersburg | 6402 | 11.170 | arch | simulation | 2005 | 2010 | No perch | 100 | 0.17 | 2.22 | 5.3 : 5 | 0 | Yellow |
| Petersburg | 6407 | 1.743 | round | simulation | 2005 | 2010 | No perch | 100 | 0.41 | 1.17 | 11.4 : 8 | 0 | Green |
| Petersburg | 6407 | 4.526 | round | simulation | 2005 | 2010 | No perch | 100 | 0.38 | 1.28 | 5.4 : 7 | 0 | Green |
| Petersburg | 6407 | 6.208 | round | simulation | 2005 | 2010 | No perch | 100 | 0.39 | 1.43 | 1.4 : 8 | 0 | Green |
| Petersburg | 6415 | 2.339 | dual arch[3] | simulation | 2000 | 2010 | No perch | 100 | 0.15 | 1.00 | 3.5 : 4 | 0 | Green |
| Petersburg | 6415 | 2.341 | dual arch[3] | simulation | 2000 | 2010 | No perch | 100 | 0.22 | 1.00 | 3.6 : 4 | 0 [1] | Green |
| Petersburg | 6415 | 2.836 | arch | simulation | 2000 | 2010 | No perch | 100 | 0.21 | 0.78 | 3.1 : 4 | 0 | Green |
| Petersburg | 6415 | 3.366 | arch | simulation | 2000 | 2010 | 0.3 feet[6] | 100 | 0.14 | 1.14 | 1.1 : 4 | 0 | Yellow |
| Petersburg | 6415 | 4.223 | arch | simulation | 2000 | 2010 | No perch | 100 | 0.43 | 1.19 | 4.6 : 3 | 0 | Green |
| Petersburg | 6415 | 7.198 | arch | simulation | 2000 | 2010 | No perch | 100 | 0.17 | 0.90 | 4.8 : 9 | 0 | Yellow |
| Petersburg | 6415 | 8.772 | arch | simulation | 1998 | 2010 | No perch | 100 | 0.12 | 0.96 | 0 : 3 | 0 | Green |
| Petersburg | 6415 | 12.729 | arch | simulation | 2005 | 2010 | No perch | 100 | 0.26 | 1.95 | 4.9 : 6 | 0 | Green |
| Petersburg | 6314S | 8.739 | round | other[7] | 2002 | 2010 | 0.1 feet | 0 | 0.00 | 0.61 | 4.5 : 12 | 0 | Red |
| Petersburg | 6314S | 8.817 | round | no-slope | 2002 | 2010 | No perch | 100 | 0.10 | 1.09 | 0.0 : 1 | 0 | Green |
| Petersburg | 6314S | 8.915 | round | no slope [2] | 2002 | 2010 | No perch | 0 | 0.00 | 1.04 | 0.3 : 0 | 0 | Green |
| Petersburg | 6314S | 8.959 | round | no slope [2] | 2002 | 2010 | No perch | 100 | 0.29 | 0.98 | 0.3 : 1 | 0 | Green |
| Petersburg | 6314S | 9.575 | round | simulation | 2002 | 2010 | No perch | 100 | 0.20 | 2.06 | 5.3 : 10 | 0 | Green |
| Petersburg | 6314S | 9.669 | round | other[7] | 2002 | 2010 | 0.4 feet | 0 | 0.00 | 1.05 | 3.8 : 8 | 0 | Red |
| Petersburg | 6314S | 12.535 | round | simulation | 2002 | 2010 | No perch | 100 | 0.27 | 0.96 | 2.1 : 12 | 0 | Green |
| Petersburg | 6314S | 13.223 | arch | simulation | 2002 | 2010 | No perch | 100 | 0.20 | 0.81 | 3.5 : 6 | 0 | Green |

| District | Road | M.P. | Culvert Type | Design | Year Install-ed | Year Monitor-ed | Culvert Outlet Perch | Percent Culvert Bedload Cover | Ratio Bedload Depth to Culvert Rise | Ratio Stream Bedwidth to Culvert Width | Percent Culvert Gradient to Percent Channel Gradient | Percent Debris Block-age | Juvenile Passage Status |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Petersburg | 6314S | 13.284 | round | other[7] | 2002 | 2010 | No perch | 0 | 0.00 | 1.11 | 2.9 : 4 | 0 | Red |
| Petersburg | 45001 | 0.185 | round | simulation | 2001 | 2010 | No perch | 100 | 0.14[8] | 1.16 | 5.5 : 8 | 0 | Green |
| Petersburg | 45001 | 0.485 | round | simulation | 2001 | 2010 | No perch | 100 | 0.14 | 1.52 | 1.9 : 6 | 0 | Yellow |
| Petersburg | 6030 | 0.512 | round | simulation | 2001 | 2010 | No perch | 100 | 0.47 | 0.92 | 1.1 : 4 | 0 | Green |
| Petersburg | 6031 | 0.583 | round | simulation | 2003 | 2011 | No perch | 100 | 0.22 | 1.56 | 0.5 : 2 | 0 | Green |
| Petersburg | 6031 | 0.597 | round | simulation | 2003 | 2011 | No perch[9] | 100 | 0.13 | 1.04 | 2.6 : 6 | 0 | Red |
| Petersburg | 6031 | 3.161 | arch | simulation | 2003 | 2011 | No perch | 93 | 0.14[10] | 1.46 | 5.1 : 5 | 0 | Red |
| Petersburg | 6031 | 3.833 | round | simulation | 2003 | 2011 | No perch | 100 | 0.32 | 1.16 | 3.6 : 5 | 0 | Green |
| Petersburg | 6031 | 4.340 | round | no slope[2] | 2003 | 2011 | No perch | 100 | 0.11 | 0.85 | 1.8 : 2 | 0 | Green |
| Petersburg | 6031 | 5.840 | round | simulation | 2003 | 2011 | No perch | 100 | 0.39 | 1.43 | 1.5 : 3 | 0 | Green |
| Petersburg | 6031 | 6.631 | round | simulation | 2003 | 2011 | No perch | 100 | 0.39 | 1.28 | 3.1 : 10 | 0 | Green |
| Petersburg | 6319 | 8.413 | round | simulation | 2003 | 2011 | No perch | 100 | 0.40 | 0.96 | 4.2 : 4 | 0 | Green |
| Petersburg | 6319 | 10.975 | round | simulation | 2003 | 2011 | No perch | 100 | 0.30 | 1.79 | 2.9 : 5 | 0 | Green |
| Petersburg | 6323 | 0.162 | round | simulation | 2003 | 2011 | No perch | 100 | 0.27 | 2.17 | 4.2 : 2 | 0 | Green |
| Petersburg | 6256 | 3.146 | arch | simulation | 2006 | 2011 | No perch | 100 | 0.30 | n/a[4] | 0.2 : 1 | 0 | Green |
| Petersburg | 6256 | 4.499 | round | simulation | 2006 | 2011 | No perch | 100 | 0.38 | n/a[4] | 1.8 : 0 | 0 | Green |
| Petersburg | 6256 | 5.528 | round | simulation | 2006 | 2011 | No perch | 100 | 0.42 | n/a[4] | 0 : 0.6 | 20 [11] | Red |
| Wrangell | 6259 | 2.334 | arch | MEAOP | 2014 | 2014 | No perch | 100 | 0.18 | 1.21 | 4.0 : 4 | 0 | Yellow |
| Wrangell | 6259 | 2.782 | arch | MEAOP | 2014 | 2014 | No perch | 100 | 0.25 | 0.63 | 4.0 : 3 | 0 | Green |
| Wrangell | 6259 | 2.787 | arch | MEAOP | 2014 | 2014 | No perch | 70 | 0.11[2] | 0.84 | 3.7 : 3 | 0 | Green |
| Wrangell | 6299 | 2.263 | arch | simulation | 2003 | 2010 | No perch | 100 | 0.29 | 0.90 | 4.8 : 9 | 0 | Green |
| Wrangell | 6299 | 2.508 | round | simulation | 2003 | 2010 | No perch | 100 | 0.33 | 1.11 | 3.3 : 5 | 0 | Green |
| Wrangell | 6299 | 2.577 | round | simulation | 2003 | 2010 | No perch | 100 | 0.23 | 0.95 | 3.8 : 5 | 0 | Green |
| Wrangell | 6585 | 5.127 | round | simulation | 2005 | 2012 | No perch | 100 | 0.28 | 1.14 | 10.4:11 | 0 | Green |
| Wrangell | 6585 | 5.285 | round | simulation | 2005 | 2012 | No perch | 100 | 0.42 | 1.04 | 0.8 : 6 | 0 | Green |

| District | Road | M.P. | Culvert Type | Design | Year Install-ed | Year Monitor-ed | Culvert Outlet Perch | Percent Culvert Bedload Cover | Ratio Bedload Depth to Culvert Rise | Ratio Stream Bedwidth to Culvert Width | Percent Culvert Gradient to Percent Channel Gradient | Percent Debris Block-age | Juvenile Passage Status |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wrangell | 6585 | 5.597 | round | simulation | 2005 | 2012 | No perch | 100 | 0.41 | 1.02 | 7.3 : 10 | 0 | Green |
| Wrangell | 6585 | 11.447 | arch | simulation | 2005 | 2012 | No perch | 100 | 0.21 | 1.17 | 3.1 : 6 | 0 | Green |
| Wrangell | 6590 | 0.677 | arch | no-slope[2] | 2014 | 2014 | Red-perch | 100 | 0.38 | 0.83 | 0.3 : 3 | 0 | Green |
| Wrangell | 6590 | 1.674 | round | other | 2014 | 2014 | Red-perch | 50 | 0.12 | 1.38 | 1.1 : 2 | 0 | Red |
| Wrangell | 6590 | 4.396 | round | other[13] | 2007 | 2014 | Red-perch | 0 | 0.00 | 1.20 | 1.7 : 5 | 0 | Red |
| Wrangell | 6590 | 6.433 | arch | simulation | 2005 | 2012 | No perch | 30 | 0.00[2] | 0.56[2] | 1.8 : 6 | 0 | Green |
| Wrangell | 6590 | 11.197 | round | simulation | 2005 | 2012 | No perch | 100 | 0.36 | 1.10 | 3.7 : 5 | 0 | Green |
| Wrangell | 6590 | 11.597 | dual arch[3] | simulation | 2005 | 2012 | No perch | 100 | 0.03 | 0.57 | 0.8 : 6 | 0 | Gray |
| Wrangell | 6590 | 14.046 | round | no-slope | 2014 | 2014 | No perch | 83 | 0.06 | 1.11 | -0.4 : 6 | 0 | Green |
| Wrangell | 6590 | 18.550 | round | simulation | 2005 | 2012 | No perch | 100 | 0.34 | 1.00 | 7.0 : 9 | 0 | Green |
| Wrangell | 6590 | 18.734 | round | hydraulic | 2005 | 2012 | No perch | 10 | 0.12 | 1.03 | 10.4 : 9 | 0 | Gray |
| Wrangell | 6590 | 22.056 | arch | no-slope | 2014 | 2014 | No perch | 96 | 0.11 | 0.88 | 0.2 : 5 | 0 | Green |
| Wrangell | 6590 | 28.661 | round | simulation | 2005 | 2012 | No perch | 100 | 0.35 | 1.17 | 11.5:12 | 0 | Green |
| Wrangell | 6590 | 36.018 | round | simulation | 2005 | 2012 | No perch | 100 | 0.34 | 0.98 | 8.5 : 11 | 0 | Green |
| Wrangell | 6590 | 36.079 | round | simulation | 2005 | 2012 | No perch | 100 | 0.38 | 1.10 | 9.5 : 12 | 0 | Green |
| Wrangell | 50054 | 0.033 | arch | MEAOP | 2014 | 2014 | No perch | 0 | 0.00 | 0.88 | 2.2 : 5 | 0 | Red |
| Wrangell | 50054 | 0.063 | round | MEAOP | 2014 | 2014 | No perch | 100 | 0.08 | 0.80 | 1.3 : 1 | 0 | Yellow |
| Wrangell | 50054 | 0.086 | round | MEAOP | 2014 | 2014 | No perch | 100 | 0.14 | 0.95 | 1.5 : 3 | 0 | Yellow |
| Wrangell | 50055 | 0.031 | arch | MEAOP | 2014 | 2014 | No perch | 100 | 0.5 | 1.69 | 2.5 : 2 | 0 | Yellow |
| Craig | 2024200 | 0.810 | round | simulation | 1999 | 2010 | No perch | 100 | 0.18[2] | 0.84 | 1.4: 4 | 0 | Green |
| Craig | 2024300 | 0.236 | round | simulation | 1999 | 2011 | No perch | 100 | 0.23 | 0.82 | 3.1 : 4 | 0 | Green |
| Craig | 2024300 | 0.260 | round | simulation | 1999 | 2011 | No perch | 100 | 0.50 | 0.88 | 0.4 : 4 | 0 | Green |
| Craig | 2100000 | 0.230 | round | simulation | 2005 | 2010 | No perch | 100 | 0.42 | 1.36 | 3.3 : 4 | 0 | Green |
| Craig | 2100000 | 2.070 | round | simulation | 2000 | 2010 | No perch | 100 | 0.18 | 1.11 | 0.4 : 7 | 0 | Green |

| District | Road | M.P. | Culvert Type | Design | Year Install-ed | Year Monitor-ed | Culvert Outlet Perch | Percent Culvert Bedload Cover | Ratio Bedload Depth to Culvert Rise | Ratio Stream Bedwidth to Culvert Width | Percent Culvert Gradient to Percent Channel Gradient | Percent Debris Block-age | Juvenile Passage Status |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wrangell | 6259 | 2.334 | arch | MEAOP | 2014 | 2014 | No perch | 100 | 0.18 | 1.21 | 4.0 : 4 | 0 | Yellow |
| Wrangell | 6259 | 2.782 | arch | MEAOP | 2014 | 2014 | No perch | 100 | 0.25 | 0.63 | 4.0 : 3 | 0 | Green |
| Wrangell | 6259 | 2.787 | arch | MEAOP | 2014 | 2014 | No perch | 70 | 0.112 | 0.84 | 3.7 : 3 | 0 | Green |
| Wrangell | 6299 | 2.263 | arch | simulation | 2003 | 2010 | No perch | 100 | 0.29 | 0.90 | 4.8 : 9 | 0 | Green |
| Wrangell | 6299 | 2.508 | round | simulation | 2003 | 2010 | No perch | 100 | 0.33 | 1.11 | 3.3 : 5 | 0 | Green |
| Wrangell | 6299 | 2.577 | round | simulation | 2003 | 2010 | No perch | 100 | 0.23 | 0.95 | 3.8 : 5 | 0 | Green |
| Wrangell | 6585 | 5.127 | round | simulation | 2005 | 2012 | No perch | 100 | 0.28 | 1.14 | 10.4:11 | 0 | Green |
| Wrangell | 6585 | 5.285 | round | simulation | 2005 | 2012 | No perch | 100 | 0.42 | 1.04 | 0.8 : 6 | 0 | Green |
| Wrangell | 6585 | 5.597 | round | simulation | 2005 | 2012 | No perch | 100 | 0.41 | 1.02 | 7.3 : 10 | 0 | Green |
| Wrangell | 6585 | 11.447 | arch | simulation | 2005 | 2012 | No perch | 100 | 0.21 | 1.17 | 3.1 : 6 | 0 | Green |
| Wrangell | 6590 | 0.677 | arch | no-slope2 | 2014 | 2014 | Red-perch | 100 | 0.38 | 0.83 | 0.3 : 3 | 0 | Green |
| Wrangell | 6590 | 1.674 | round | other | 2014 | 2014 | Red-perch | 50 | 0.12 | 1.38 | 1.1 : 2 | 0 | Red |
| Wrangell | 6590 | 4.396 | round | other13 | 2007 | 2014 | Red-perch | 0 | 0.00 | 1.20 | 1.7 : 5 | 0 | Red |
| Wrangell | 6590 | 6.433 | arch | simulation | 2005 | 2012 | No perch | 30 | 0.002 | 0.562 | 1.8 : 6 | 0 | Green |
| Wrangell | 6590 | 11.197 | round | simulation | 2005 | 2012 | No perch | 100 | 0.36 | 1.10 | 3.7 : 5 | 0 | Green |
| Wrangell | 6590 | 11.597 | dual arch3 | simulation | 2005 | 2012 | No perch | 100 | 0.03 | 0.57 | 0.8 : 6 | 0 | Gray |
| Wrangell | 6590 | 14.046 | round | no-slope | 2014 | 2014 | No perch | 83 | 0.06 | 1.11 | -0.4 : 6 | 0 | Green |
| Wrangell | 6590 | 18.550 | round | simulation | 2005 | 2012 | No perch | 100 | 0.34 | 1.00 | 7.0 : 9 | 0 | Green |
| Wrangell | 6590 | 18.734 | round | hydraulic | 2005 | 2012 | No perch | 10 | 0.12 | 1.03 | 10.4 : 9 | 0 | Gray |
| Wrangell | 6590 | 22.056 | arch | no-slope | 2014 | 2014 | No perch | 96 | 0.11 | 0.88 | 0.2 : 5 | 0 | Green |
| Wrangell | 6590 | 28.661 | round | simulation | 2005 | 2012 | No perch | 100 | 0.35 | 1.17 | 11.5:12 | 0 | Green |
| Wrangell | 6590 | 36.018 | round | simulation | 2005 | 2012 | No perch | 100 | 0.34 | 0.98 | 8.5 : 11 | 0 | Green |
| Wrangell | 6590 | 36.079 | round | simulation | 2005 | 2012 | No perch | 100 | 0.38 | 1.10 | 9.5 : 12 | 0 | Green |
| Wrangell | 50054 | 0.033 | arch | MEAOP | 2014 | 2014 | No perch | 0 | 0.00 | 0.88 | 2.2 : 5 | 0 | Red |

| District | Road | M.P. | Culvert Type | Design | Year Install-ed | Year Monitor-ed | Culvert Outlet Perch | Percent Culvert Bedload Cover | Ratio Bedload Depth to Culvert Rise | Ratio Stream Bedwidth to Culvert Width | Percent Culvert Gradient to Percent Channel Gradient | Percent Debris Block-age | Juvenile Passage Status |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wrangell | 50054 | 0.063 | round | MEAOP | 2014 | 2014 | No perch | 100 | 0.08 | 0.80 | 1.3 : 1 | 0 | Yellow |
| Wrangell | 50054 | 0.086 | round | MEAOP | 2014 | 2014 | No perch | 100 | 0.14 | 0.95 | 1.5 : 3 | 0 | Yellow |
| Wrangell | 50055 | 0.031 | arch | MEAOP | 2014 | 2014 | No perch | 100 | 0.5 | 1.69 | 2.5 : 2 | 0 | Yellow |
| Craig | 2000000 | 102.907 | arch | MEAOP | 2012 | 2014 | No perch | 90 | 0.37 | 0.94 | 1 : 2 | 0 | Green |
| Craig | 2000000 | 122.678 | round | MEAOP | 2013 | 2014 | No perch | 40 | 0.22 | 1.39 | 3.8 : 4.5 | 0 | Green |
| Craig | 2000000 | 125.242 | arch | MEAOP | 2013 | 2014 | No perch | 100 | 0.16 | 1.09 | 1.8 : 3.5 | 0 | Green |
| Craig | 2000860 | 0.659 | arch | MEAOP | 2013 | 2014 | No perch | 100 | 0.26 | 1.01 | 2.7 : 3.5 | 0 | Green |
| Craig | 2085000 | 0.944 | round | MEAOP | 2013 | 2014 | No perch | 100 | 0.28 | 1.16 | 3.8 : 4.5 | 0 | Green |
| Craig | 2024200 | 0.810 | round | simulation | 1999 | 2010 | No perch | 100 | 0.182 | 0.84 | 1.4: 4 | 0 | Green |
| Craig | 2024300 | 0.236 | round | simulation | 1999 | 2011 | No perch | 100 | 0.23 | 0.82 | 3.1 : 4 | 0 | Green |
| Craig | 2024300 | 0.260 | round | simulation | 1999 | 2011 | No perch | 100 | 0.50 | 0.88 | 0.4 : 4 | 0 | Green |
| Craig | 2100000 | 0.230 | round | simulation | 2005 | 2010 | No perch | 100 | 0.42 | 1.36 | 3.3 : 4 | 0 | Green |
| Craig | 2100000 | 2.070 | round | simulation | 2000 | 2010 | No perch | 100 | 0.18 | 1.11 | 0.4 : 7 | 0 | Green |
| Craig | 2700000 | 0.710 | arch | MEAOP | 2012 | 2014 | No perch | 100 | 0,17 | 1.36 | 3.0 : 2.5 | 0 | Green |
| Thorne Bay | 3000000 | 89.221 | arch | MEAOP | 2013 | 2014 | No perch | 100 | 0.24 | 1.19 | 3.8 : 6.5 | 0 | Green |
| Thorne Bay | 3015000 | 1.773 | arch | MEAOP | 2012 | 2012 | No perch | 100 | 0.11 | 0.76 | 3.4 : 10 | 0 | Red |
| Thorne Bay | 3015000 | 1.773 | arch | MEAOP | 2012 | 2013 | No perch | 100 | 0.15 | 0.76 | 3.4 : 10 | 0 | Red |
| Thorne Bay | 3015000 | 1.773 | arch | MEAOP | 2012 | 2014 | No perch | 98 | 0.11 | 0.76 | 3.4 : 10 | 0 | Red |
| Thorne Bay | 3015000 | 2.641 | arch | simulation | 2010 | 2011 | No perch | 100 | 0.21 | 0.98 | 6.6 : 6 | 0 | Green |
| Thorne Bay | 3015000 | 0.344 | round | simulation | 2010 | 2011 | No perch | 100 | 0.25 | 1.67 | 5.5 : 2 | 0 | Green |
| Thorne Bay | 3015000 | 8.743 | arch | MEAOP | 2012 | 2012 | No perch | 50 [12] | 0.1512 | 1.34 | 4.2 : 7 | 0 | Green |
| Thorne Bay | 3015000 | 8.743 | arch | MEAOP | 2012 | 2013 | No perch | 58 [12] | 0.1512 | 1.34 | 4.2 : 7 | 0 | Green |
| Thorne Bay | 3015000 | 8.743 | arch | MEAOP | 2012 | 2014 | No perch | 100 | 0.41 | 1.34 | 4.2 : 7 | 0 | Green |
| Thorne Bay | 3015000 | 6.830 | round | simulation | 2010 | 2011 | No perch | 100 | 0.29 | 1.22 | 5.5 : 4 | 0 | Green |
| Thorne Bay | 3015250 | 0.030 | round | simulation | 2010 | 2011 | No perch | 100 | 0.39 | 1.26 | 4.6 : 5 | 0 | Green |

| District | Road | M.P. | Culvert Type | Design | Year Install-ed | Year Monitor-ed | Culvert Outlet Perch | Percent Culvert Bedload Cover | Ratio Bedload Depth to Culvert Rise | Ratio Stream Bedwidth to Culvert Width | Percent Culvert Gradient to Percent Channel Gradient | Percent Debris Block-age | Juvenile Passage Status |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Thorne Bay | 3030850 | 0.270 | concrete box | hydraulic | 2002 | 2010 | No perch | 100 | n/a | n/a [4] | 5.0 : 4 | 0 [1] | Gray |
| Thorne Bay | 3030850 | 0.300 | round | simulation | 2002 | 2010 | No perch | 100 | 0.34 | 1.72 | 6.0 : 7 | 0 | Green |
| Thorne Bay | 3030850 | 0.480 | concrete box | hydraulic | 2002 | 2010 | No perch | 100 | n/a | n/a [4] | 0.7 : 3 | 0 | Gray |
| Sitka | 7540CB | 6.827 | arch | simulation | 2000 | 2013 | No perch | 100 | 0.25 | 1.02 | 6.1 : 5 | 0 | Green |
| Sitka | 7540CB | 6.845 | round | simulation | 2000 | 2013 | No perch | 100 | 0.182 | 0.652 | 0.3 : 5 | 0 | Green |
| Sitka | 7540CB | 7.267 | round | simulation | 2004 | 2013 | No perch | 100 | 0.41 | 1.61 | Unk : 1 | 0 | Green |
| Sitka | 7540CB | 7.755 | round | simulation | 2004 | 2013 | No perch | 100 | 0.25 | 1.14 | 4.1 : 4 | 0 | Green |
| Sitka | 7540CB | 8.143 | Round | simulation | 2004 | 2013 | No perch | 100 | 0.39 | 1.56 | 4.6 : 3 | 0 | Green |
| Sitka | 7540CB | 8.184 | round | simulation | 2004 | 2013 | No perch | 100 | 0.38 | 1.72 | 4.3 : 3 | 0 | Green |
| Sitka | 7540CB | 8.980 | round | simulation | 2004 | 2013 | No perch | 100 | 0.31 | 0.81 | 7 : 6.1 | 0 | Green |
| Sitka | 7540CB | 14.008 | round | simulation | 2004 | 2013 | No perch | 100 | 0.37 | 1.00 | 5.7 : 6 | 0 | Green |
| Sitka | 7542 | 0.027 | arch | simulation | 2005 | 2013 | No perch | 100 | 0.22 | 0.78 | 4.5 : 3 | 0 | Green |
| Sitka | 7542 | 0.109 | round | simulation | 2004 | 2013 | No perch | 100 | 0.37 | 1.35 | 1.7 : 1 | 0 | Green |
| Sitka | 7542 | 0.314 | round | simulation | 2004 | 2013 | No perch | 100 | 0.40 | 0.59 | 2.3 : 2 | 0 | Gray |
| Sitka | 7551 | 0.168 | round | simulation | 2004 | 2013 | No perch | 100 | 0.36 | 1.52 | 1.9 : 2 | 0 | Green |
| Ketchikan | 8000000 | 22.413 | round | simulation | 2010 | 2013 | No perch | 100 | 0.27 | 1.13 | 5.8 : 8 | 0 | Green |
| Ketchikan | 8000000 | 22.493 | round | simulation | 2010 | 2013 | No perch | 100 | 0.24 | 1.08 | 3.3 : 12 | 0 | Green |
| Ketchikan | 8040000 | 1.771 | arch | simulation | 2010 | 2013 | No perch | 100 | 0.29 | 0.91 | 4.7 : 9 | 0 | Green |
| Ketchikan | 8040000 | 4.187 | round | simulation | 2010 | 2013 | No perch | 100 | 0.26 | 1.32 | 3.2 : 5 | 0 | Green |
| Ketchikan | 8040000 | 5.134 | arch | simulation | 2010 | 2013 | No perch | 100 | 0.25 | 0.96 | 4.3 : 5 | 0 | Green |
| Hoonah | 8504 | 0.089 | round | no-slope | 1999 | 2014 | No perch | 100 | 0.26 | 0.83 | 0.5: 5 | 0 | Green |
| Hoonah | 8504 | 1.169 | round | no-slope | 1999 | 2014 | No perch | 100 | 0.21 | 0.88 | -0.3 : 4 | 0 | Green |
| Hoonah | 8504 | 1.181 | round | no-slope | 1999 | 2014 | No perch | 100 | 0.13 | 0.88 | 0.5 : 4 | 0 | Green |
| Hoonah | 8513 | 0.273 | round | other | 1999 | 2014 | No perch | 15 | 0.00 | 1.36 | 7 : 21 | 0 | Red |

| District | Road | M.P. | Culvert Type | Design | Year Install-ed | Year Monitor-ed | Culvert Outlet Perch | Percent Culvert Bedload Cover | Ratio Bedload Depth to Culvert Rise | Ratio Stream Bedwidth to Culvert Width | Percent Culvert Gradient to Percent Channel Gradient | Percent Debris Block-age | Juvenile Passage Status |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hoonah | 8513 | 0.954 | round | no-slope | 2000 | 2014 | No perch | 100 | 0.14 | 0.84 | -0.1 : 14 | 0 | Green |
| Hoonah | 8513 | 1.463 | round | no-slope | 2000 | 2014 | No perch | 100 | 0.27 | 0.92 | -0.1 : 9 | 0 | Green |
| Hoonah | 8513 | 1.922 | round | other | 2000 | 2014 | No perch | 100 | 0.08 | 0.61 | 0.8 : 2 | 0 | Gray |
| Hoonah | 8530 | 3.077 | round | simulation | 2005 | 2014 | No perch | 100 | 0.35 | 0.63 | 1.8 : 2 | 0 | Green |
| Hoonah | 8530 | 4.130 | round | simulation | 2005 | 2014 | No perch | 100 | 0.36 | 1.33 | 6.4 : 5 | 0 | Green |
| Hoonah | 8530 | 10.912 | round | no-slope | 2000 | 2014 | No perch | 100 | 0.48 | 0.77 | -0.1 : 2 | 0 | Green |
| Hoonah | 8530 | 13.886 | round | other | 1999 | 2014 | No perch | 100 | 0.10 | 1.4 | 1.8 : 4 | 0 | Gray |
| Hoonah | 8534 | 0.397 | arch | simulation | 2005 | 2014 | No perch | 100 | 0.20 | 1.05 | 4.4 : 6 | 0 | Green |
| Hoonah | 8534 | 1.445 | round | simulation | 2005 | 2014 | No perch | 100 | 0.36 | 0.98 | 7.1 : 9 | 0 | Green |
| Hoonah | 8534 | 1.554 | round | other | 2000 | 2014 | No perch | 100 | 0.04 | 0.78 | 2.9 : 10 | 0 | Red |
| Hoonah | 8534 | 1.895 | round | no-slope | 2000 | 2014 | No perch | 100 | 0.25 | 0.64 | -0.8 : 7 | 0 | Grey |

[1] Culvert was partially blocked by woody debris at initial site visit but was subsequently cleared and fish passage was restored.

[2] Flow is backwatered in the culvert.

[3] There are two culverts installed at this crossing. One is occasionally dewatered at lower flows and acts as an overflow culvert.

[4] Channel is palustrine therefore comparing channel width to culvert width is not as relevant.

[5] At base flows, stream flow through the culvert is subsurface for approximately 60 percent of its length and is most likely due to lack of finer bedload material. Stream flow 50 feet downstream of the culvert has interrupted flow for 5 feet which may naturally also impede fish passage at some flows.

[6] The bedload retaining weirs placed in this culvert have not adequately retained bedload and the retaining weir at the culvert outlet has a 3 inch perch due to an inadequate downstream control. Fifteen feet upstream of the culvert is a 2.7 foot vertical natural fish barrier with a 5 inch jump pool.

[7] Stream crossing structure was not designed to provide fish passage due to it not being identified as a fish stream in the Tongass AOP database prior to installation.

[8] The installed bedload retaining weirs have not retained bedload to the desirable depths and small 0.2 foot vertical drops are present at most weirs.

[9] Furthest downstream rockband in culvert has scoured bedload downstream of it leaving a 0.8 foot drop. Need to potentially raise downstream control and reinsert rock in last several feet of culvert.

[10] No bedload present in upstream 4 feet of culvert however approximately 29 percent bedload depth in remaining section of culvert

[11] Culvert is partially blocked by woody debris and as of report date has not been cleared.

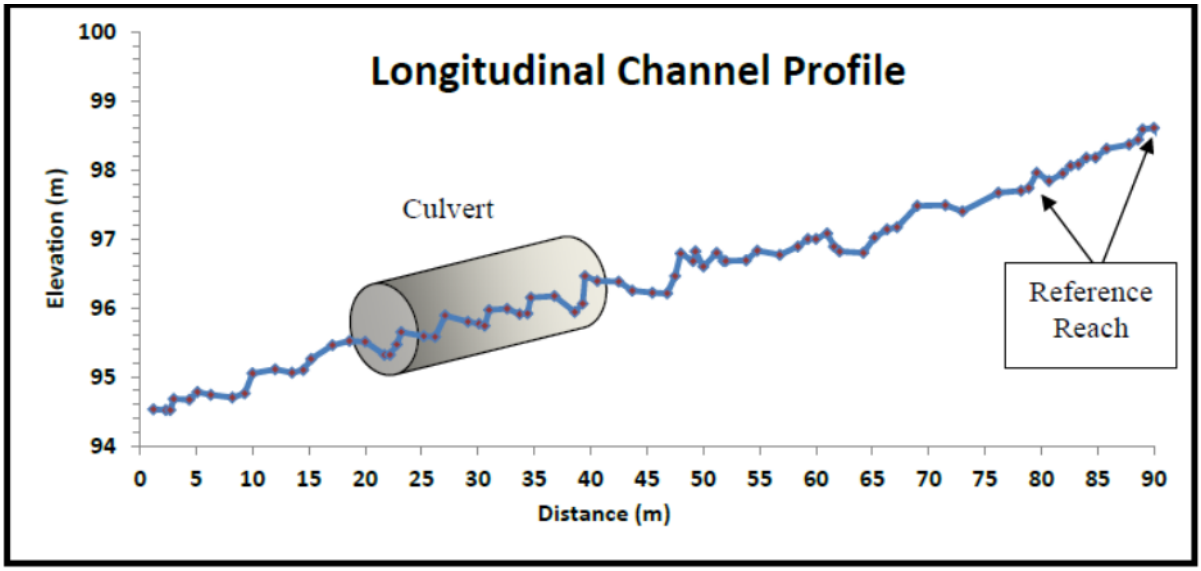
[12] This simplified stream simulation culvert does not have 100 percent bedload cover or does not meet the minimum threshold of 20 percent of bedload depth to culvert rise criteria, however the section without bedload or insufficient bedload depth is backwatered and effective passage is achieved. Bedload material is expected to continue to accumulate in the culvert.

[13] Stream crossing structure was not designed to provide fish passage due to project personnel apparently not aware of fish stream status reported in Tongass AOP database.

In addition to evaluating the stream crossings against the criteria of the Alaska Region's juvenile fish passage criteria matrix, a subsample of stream crossings are assessed by comparing them to adjacent reference reaches. These reference reach surveys include comparisons of longitudinal profile, cross-sectional profile, particle size composition and salt tracer rates. Additional reference reach survey results have been reported in previous Tongass Monitoring and Evaluation Reports.

### Road 3015250 milepost 0.030 (Photos 3 and 4)

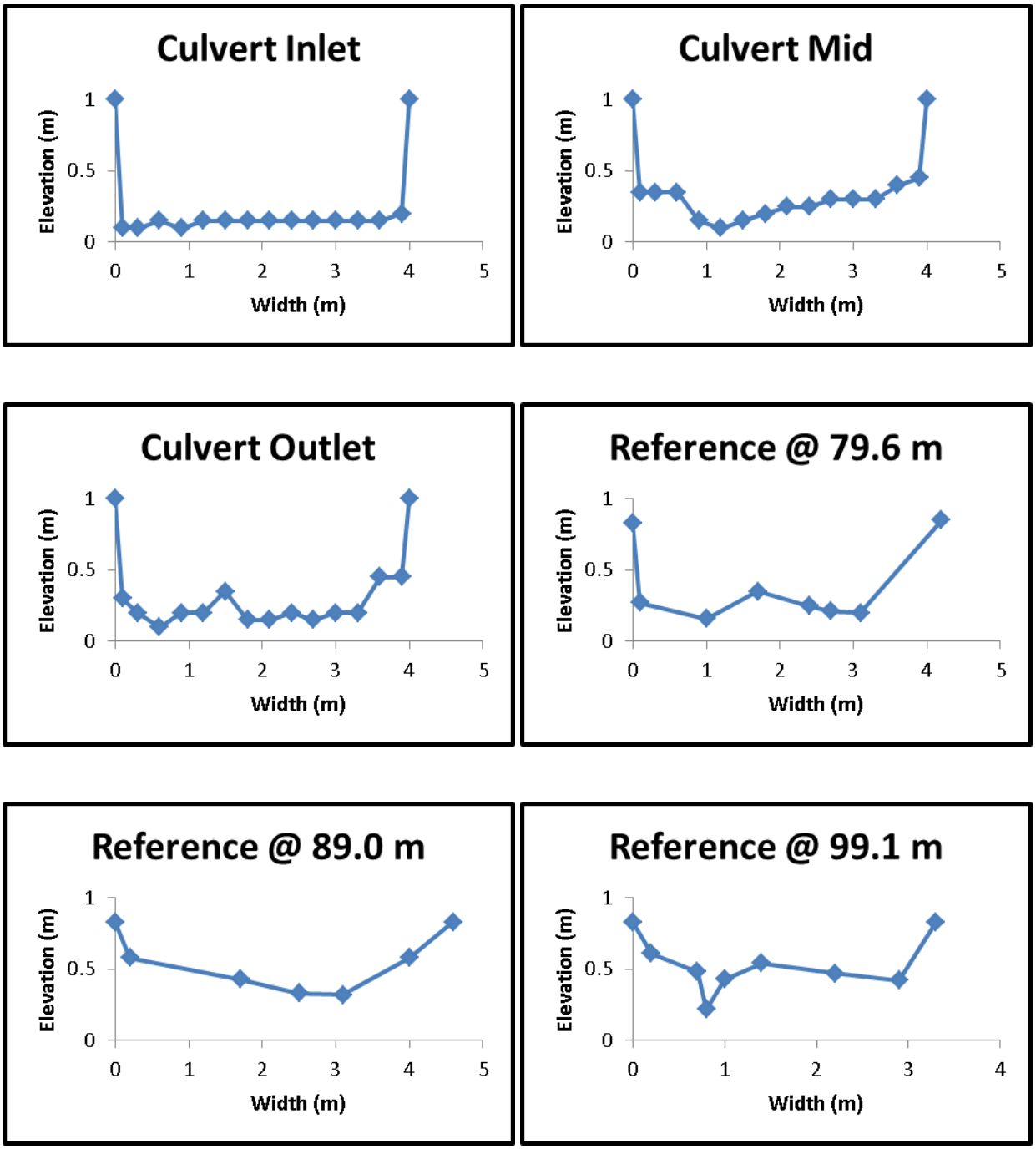
The 144 inches round corrugated metal culvert installation on road 3015250 milepost 0.030 uses a stream simulated design and was installed in 2010 (Photos 3 and 4). It was evaluated by comparing it to an upstream reference reach representative of this section of the stream. The channel in the vicinity of the culvert is a moderate gradient channel with mixed bedrock and alluvium control with a pool-riffle bed form. The channel gradient within the reference reach is 5.8 percent and within the culvert it is 4.8 percent (Figure 3).



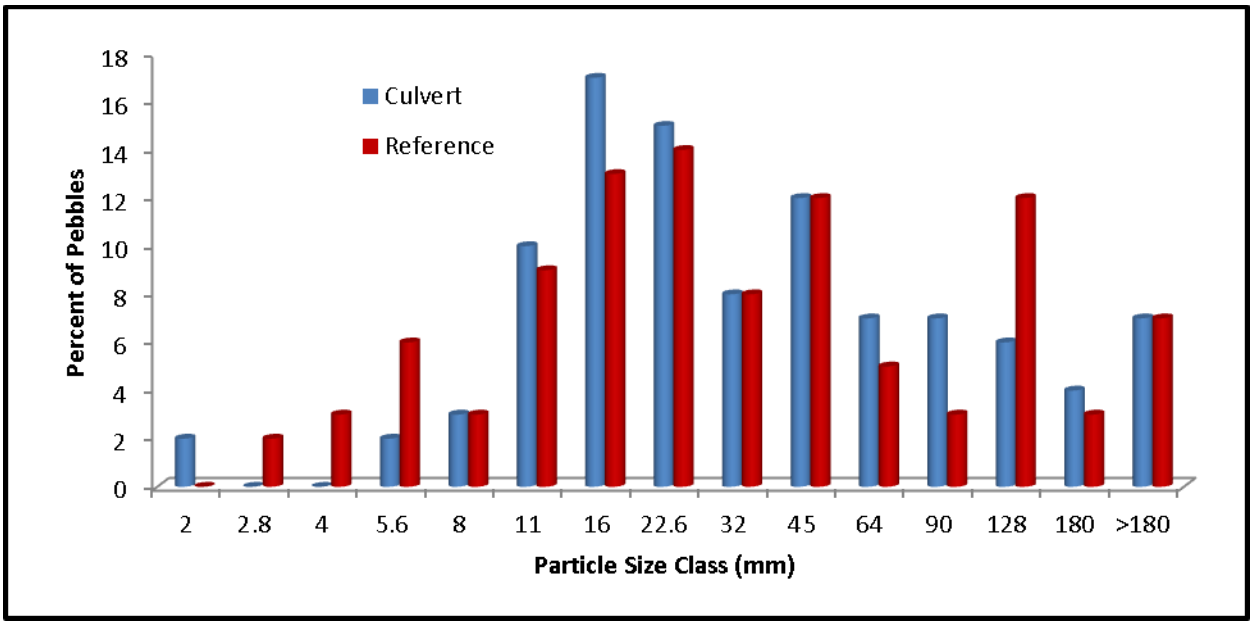

**Stream and Fish Figure 3. Longitudinal channel profile – road 3015250 milepost 0.030**

Cross sectional channel profiles were surveyed at three locations within the culvert and in the reference reach (Figure 4). Stream bed and bankfull width in the culvert is obviously more controlled by the culvert walls and is more contained than the reference reach. Channel bedwidths and profiles within the culvert and reference reach were fairly similar. The bedwidth in the culvert is 3.9 meters and the average bedwidth in the reference reach is 3.1 meters.

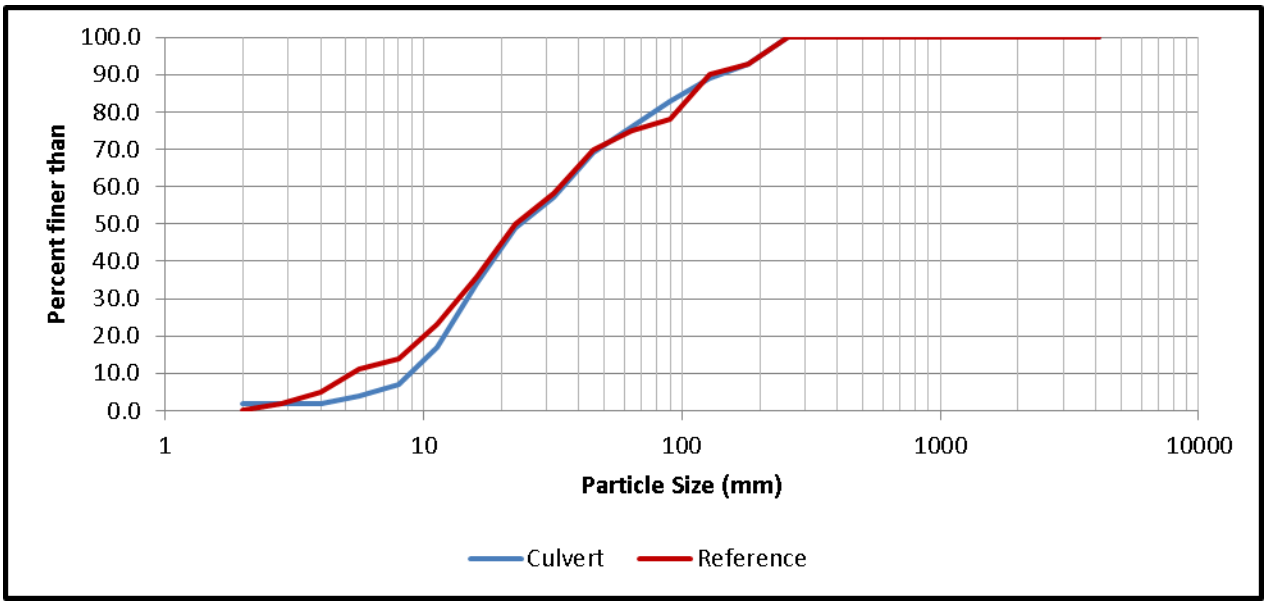
Particle size distribution was measured within the culvert and within the upstream reference reach. Both the reference reach and the culvert particle distribution were well-graded and similar (Figure 5). The median particle size (D50) in the culvert, as well as in the reference reach, is 22.6 mm (Figure 6).




**Stream and Fish Figure 4. Cross-sectional culvert and channel reference profiles – road 3015250 milepost 0.030**




**Stream and Fish Figure 5. Particle size histogram – road 3015250 milepost 0.030**

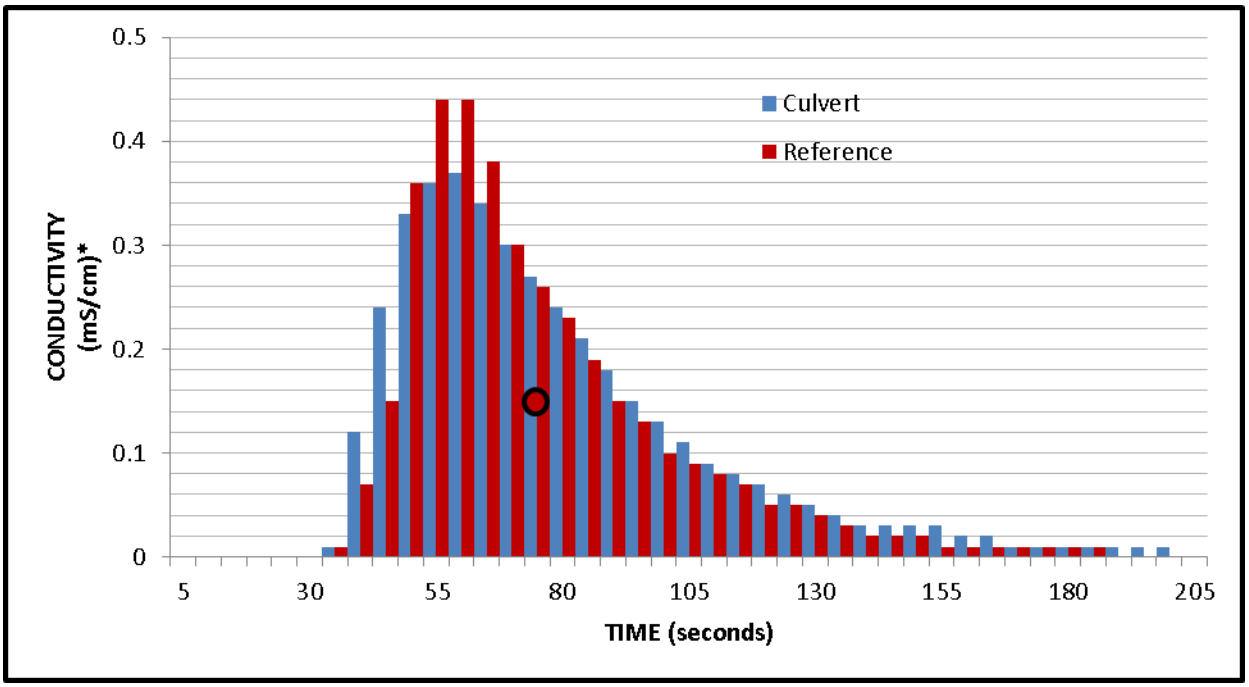



**Stream and Fish Figure 6. Particle size cumulative frequency – road 3015250 milepost 0.030**

The results of the salt tracer comparison indicated a very similar pattern in the flow characteristics within the culvert and reference reach (Figure 7). Results from the calculation of minimum, centroid and maximum flow velocities also indicates similar conditions in the culvert and the reference reach (Table 3).

*Stream and Fish Photo 3. Culvert inlet, road 3015250 milepost 0.030*

*Stream and Fish Photo 4. Culvert bedload, road 3015250 milepost 0.030*




**Stream and Fish Figure 7. Salt tracer – road 3015250 milepost 0.030**

**Stream and Fish Table 3. Salt tracer – road 3015250 milepost 0.030**

| Reach | Maximum Velocity | Centroid Velocity | Minimum Velocity |
|---|---|---|---|
| Culvert | 0.52 meters /sec | 0.25 meters/sec | 0.09 meters/sec |
| Reference | 0.52 meters /sec | 0.26 meters/sec | 0.10 meters/sec |

Road 40000 milepost 3.706 (Photo 5)

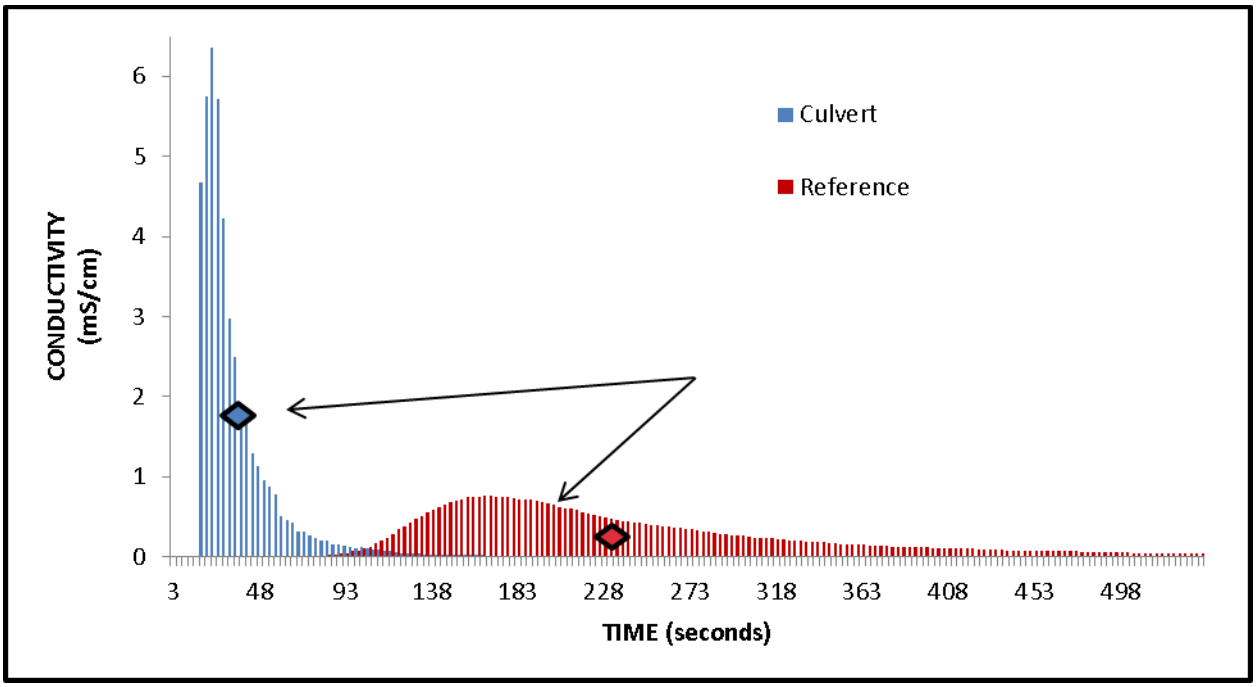
This culvert is an un-remediated stream crossing that does not meet fish passage standards (i.e., red crossing). The evaluation of the un-remediated red culvert was done to provide a relative comparison to that of the remediated culverts.

*Stream and Fish Photo 5. Red culvert, road 40000 milepost 3.706*

The culvert is within a high gradient contained channel with a channel gradient of 8 percent and a bedwidth of 11.7 feet. The structure is a 48 inch round corrugated metal culvert installed at 7 percent with no bedload retention and has a 0.7 feet outlet perch (Photo 5). The culvert is undersized for the channel and the culvert width to channel bedload width ratio is 0.34

The salt trace results clearly indicate the substantial differences in flow velocities between the culvert and an upstream reference reach (Photo 6, Figure 8). Obviously this culvert does not match the flow conditions found within the reference reach and is assumed to impair the efficient passage of fish. The maximum, centroid and minimum velocities of the sodium chloride solution are not similar (Table 4).

*Stream and Fish Photo 6. Reference reach, road 40000 milepost 3.706*




**Stream and Fish Figure 8. Salt tracer – road 40000 milepost 3.706**

**Stream and Fish Table 4. Road 40000 milepost 3.706 salt tracer velocities**

| Reach | Maximum Velocity | Centroid Velocity | Minimum Velocity |
|---|---|---|---|
| Culvert | 0.97 meters /sec | 0.41 meters/sec | 0.09 meters/sec |
| Reference | 0.68 meters /sec | 0.06 meters/sec | 0.02 meters/sec |

## Minimally Engineered Aquatic Organism Passage (MEAOP) Designed Culverts

In an effort to reduce the significant costs associated with the survey, design and installation of culverts intended to provide fish passage, the Tongass National Forest has installed four culverts in 2012 five in 2013 and seven in 2014 using a design coined minimally engineered aquatic organism passage (MEAOP).

This approach strives to produce, overtime, stream conditions in the culvert that are reasonably similar to that found in the natural stream. Similar to stream simulated designed culverts, the goal is to create fish passage conditions in the culvert which reasonably mirror that of the natural channel by attempting to match stream gradient, width and bedload roughness. The general process involves embedding a properly sized culvert then depositing (surcharging) bedload material, sized to be capable of mobilizing at high flows, in the channel immediately upstream of the culvert (Photo 7). The expectation is that the material will mobilize, be deposited and retained in the embedded culvert.

The MEAOP design contrasts with stream simulation design in a few important ways. Stream simulation design typically entails a more comprehensive stream survey and engineering analysis which potentially reduces the risk of adverse effects. The most noticeable visual difference is an improved matching of the natural channels, roughness, bedform, diversity of stream velocities, depths and widths due to the greater attention to bedload size selection and placement within the culvert of a steam simulated designed structure.

The MEAOP design is an experimental design concept and monitoring is conducted annually by Tongass personnel on all of the installations. All 16 MEAOP designed culverts were monitored in 2014 after flow events significant enough to mobilize the surcharged bedload material deposited upstream of the culvert.

*Stream and Fish Photo 7. MEAOP culvert with surcharge material upstream of culvert*

During 2014 the 9 MEAOP culverts installed in 2012 and 2013 were also evaluated by the Forest Service's Washington Office Virtual AOP Design Assistance Team (Gubernick and Weinhold 2015). The intent of this review was to look at how well the structures were performing and gain insight on how subsequent MEAOP installations might be modified in the following years. Some of the recommendations from the review have already been incorporated into several 2015 MEAOP installations.

## MEAOP – 2014 Installations

### Road 6259 milepost 2.334 (Photo 8)

Approximately 6 inches minus surcharged material was placed in the channel upstream of the culvert. Finer surcharge material is evident downstream of culvert. The installation was found to be adequate for fish passage (Table 5). Less than 1 cubic yard of the surcharged material remains upstream of the culvert following a high flow.

**Stream and Fish Table 5. Road 6259 milepost 2.334; culvert specifications**

| | |
|---|---|
| Size | 60" x 90" x 42' |
| Culvert gradient/natural channel gradient | 4.0 percent / 4.0 percent |
| Percent of culvert length with bedload material | 100 percent |
| Bedload depth to culvert rise proportion at inlet/outlet | 0.06 / 0.32 |
| Bedload particle size in culvert/natural channel | Gravel Cobble / Sand Gravel Organic |
| Culvert width to channel bedwidth proportion | 1.21 |
| Outlet perch present | No |
| Backwatered flow conditions | 0 percent of length |
| Headcutting evident | No |
| Debris blockage present | No |

Culvert outlet, looking upstream

Culvert inlet, looking downstream

Culvert barrel, looking upstream

Culvert barrel, looking downstream

*Stream and Fish Photo 8. MEAOP designed culvert, road 6259 milepost 2.334*

## Road 6259 milepost 2.782 (Photo 9)

Design specifications required that 1.5 inches minus surcharged material be placed in the channel upstream of the culvert. The installation was found to be adequate for fish passage (Table 6). The inlet is poorly armored. Less than 1 cubic yard of the surcharged material remains upstream of the culvert following a high flow.

**Stream and Fish Table 6. Road 6259 milepost 2.782; culvert specifications**

| | |
|---|---|
| Size | 43” x 52” x 38’ |
| Culvert gradient/natural channel gradient | 4.0 percent / 3.0 percent |
| Percent of culvert length with bedload material | 100 percent |
| Bedload depth to culvert rise proportion at inlet/outlet | 0.11 / 0.39 |
| Bedload particle size in culvert/natural channel | Gravel Sand / Gravel Cobble Sand |
| Culvert width to channel bedwidth proportion | 0.63 |
| Outlet perch present | No |
| Backwatered flow conditions | 98 percent of length |
| Headcutting evident | No |
| Debris blockage present | No |

Culvert outlet, looking upstream

Culvert inlet, looking downstream

Culvert barrel, looking upstream

Culvert barrel, looking downstream

*Stream and Fish Photo 9. MEAOP designed culvert, road 6259 milepost 2.782*

Road 6259 milepost 2.787 (Photo 10)

Design specifications required that 1.5 inches minus surcharged material be placed in the channel upstream of the culvert. The installation was found to be adequate for fish passage (Table 7). Approximately 2 cubic yards of the surcharged material remains upstream of the culvert following a high flow.

**Stream and Fish Table 7. Road 6259 milepost 2.787; culvert specifications**

| | |
|---|---|
| Size | 44” x 51” x 40’ |
| Culvert gradient/natural channel gradient | 3.7 percent / 3.0 percent |
| Percent of culvert length with bedload material | 70 percent |
| Bedload depth to culvert rise proportion at inlet/outlet | 0.0 / 0.26 |
| Bedload particle size in culvert/natural channel | Gravel Sand / Gravel Cobble Organic |
| Culvert width to channel bedwidth proportion | 0.84 |
| Outlet perch present | No |
| Backwatered flow conditions | 100 percent of length |
| Headcutting evident | No |
| Debris blockage present | No |

Culvert outlet, looking upstream

Culvert inlet, looking downstream

Culvert barrel, looking upstream

Culvert barrel, looking downstream

*Stream and Fish Photo 10. MEAOP designed culvert, road 6259 milepost 2.787*

Road 50054 milepost 0.033 (Photo 11)

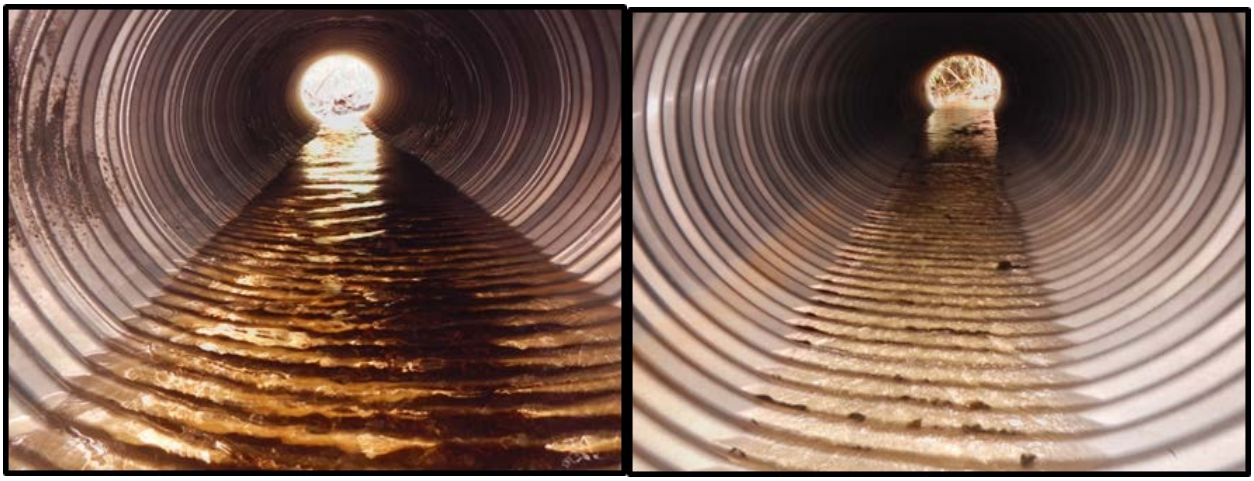
Design specifications required that 1.5 inches minus surcharged material be placed in the channel upstream of the culvert. The installation was found not to be adequate for fish passage (Table 8). A headcut is present upstream. Approximately 2 cubic yards of the surcharged material remains upstream of the culvert following a high flow.

**Stream and Fish Table 8. Road 50054 milepost 0.033; culvert specifications**

| | |
|---|---|
| Size | 44” x 53” x 33’ |
| Culvert gradient/natural channel gradient | 2.2 percent / 5.0 percent |
| Percent of culvert length with bedload material | 0 percent |
| Bedload depth to culvert rise proportion at inlet/outlet | 0.07 / 0.12 |
| Bedload particle size in culvert/natural channel | None / Gravel, Cobble, Organic |
| Culvert width to channel bedwidth proportion | 0.88 |
| Outlet perch present | No |
| Backwatered flow conditions | Only 25 percent of length |
| Headcutting evident | Yes |
| Debris blockage present | No |

Culvert outlet, looking upstream

Culvert inlet, looking downstream



Culvert barrel, looking upstream  Culvert barrel, looking downstream

*Stream and Fish Photo 11. MEAPOP designed culvert, road 50054 milepost 0.033*

## Road 50054 milepost 0.063 MEAOP (Photo 12)

Design specifications required that 1.5 inches minus surcharged material be placed in the channel upstream of the culvert. The installation was found to be adequate for fish passage (Table 9). None of the surcharged material remains upstream of the culvert following a high flow.

**Stream and Fish Table 9. Road 50054 milepost 0.063; culvert specifications**

| | |
|---|---|
| Size | 36” x 36” x 32’ |
| Culvert gradient/natural channel gradient | 1.3 percent / 1.0 percent |
| Percent of culvert length with bedload material | 100 percent |
| Bedload depth to culvert rise proportion at inlet/outlet | 0.07 / 0.12 |
| Bedload particle size in culvert/natural channel | Gravel & Sand / Sand, Silt, Organic |
| Culvert width to channel bedwidth proportion | 0.80 |
| Outlet perch present | No |
| Backwatered flow conditions | 90 percent of culvert length |
| Headcutting evident | No |
| Debris blockage present | No |

Culvert outlet, looking upstream

Culvert inlet, looking downstream

Culvert barrel, looking upstream

Culvert barrel, looking downstream

*Stream and Fish Photo 12. MEAOP designed culvert, road 50054, milepost 0.063*

Road 50024 milepost 0.086 (Photo 13)

Design specifications required that 1.5 inches minus surcharged material be placed in the channel upstream of the culvert. The installation was found to be adequate for fish passage (Table 10). Approximately 1 cubic yard of surcharged material remains upstream of the culvert following a high flow.

**Stream and Fish Table 10. Road 50024 milepost 0.086; culvert specifications**

| | |
|---|---|
| Size | 36 ”x 36” x 28’ |
| Culvert gradient/natural channel gradient | 1.5 percent / 3.0 percent |
| Percent of culvert length with bedload material | 100 percent |
| Bedload depth to culvert rise proportion at inlet/outlet | 0.19 / 0.09 |
| Bedload particle size in culvert/natural channel | Gravel & Sand / Sand & Silt |
| Culvert width to channel bedwidth proportion | 0.95 |
| Outlet perch present | No |
| Backwatered flow conditions | Only 85 percent of length |
| Headcutting evident | No |
| Debris blockage present | No |

Culvert outlet, looking upstream

Culvert inlet, looking downstream

Culvert barrel, looking upstream

Culvert barrel, looking downstream

*Stream and Fish Photo 13. MEAOP designed culvert, road 50024 milepost 0.086*

## Road 50055 milepost 0.031 (Photo 14)

Design specifications required that 6 inches minus surcharged material be placed in the channel upstream of the culvert and in-filled approximately 6 feet from each end of the culvert to a depth of 1.0 feet. The installation was found to be adequate for fish passage (Table 11). A small amount of surcharged material remains upstream of the culvert following a high flow.

**Stream and Fish Table 11. Road 50055 milepost 0.031; culvert specifications**

| | |
|---|---|
| Size | 55” x 73” x 40’ |
| Culvert gradient/natural channel gradient | 2.5 percent / 2.0 percent |
| Percent of culvert length with bedload material | 100 percent |
| Bedload depth to culvert rise proportion at inlet/outlet | 0.05 / 0.08 |
| Bedload particle size in culvert/natural channel | Sand & Gravel / Gravel & Sand |
| Culvert width to channel bedwidth proportion | 1.69 |
| Outlet perch present | No |
| Backwatered flow conditions | Only 66 percent of length |
| Headcutting evident | No |
| Debris blockage present | No |

Culvert outlet, looking upstream

Culvert inlet, looking downstream

Culvert barrel, looking upstream

Culvert barrel, looking downstream

*Stream and Fish Photo 14. MEAOP designed culvert, road 50055 milepost 0.031*

## MEAOP – 2013 Installations

The 2013 MEAOP installed culverts were monitored in both 2013 and 2014.

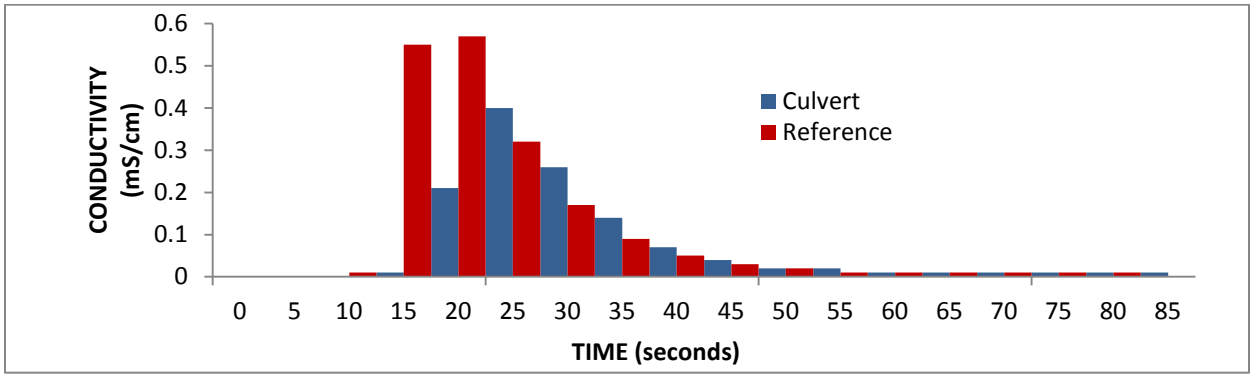
### Road 2085000 milepost 0.944 (Photo 15)

Design specifications required that surcharged material deposited upstream of the culvert and in-filled approximately 6 feet from each end of the culvert to a depth of 1.5 feet. The installation was found to be adequate for fish passage (Table 12). Following a high flow a substantial amount of the surcharged material deposited upstream of the culvert still remained. Much of this material is above bankfull and will most likely not be mobilized into the culvert during usual high flow events.

**Stream and Fish Table 12. Road 2085000 milepost 0.944; culvert specifications**

| | |
|---|---|
| Size | 55" x 73 "x 38' |
| Culvert gradient/natural channel gradient | 2013: 3.8 percent / 4.5 percent |
| Percent of culvert length with bedload material | 2013: 100 percent 2014: 100 percent |
| Bedload depth to culvert rise proportion at inlet/outlet | 2013: 0.30 / 0.26 2014: 0.30 / 0.28 |
| Bedload particle size in culvert/natural channel | Gravel & Cobble / Gravel & Cobble |
| Culvert width to channel bedwidth proportion | 1.16 |
| Outlet perch present | No |
| Backwatered flow conditions | No |
| Headcutting evident | Yes |
| Debris blockage present | No |

In addition to assessing the culvert with the criteria of the fish passage matrix a comparison of culvert conditions to a reference reach was completed with a salt trace. The results of the salt trace comparison indicated a fairly similar pattern in the flow characteristics within the culvert and reference reach (Figure 9). The minimum, centroid and maximum flow velocities were computed from the salt trace and are presented in Table 13.




**Stream and Fish Figure 9. Salt tracer, road 2085000 milepost 0.944 - 2013**

**Stream and Fish Table 13. Road 2085000 milepost 0.944 salt tracer velocities (2013)**

| Reach | Maximum Velocity | Centroid Velocity | Minimum Velocity |
|---|---|---|---|
| Culvert | 0.77 meters /sec | 0.25 meters/sec | 0.14 meters/sec |
| Reference | 1.16 meters /sec | 0.27 meters/sec | 0.15 meters/sec |

Culvert outlet, looking upstream in 2013 and 2014

Culvert inlet, looking downstream in 2013 and 2014

Culvert barrel, looking upstream in 2013 and 2014

Culvert barrel, looking downstream in 2013 and 2014

*Stream and Fish Photo 15. MEAOP designed culvert, road 2085000 milepost 0.944*

## Road 2000000 milepost 122.678 (Photo 16)

Design specifications required that surcharged material be in-filled approximately 6 feet from each end of the culvert to a depth of 1.0 feet and placed upstream of the culvert. The installation was found to be adequate for fish passage (Table 14). The culvert has 40 percent of its length covered with bedload material but the section of the culvert without bedload was backwatered.

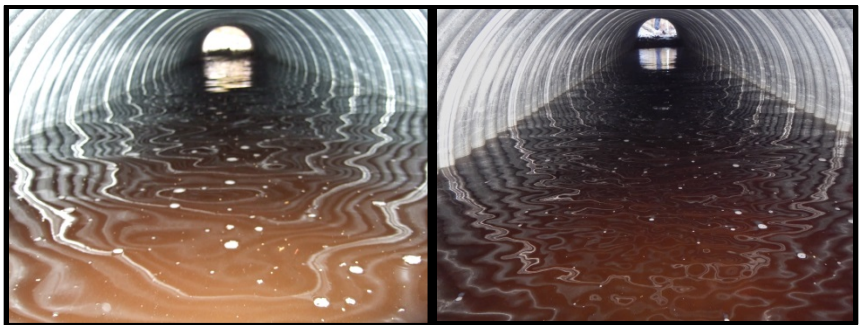
Following a high flow approximately 3 cubic yards of the surcharged material deposited upstream of the culvert still remained. Much of this material is above bankfull and will most likely not be mobilized into the culvert during usual high flow events. No native bedload material has mobilized into the culvert and is not likely to due to palustine character of the stream.

**Stream and Fish Table 14. Road 2000000 milepost 122.678; culvert specifications**

| | | |
|---|---|---|
| Size | 46” x 60” x 46’ | |
| Culvert gradient/natural channel gradient | 3.8 percent / 4.5 percent | |
| Percent of culvert length with bedload material | 2013: 38 percent | 2014: 40 percent |
| Bedload depth to culvert rise proportion at inlet/outlet | 2013: 0.37 / 0.22 | 2014: 0.43 / 0.22 |
| Bedload particle size in culvert/natural channel | Gravel & Cobble / Silt & Organics | |
| Culvert width to channel bedwidth proportion | 1.39 | |
| Outlet perch present | No | |
| Backwatered flow conditions | 72 percent of culvert length | |
| Headcutting evident | No | |
| Debris blockage present | No | |

Culvert outlet, looking upstream in 2013 and 2014

Culvert inlet, looking downstream in 2013 and 2014



Culvert barrel, looking upstream in 2013 and 2014

Culvert barrel, looking downstream in 2013 and 2014

*Stream and Fish Photo 16. MEAOP designed culvert, road 2000000 milepost 122.678*

## Road 2000000 milepost 125.242 (Photo 17)

Design specifications required that surcharged material be in-filled approximately 10 feet from each end of the culvert to a depth of 2.0 feet as well as upstream of the culvert for stream flow mobilization. The installation was found to be adequate for fish passage (Table 14). The culvert has 100 percent of its length covered with bedload material which is an increase from the previous year.

Following a high flow, approximately 5 cubic yards of the surcharged material deposited upstream of the culvert still remained. Much of this material is above bankfull and will most likely not be mobilized into the culvert during usual high flow events. Approximately 20 percent of the bedload within the culvert is composed of native material.

**Stream and Fish Table 15. Road 2000000 milepost 125.242; culvert specifications**

| | | |
|---|---|---|
| Size | 101” x 157” x 65’ mitered inlet and outlet | |
| Culvert gradient/natural channel gradient | 1.8 percent / 3.5 percent | |
| Percent of culvert length with bedload material | 2013: 86 percent | 2014: 100 percent |
| Bedload depth to culvert rise proportion at inlet/outlet | 2013: 0.23 / 0.17 | 2014: 0.20 / 0.16 |
| Bedload particle size in culvert/natural channel | Gravel, Cobble, Sand/Gravel, Cobble, Sand | |
| Culvert width to channel bedwidth proportion | 1.09 | |
| Outlet perch present | No | |
| Backwatered flow conditions | Yes, 35 percent of culvert length | |
| Headcutting evident | Yes | |
| Debris blockage present | No | |

Culvert outlet, looking upstream in 2013 and 2014

Culvert inlet, looking downstream in 2013 and 2014

Culvert barrel, looking upstream in 2013 and 2014

Culvert barrel, looking downstream in 2013 and 2014

*Streams and Fish Photo 17. MEAOP designed culvert, road 2000000 milepost 125.242*

## Road 2000860 milepost 0.659 (Photo 18)

Design specifications required that surcharged material be in-filled approximately 8 feet from each end of the culvert to a depth of 2.0 feet as well as upstream of the culvert for stream flow mobilization. The installation was found to be adequate for fish passage (Table 16). The culvert has 100 percent of its length covered with bedload material which is a significant increase from the previous year.

Following a high flow approximately 2 cubic yards of the surcharged material deposited upstream of the culvert still remained. Much of this material is above bankfull and will most likely not be mobilized into the culvert during usual high flow events. The bedload within the culvert is a mix of native and surcharge material.

**Stream and Fish Table 16. Road 2000860 milepost 0.659; culvert specifications**

| | | |
|---|---|---|
| Size | 67” x 95” x 35’ | |
| Culvert gradient/natural channel gradient | 2.7 percent / 3.5 percent | |
| Percent of culvert length with bedload material | 2013: 54 percent | 2014: 100 percent |
| Bedload depth to culvert rise proportion at inlet/outlet | 2013: 0.30 / 0.25 | 2014: 0.34 / 0.26 |
| Bedload particle size in culvert/natural channel | Gravel, Sand, Cobble / Gravel, Sand, Cobble | |
| Culvert width to channel bedwidth proportion | 1.01 | |
| Outlet perch present | No | |
| Backwatered flow conditions | No | |
| Headcutting evident | Yes | |
| Debris blockage present | No | |

Culvert outlet, looking upstream in 2013 and 2014

Culvert inlet, looking downstream in 2013 and 2014

Culvert barrel, looking upstream in 2013 and 2014

Culvert barrel, looking downstream in 2013 and 2014

*Stream and Fish Photo 18. MEAOP designed culvert, road 2000860 milepost 0.659*

## Road 3000000 milepost 89.221 (Photo 19)

Design specifications required that surcharged material be in-filled approximately 6 feet from each end of the culvert to a depth of 1.5 feet as well as upstream of the culvert for stream flow mobilization. The installation was found to be adequate for fish passage (Table 17). The culvert has 100 percent of its length covered with bedload material, which is a significant increase from the previous year. Approximately 10 percent of the culvert bedload is native material.

Following a high flow surcharged material deposited upstream of the culvert still remained. Much of this material is above bankfull and will most likely not be mobilized into the culvert during usual high flow events.

**Stream and Fish Table 17. Road 3000000 milepost 89.221; culvert specifications**

| | | |
|---|---|---|
| Size | 55” x 73” x 65’ | |
| Culvert gradient/natural channel gradient | 3.8 percent / 6.5 percent | |
| Percent of culvert length with bedload material | 2013: 54 percent | 2014: 100 percent |
| Bedload depth to culvert rise proportion at inlet/outlet | 2013: 0.15 / 0.21 | 2014: 0.17 / 0.24 |
| Bedload particle size in culvert/natural channel | Gravel, Cobble, Sand / Gravel, Cobble, Sand | |
| Culvert width to channel bedwidth proportion | 1.19 | |
| Outlet perch present | No | |
| Backwatered flow conditions | 11 percent of culvert length | |
| Headcutting evident | No | |
| Debris blockage present | No | |

Culvert outlet, looking upstream in 2013 and 2014

Culvert inlet, looking downstream in 2013 and 2014

Culvert barrel, looking upstream in 2013 and 2014

Culvert barrel, looking downstream in 2013 and 2014

*Stream and Fish Photo 19. MEAOP designed culvert, road 3000000 milepost 89.221*

## MEAOP – 2012 Installations

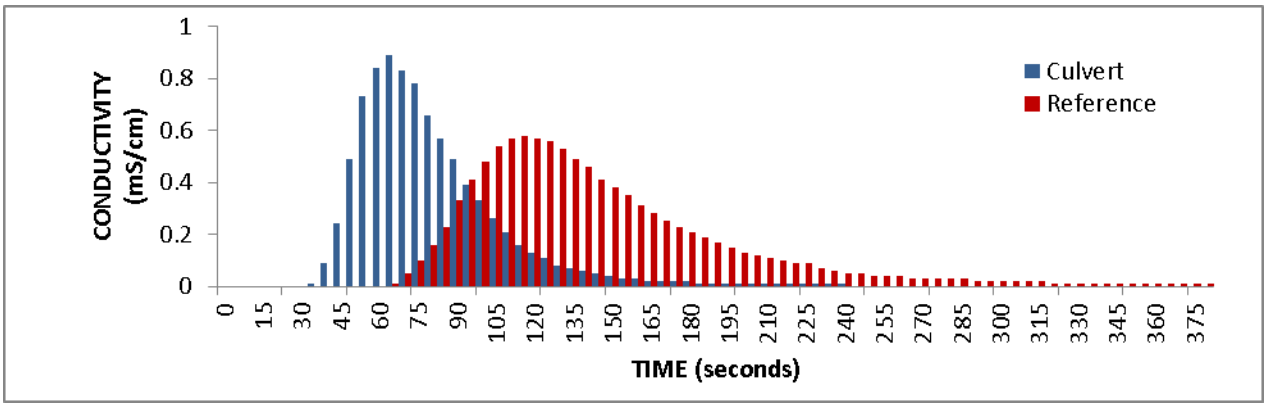
The 2012 MEAOP installed culverts were monitored in 2012, 2013 and 2014.

### Road 3015000 milepost 1.773 (Picture 20)

The MEAOP designed culvert was found not to be adequate for fish passage using the Alaska Region's Juvenile Fish Passage Criteria Matrix (Table 18). There is loss of bedload material at the inlet due to a potentially poorly located rock grade control causing scour. In addition to assessing the culvert with the criteria of the fish passage matrix a comparison of culvert conditions to a reference reach was completed with a salt trace. The results of the salt trace comparison indicated a dissimilar pattern in the flow characteristics within the culvert and reference reach (Figure 10). The minimum, centroid and maximum flow velocities were computed from the salt trace and are presented in Table 19.

**Stream and Fish Table 18. Road 3015000 milepost 1.773; culvert specifications**

| | |
|---|---|
| Size | 46" x 60" x 40' |
| Culvert gradient/natural channel gradient | 3.5 percent / 10 percent |
| Percent of culvert length with bedload material | 2012: 100 percent 2013: 100 percent 2014: 98 percent |
| Bedload depth to culvert rise proportion at inlet/outlet | 2012: 0.09 / 0.11 2013: 0.14 / 0.17 2014: 0.00 / 0.20 |
| Bedload particle size in culvert/natural channel | Gravel, Cobble, Sand / Gravel, Sand, Cobble |
| Culvert width to channel bedwidth proportion | 0.76 |
| Outlet perch present | No |
| Backwatered flow conditions | No |
| Headcutting evident | No |
| Debris blockage present | No |




**Stream and Fish Figure 10. Salt tracer - road 3015000 milepost 1.773 (2013)**

**Stream and Fish Table 19. Road 3015000 milepost 1.773 salt tracer velocities (2013)**

| Reach | Maximum Velocity | Centroid Velocity | Minimum Velocity |
|---|---|---|---|
| Culvert | 0.77 meters /sec | 0.25 meters/sec | 0.14 meters/sec |
| Reference | 1.16 meters /sec | 0.27 meters/sec | 0.15 meters/sec |

Culvert outlet, looking upstream

2012 2013 2014

Culvert inlet, looking downstream

2012 2013 2014

Culvert barrel, looking upstream

2012 2013 2014

Culvert barrel, looking downstream

2012 2013 2014

*Stream and Fish Photo 20. MEAOP designed culvert, road 3015000 milepost 1.773*

## Road 3015000 Milepost 8.743 (Photo 21)

The MEAOP designed culvert was found to be adequate for fish passage using the Alaska Region's juvenile fish passage criteria matrix. The extent and depth of the bedload in the culvert increased dramatically from previous years (Table 20). Approximately 2 cubic yards of the surcharged material deposited upstream of the culvert still remains following several high flow events. Much of this material is above bankfull and will most likely not be mobilized into the culvert during usual high flow events.

**Stream and Fish Table 20. Road 3015000 milepost 8.743; culvert specifications**

| | | | |
|---|---|---|---|
| Size | 63" x 87" x 32' | | |
| Culvert gradient/natural channel gradient | 4.2 percent / 7.5 percent | | |
| Percent of culvert length with bedload material | 2012: 50 percent percent | 2013: 58 percent | 2014: 100 |
| Bedload depth to culvert rise proportion at inlet/outlet | 2012: 0.30 / 0.00 049 | 2013: 0.31 / 0.00 | 2014: 034 / |
| Bedload particle size in culvert/natural channel | Gravel, Cobble, Sand / Gravel, Sand, Cobble | | |
| Culvert width to channel bedwidth proportion | 1.34 | | |
| Outlet perch present | No | | |
| Backwatered flow conditions | No | | |
| Headcutting evident | Yes | | |
| Debris blockage present | No | | |

Culvert outlet, looking upstream

2012 2013 2014

Culvert inlet, looking downstream

2012 2013 2014

Culvert barrel, looking upstream

2012 2013 2014

Culvert barrel, looking downstream

2012 2013 2014

*Stream and Fish Photo 21. MEAOP, road 3015000 milepost 8.743*

## Road 2000000 milepost 102.907 (Photo 22)

The culvert was found to be adequate for fish passage using the Alaska Region's Juvenile Fish Passage Criteria Matrix (Table 21). The depth of bedload in the culvert inlet has decreased from the previous year due to poor culvert alignment with the stream channel. Bedload material and flow velocities are variable transversely within the culvert. Approximately 90 percent of the surface bedload in the culvert is native material. Surcharge material is distributed downstream of the culvert to approximately 200 feet. Approximately 3 cubic yards of the surcharged material deposited upstream of the culvert still remains following several high flow events. Much of this material is above bankfull and will most likely not be mobilized into the culvert during usual high flow events.

**Stream and Fish Table 21. Road 2000000 milepost 102.907; culvert specifications**

| | |
|---|---|
| Size | 110” x 171” x 40’ mitered inlet and outlet |
| Culvert gradient/natural channel gradient | 1 percent / 2 percent |
| Percent of culvert length with bedload material | 2012: 100 percent 2013: 100 percent 2014: 100 percent |
| Bedload depth to culvert rise proportion at inlet/outlet | 2012: 0.12 / 0.18 2013: 0.18 / 0.24 2014: 0.05 / 0.37 |
| Culvert width to channel bedwidth proportion | 0.94 |
| Outlet perch present | No |
| Backwatered flow conditions | 0 percent of culvert length |
| Headcutting evident | Yes |
| Debris blockage present | No |

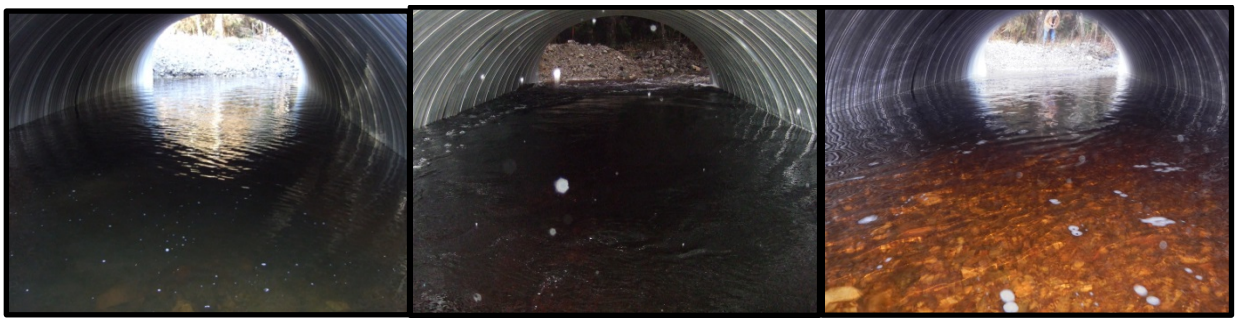
Culvert outlet, looking upstream

2012 2013 2014

Culvert inlet, looking downstream

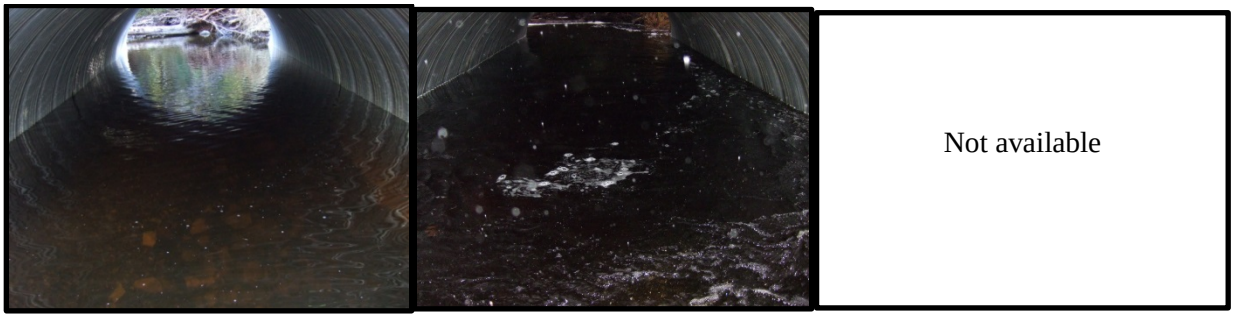
2012 2013 2014

Culvert barrel, looking upstream



2012 2013 2014

Culvert barrel, looking downstream




2012 2013 2014

*Stream and Fish Photo 22. MEAOP designed culvert, road 2000000 milepost 102.907*

## Road 2700000 milepost 0.710 (Photos 23 and 24)

The culvert was found to be adequate for fish passage using the Alaska Region's juvenile fish passage criteria matrix. The extent and depth of bedload in the culvert has increased significantly from the previous year (Table 22). The bedload material at the inlet is mostly native material (80 percent) while at the outlet it is present to a much lesser extent (10 percent). The culvert installation has undermined existing upstream grade controls. This has caused a headcut which has hit a bedrock ledge causing a potential fish migration barrier. It is anticipated that that the headcut will continue to advance upstream once a woody debris grade control on the bedrock lip fails (Photo 23). A few cubic yards of the surcharged material deposited upstream of the culvert still remains following several high flow events. Much of this material is above bankfull and will most likely not be mobilized into the culvert during usual high flow events.

*Stream and Fish Photo 23. Headcut upstream of road 2700000 milepost 0.710*

**Stream and Fish Table 22. Road 2700000 milepost 0.710; culvert specifications**

| | |
|---|---|
| Size | 71" x 103" x 42' |
| Culvert gradient/natural channel gradient | 3.0 percent / 2.5 percent |
| Percent of culvert length with bedload material | 2012: 45 percent 2013: 45 percent<br>2014: 100 percent |
| Bedload depth to culvert rise proportion at inlet/outlet | 2012: 0.31 / 0.00 2013: 0.31 / 0.00<br>2014: 0.34 / 0.17 |
| Culvert width to channel bedwidth proportion | 1.36 |
| Outlet perch present | No |
| Backwatered flow conditions | Yes, 88 percent of culvert length |
| Headcutting evident | Yes |
| Debris blockage present | No |

An additional assessment was completed at this stream crossing to evaluate how similar physical and hydraulic conditions are within the structure and at the inlet and outlet transition zones compared to that of a nearby representative stream reach. The assessment compared bankfull width, wetted width, maximum depth, key particle sizes and bank irregularity (i.e., frequency of protrusions). The analysis calculates the median, 25 percent and 75 percent quartile and minimum and maximum measured values for the reference reach which is compared to measurements within the structure and at the inlet and outlet transition zones. These values are used to determine a relative rating. Poor ratings were given to the bankfull width within the culvert, over-widened channel widths at the outlet and uniform bank configuration in the culvert (Table 23).

Culvert gradient is comparable with that of the natural channel but the culvert bed profile is homogenous and does not mimic the step-pool bedform of the channel (Figure 11).

**Stream and Fish Table 23. Road 2700000 milepost 0.710; reference reach comparison**

**Bankfull Width Comparison**

| Bankfull Width (ft) | Minimum | 25 percent Quartile | Median | 75 percent Quartile | Maximum | Rating |
|---|---|---|---|---|---|---|
| Reference Reach | 9.4 | 11.4 | 13.4 | 13.65 | 15.5 | N/A |
| Structure | 8.4 | 8.4 | 8.4 | 8.4 | 8.4 | Poor |
| Inlet Transition | 8.5 | 9.7 | 10.8 | 11.6 | 17 | At-Risk |
| Outlet Transition | 10.6 | 12.2 | 13.2 | 13.65 | 14.3 | Good |

**Wetted Width Comparison**

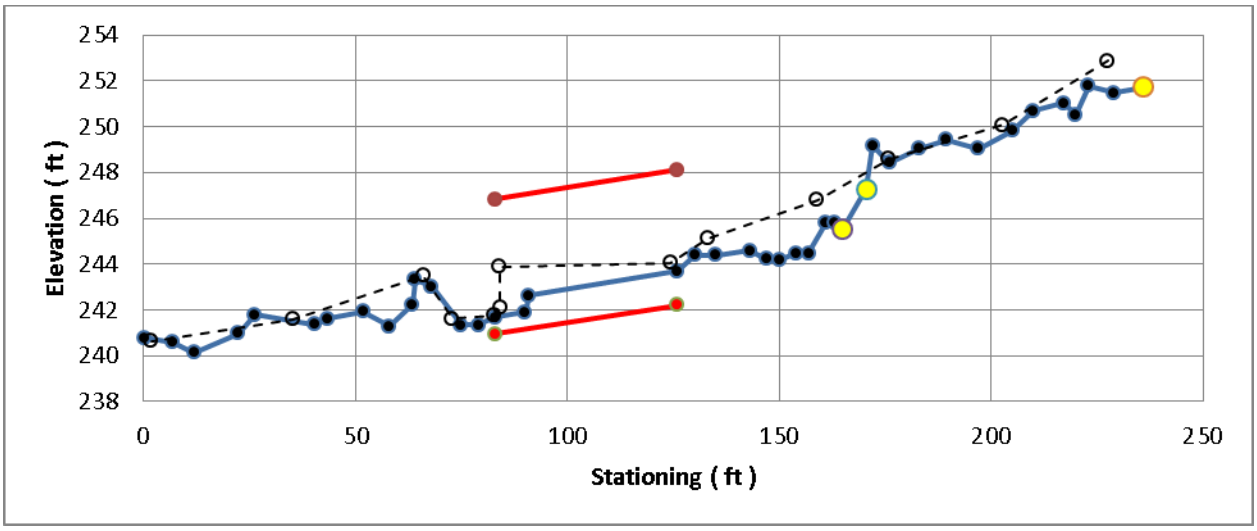
| Wetted Width (ft) | Minimum | 25 percent Quartile | Median | 75 percent Quartile | Maximum | Rating |
|---|---|---|---|---|---|---|
| Reference Reach | 3.9 | 4.9 | 6.6 | 7.4 | 9.4 | N/A |
| Structure | 8.4 | 8.4 | 8.4 | 8.4 | 8.4 | At-Risk |
| Inlet Transition | 6.4 | 7.1 | 7.2 | 8.0 | 8.5 | Good |
| Outlet Transition | 10 | 10.45 | 11.2 | 11.75 | 12.3 | Poor |

**Key Particle Comparison**

| Key Particle Size | Minimum | 25 percent Quartile | Median | 75 percent Quartile | Maximum | Rating |
|---|---|---|---|---|---|---|
| Reference Reach | 170 | 200 | 210 | 250 | 290 | N/A |
| Structure | 165 | 190 | 230 | 260 | 390 | Good |
| Inlet Transition | 170 | 210 | 220 | 260 | 320 | Good |
| Outlet Transition | N/A Pool | | | | | |

**Bank Irregularity Comparison**

| Bank Protrusions | Number | Channel Length (ft) | Channel Width (ft) | Frequency | Rating |
|---|---|---|---|---|---|
| Reference Reach | 10 | 40 | 13.4 | 3.4 | N/A |
| Structure | 1 | 42 | 8.4 | 2.4 | Uniform |
| Inlet Transition | 4 | 18 | 10.8 | 0.2 | Irregular |
| Outlet Transition | 5 | 16 | 13.2 | 4.1 | Irregular |




**Stream and Fish Figure 11. Road 2700000 milepost 0.710, longitudinal profile**

Culvert outlet, looking upstream

2012 2013 2014

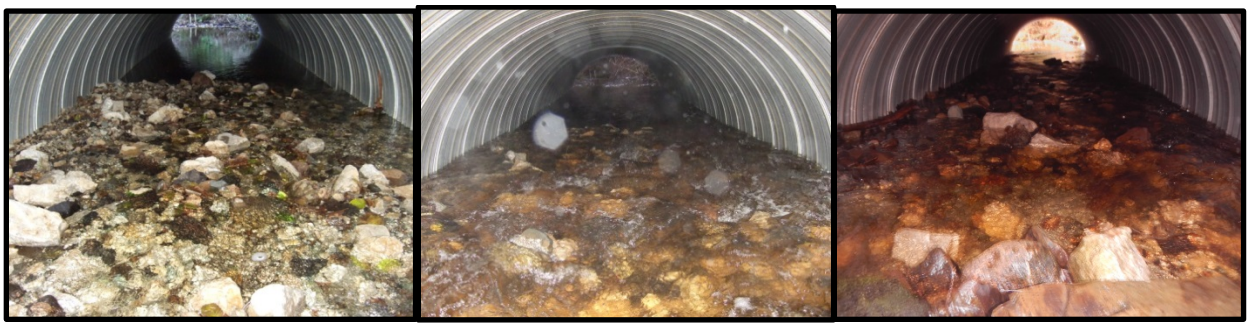
Culvert inlet, looking downstream

2012 2013 2014

Culvert barrel, looking upstream

2012 2013 2014

Culvert barrel, looking downstream



2012 2013 2014

*Stream and Fish Photo 24. MEAOP designed culvert ; road 2700000 milepost 0.710*

## Evaluation of Results

Fifteen (9 percent) of the 164 culverts monitored to date and assessed via the Alaska Region juvenile fish passage criteria matrix do not meet State of Alaska passage standards (red) and may to some extent impede the passage of juvenile fish. The 15 crossings determined not to be consistent with juvenile passage standards can be generally attributed to several different reasons. 1) Three of the 15 red culverts were known fish stream crossings requiring passage considerations but were installed without fish passage design considerations due to project personnel apparently being unaware of aquatic passage objective. 2) Four of the red crossings were installed without passage considerations because they were not identified as crossings requiring fish passage until after construction was completed. 3) Two of the culverts not meeting juvenile passage standards are MEAOP designed culverts and have not accumulated enough bedload within them to provide adequate roughness and moderate water velocity. These culverts will potentially continue to accumulate bedload overtime. 4) Two of the red culverts are stream simulated designed culverts that have had sections completely scoured free of bedload. 5) One culvert is not providing adequate passage because it is blocked by woody debris. 6) Three are red due to inadequate fish passage design considerations.

In an effort to reduce the significant costs associated with designing and installing culverts which provide fish passage, the Tongass National Forest is evaluating an approach coined minimally engineered aquatic organism passage (MEAOP) design. Similar to stream simulation design, the goal is to create fish passage conditions in the culvert which attempt to mirror that of the natural channel as much as possible by matching stream gradient, width and bedload roughness. Compared to stream simulation design MEAOP design typically involves less comprehensive stream survey and engineering analysis and relies to some degree on natural stream bedload mobilization to infill the culvert. Due to these differences there may be an inherent greater risk of not achieving or maintaining fish passage and greater associated maintenance costs.

Results from this monitoring indicate that 2 (13 percent) of the 16 installed MEAOP culverts are red and not meeting juvenile fish passage standards. By comparison, 2 percent of the 112 monitored stream simulated designed culverts are red.

The Forest Service's Washington Office (WO) Virtual AOP Design Team reviewed the nine MEAOP designed culverts installed during 2012 and 2013. The review was a critique of the existing installations and it provided recommendations for modifications to the design approach (Gubernick and Weinhold 2015).

The review found that the MEAOP designed culverts had a number of design considerations and site risks not recognized or analyzed during the design process. These omissions will likely require additional maintenance.

In general, the WO review recommended more consideration of the following in future MEAOP design.

1. Reduce the potential for headcut by considering: 1) the effect of the free erodible face in the streambed caused by embedding a culvert without infilling the culvert bed; 2) the effect of reducing the channel width cross-section and the associated increase in shear stress by the placement of the surcharge material upstream of the culvert; 3) tie the design profile to existing stable grade controls or constructing new grade control; 4) the size and mobility of the channel substrate.
2. Improve the longitudinal survey and use grade control and pool scour data to assist with determining structure design profile instead of a reach-averaged gradient method.
3. Improve the design of constructed grade controls and the stability evaluation of existing natural grade controls.
4. Improve inlet and outlet transitions from culvert to natural stream channel.
5. Use a representative reach to determine structure width and cross-section shape instead of the 66$^{th}$ percentile of a measured and pooled stream widths obtained over a variety of channel gradients.
6. Assure adequate sediment supply is available for infilling the culvert.
7. Conduct a simple geomorphic assessment to identify subsurface conditions.

MEAOP design was founded on the desire to reduce the cost of AOP remediation. The economic analysis of MEAOP design provided in the WO report suggests that the cost savings afforded with the use of a MEAOP design over stream simulation is a small percentage of project costs. In general, MEAOP design may reduce the cost of survey and design at small stream crossings by $2,000 - $3,000 and construction costs by another $3,000 - $4,000.

The WO review recommended the development of a Forest interdisciplinary AOP design team(s) consisting of Tongass National Forest biologists, hydrologists and engineers. They also recommended continuing to monitor the MEAOP installations.

### *Actions in Response to Monitoring Results*

We do not recommend any changes to Forest Plan standards and guidelines in response to preliminary monitoring results.

Recommended actions:

1. Continue to monitor all new and recent culvert installations in fish streams including annual monitoring of all MEAOP culvert designs.
2. Review the economics and value of MEAOP design.
3. Improve the accessibility of Tongass AOP data.
4. Develop a Tongass AOP IDT design team.

# 15. Streams and Fish Habitat: Riparian

**Goal:** Maintain or restore the natural range and frequency of aquatic habitat conditions on the Tongass National Forest to sustain the diversity and production of fish and other freshwater organisms.

**Objective:** Use baseline fish habitat objectives, as identified in the Forest Plan, to evaluate the relative health or condition of riparian and aquatic habitat. Design and implement fish habitat improvement projects annually across the Forest.

**Background:** The vegetation inherent in riparian areas is recognized as an important controlling factor and component in maintaining the natural range and frequency of aquatic habitat conditions. The Forest Plan contains several Riparian Standards and Guidelines that are intended to retain the integrity of riparian management areas. These standards specifically intend to: (1) maintain natural and beneficial quantities of large woody debris over the short and long term, (2) maintain stream banks and stream channel processes, (3) provide for the beneficial uses of riparian areas by maintaining water quality, and (4) maintain optimum salmon stream temperatures. By maintaining or restoring riparian vegetation in a condition found within the range of natural variability, it is anticipated that these Riparian Standards and Guidelines can largely be achieved.

## Streams and Fish Habitat Question: *Is riparian vegetation maintained or restored to a condition that supports key riparian functions?*

### Evaluation Criteria

Windthrow is a natural and important phenomenon of southeast Alaska. It recycles forest stands while maintaining and renewing the forest ecosystem. However, timber harvest has the potential to exacerbate the rate of windthrow in adjacent forest stands, including riparian management areas, beyond that found within the natural range of variability. Monitoring the incidence of windthrow in riparian management areas and comparing that to windthrow found in control riparian areas will assess whether the buffers are retained in a condition found within the natural range of variability.

The incidence and characteristics of windthrow is monitored in riparian buffers of Class I, II and III streams on the Tongass National Forest that are associated with timber sales consistent with the Forest Plan. Windthrow is monitored in both Riparian Management Areas (RMAs) and within adjacent areas where trees are retained to provide a zone of reasonable assurance of windfirmness in the RMA.

*Stream and Fish Photo 1. Wind-induced uprooted tree*

The amount of windthrow is measured as the number of windthrown trees compared to the total number of originally standing trees in the buffer. The number of trees felled due to windthrow is documented and measured using low-altitude digital still aerial photographs.

*Stream and Fish Photo 1. Low altitude digital aerial image of harvest unit and associated stream buffer*

## Sampling/Reporting Period

The sampling schedule is annual. Initial, pre-windthrow, baseline conditions are obtained after harvest of a unit but before the windthrow prone months of the year. Windthrow-inducing storms in southeast Alaska typically occur during the late fall and winter months. Repeated measurements of tree loss due to windthrow are then obtained annually for the first 5 years after harvest and then again 10 and 15 years after harvest. The reporting and evaluation schedule is at a five-year interval.

## Monitoring Results

Fiscal year 2014 was the fifteenth consecutive year that windthrow within stream buffers was monitored. The monitored stream buffers are generally located within the southern half of the Forest, which is predominantly where recent timber harvest has occurred (Figure 1). There are currently 260 stream buffers monitored. They are located on 5 ranger districts and are associated with 36 timber sales and 142 harvest units that were harvested from 2000 through 2007. The sample population contains the majority of RMAs associated with harvest activity on the Tongass National Forest, during this period. Monitoring protocol stipulates that buffers be monitored annually for the first five years after harvest and then again 10 and 15 years after harvest. During 2014, the buffers associated with harvest units harvested in 2004 were resampled.

In 2012, the Tongass National Forest purchased a new camera system for acquisition of low altitude digital images. The Canon EOS 5D Mark II is a full frame, 21.1 mp digital SLR and is equipped with 50 or 85 mm lenses and an inertial measurement unit (IMU). The IMU measures aircraft pitch, roll and yaw for more controlled imagery. The new system provides three times the spatial resolution and five times the spatial extent as the previous system. In addition, the new system provides the potential to create 3D

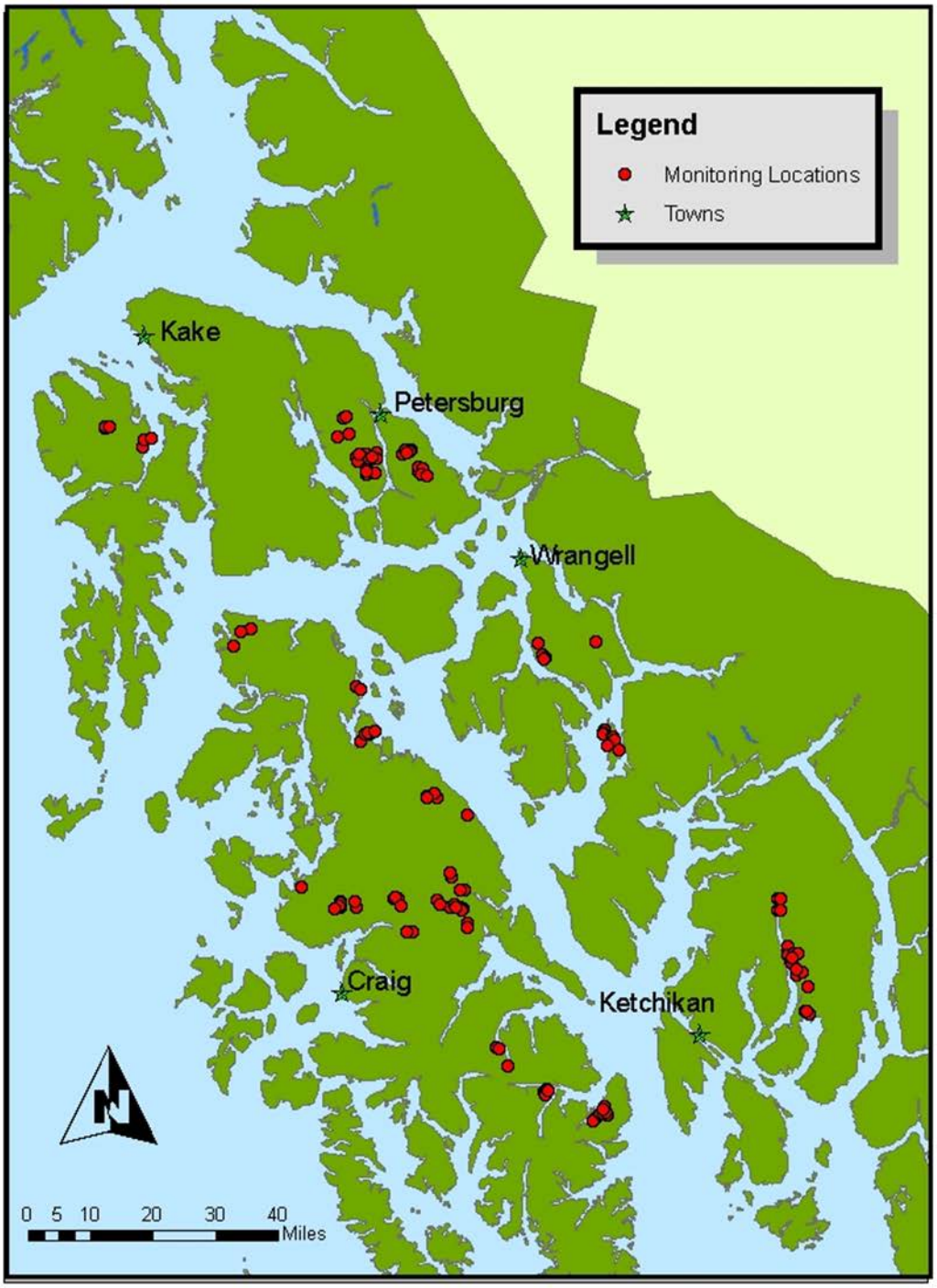
digital imagery. The Cannon EOS 5D Mark II camera was used for image acquisition in 2014; however, the IMU malfunctioned, which resulted in reduced processing capabilities.

The 260 monitored RMAs are associated with harvest units harvested from 2000 to 2007 and the number associated with each harvest year varies widely from 9 in 2004 to 92 in 2005. The orientation of buffers is well represented and varies from 17 buffers with northwest exposure orientations to 41 with an east exposure orientation. Approximately 60 percent of the buffers are adjacent to Class III streams (non-fish bearing, water quality concern streams). The remaining 40 percent of the buffers are adjacent to Class I or II streams (anadromous and resident fish bearing streams). Approximately 35 percent of the buffers are associated with streams that have buffers on both sides of the stream and 65 percent are associated with streams that only have a buffer on one side of the stream. Seventy-two (28 percent) of the streams that have buffers on both sides are Class III streams (Table 1).

To date, not all acquired imagery has been analyzed for windthrow amounts or characteristics. Analysis has not been completed on imagery collected in 2010 that is associated with 2005 harvest units, imagery collected in 2010-2011 that is associated with 2006 harvest units, imagery collected in 2010-2012 that is associated with 2007 harvest units, imagery collected in 2013 associated with 2003 harvest units or imagery collected in 2014 associated with 2004 harvest units. This represents 273 data points of the approximately 1,750 collected to date. Recently, effort and emphasis was directed toward improving the process of determining and documenting windthrow within the low altitude digital images. In addition to the purchase and refinement of a new camera system, progress has been made in creating more accurately geo-referenced images and creation of an ArcGIS geodatabase for improved documentation and change analysis.

Results from the portion of the images that have been analyzed to date have shown that post-harvest windthrow is present in 146 (56 percent) of the 260 buffers monitored and associated with harvest units harvested from 2000 through 2007. The distribution of the cumulative amount of windthrow is not normally distributed and is heavily skewed toward the left tail or toward zero percent of windthrow (Figure 2). The mean amount of windthrow in the buffers is 6.8 percent, the median is 0.9 percent. The amount of windthrow is expressed as the cumulative number of trees windthrown divided by the original number standing trees in a buffer. The cumulative windthrow mortality in the buffers is highly variable and ranges from 0 to 85 percent. Forty-four percent of the buffers have no windthrow within them, 72 percent of the buffers have less than 5 percent windthrow mortality, 82 percent have less than 10 percent windthrow and 97 percent of the buffers have less than 50 percent windthrow within them. The annual and cumulative amount of windthrow measured within each of the 260 monitored stream buffers is provided in Figures 2 and 3.

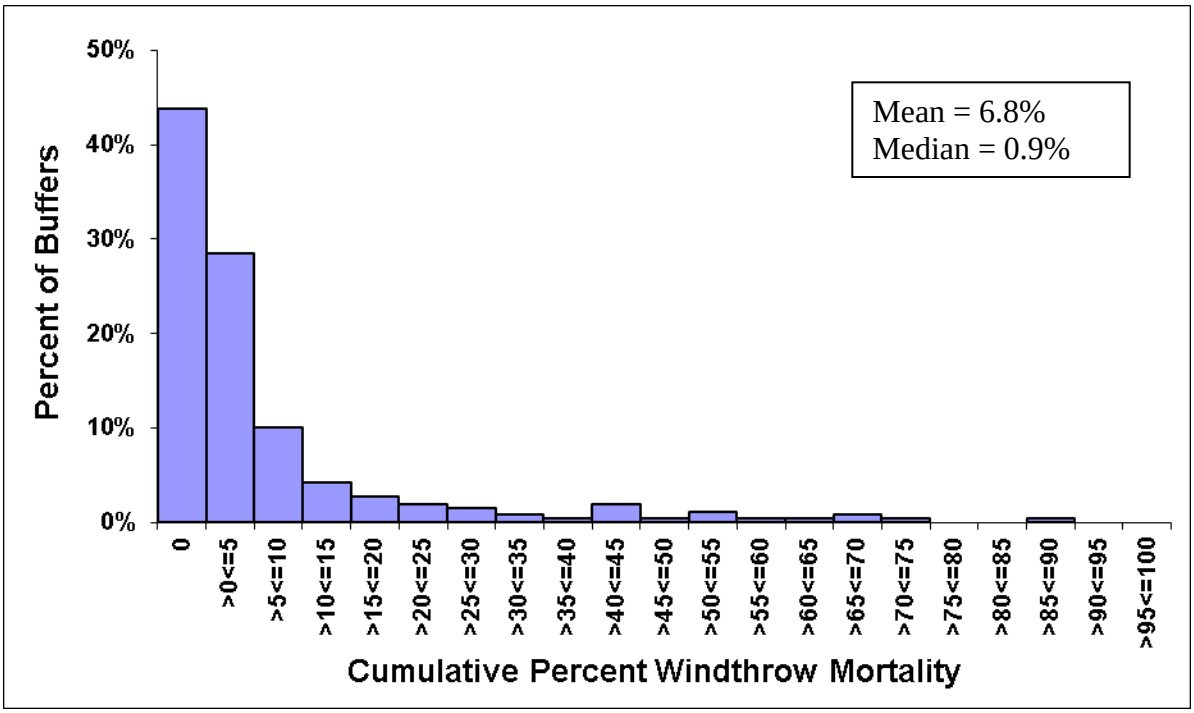
The amount of windthrow compared to time elapsed since harvest is variable. However, the results suggest a general trend of windthrow rate decreasing as the time since harvest increases (Figure 3). The average annual cumulative percent of windthrow that has occurred within buffers monitored after 1, 2, 3, 4, 5 and 10 years is respectively 2.2 percent, 4.5 percent, 4.5 percent, 5.2 percent, 5.2 percent and 8.4 percent.



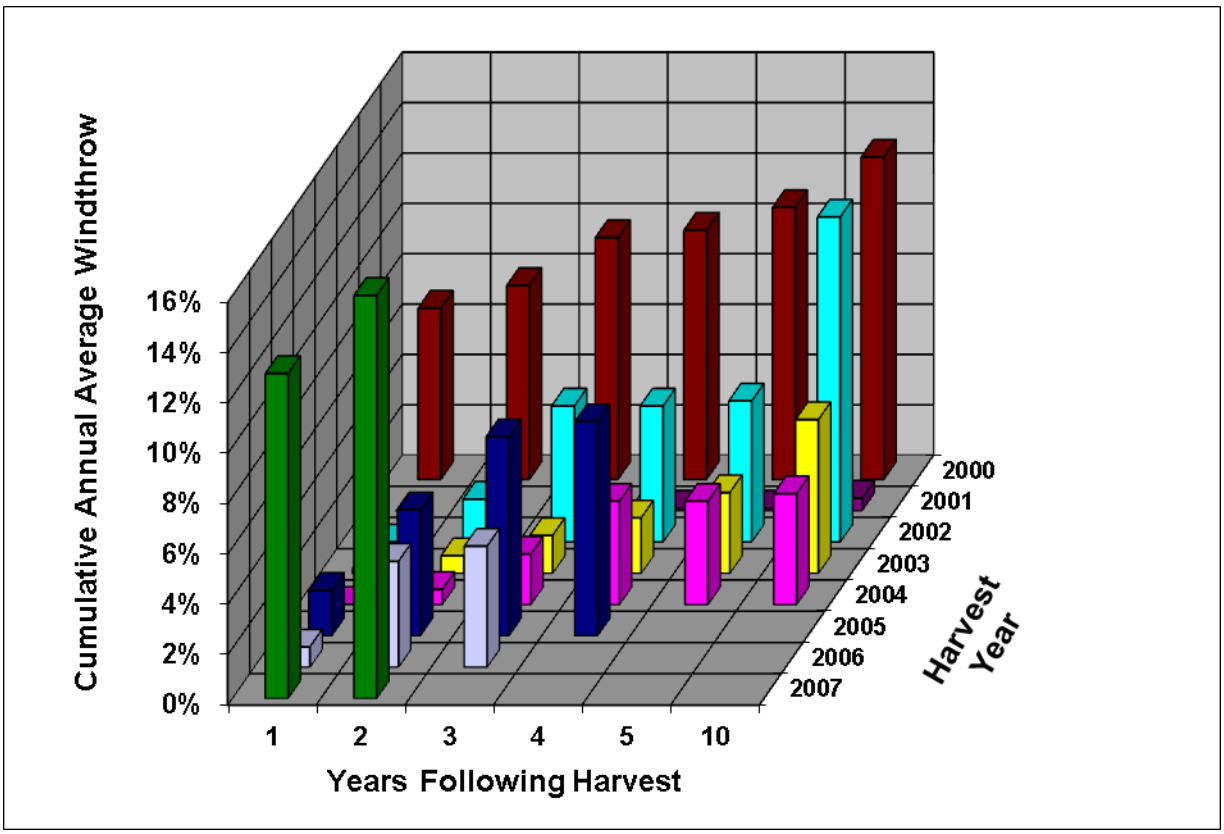

**Stream and Fish Figure 1. Location of stream buffers monitored for windthrow**

**Stream and Fish Figure 1. Characteristics of monitored stream buffers**

| Characteristics | Number of Buffers | Percent of Total |
|---|---|---|
| **Year of Harvest** | | |
| 2000 | 28 | 10.8% |
| 2001 | 26 | 10.0 % |
| 2002 | 11 | 4.2 % |
| 2003 | 27 | 10.4 % |
| 2004 | 9 | 3.5 % |
| 2005 | 92 | 35.4 % |
| 2006 | 56 | 21.5 % |
| 2007 | 11 | 4.2% |
| **Buffer Exposure Orientation** | | |
| north | 35 | 13.5 % |
| northeast | 35 | 13.5 % |
| east | 41 | 15.7 % |
| southeast | 27 | 10.4 % |
| south | 35 | 13.5 % |
| southwest | 30 | 11.5 % |
| west | 40 | 15.4 % |
| northwest | 17 | 6.5 % |
| **Buffer Location** | | |
| Buffers on one side of stream | 169 | 65.0 % |
| Class I or II (fish streams) | 86 | 33.1 % |
| Class III | 83 | 31.9 % |
| Buffers on both sides of stream | 91 | 35.0 % |
| Class I or II (fish streams) | 19 | 7.3 % |
| Class III | 72 | 27.7 % |
| **Stream Class** | | |
| Class I or II (fish streams) | 105 | 40.5 % |
| Class III | 155 | 59.5 % |
| **Total** | **260** | |

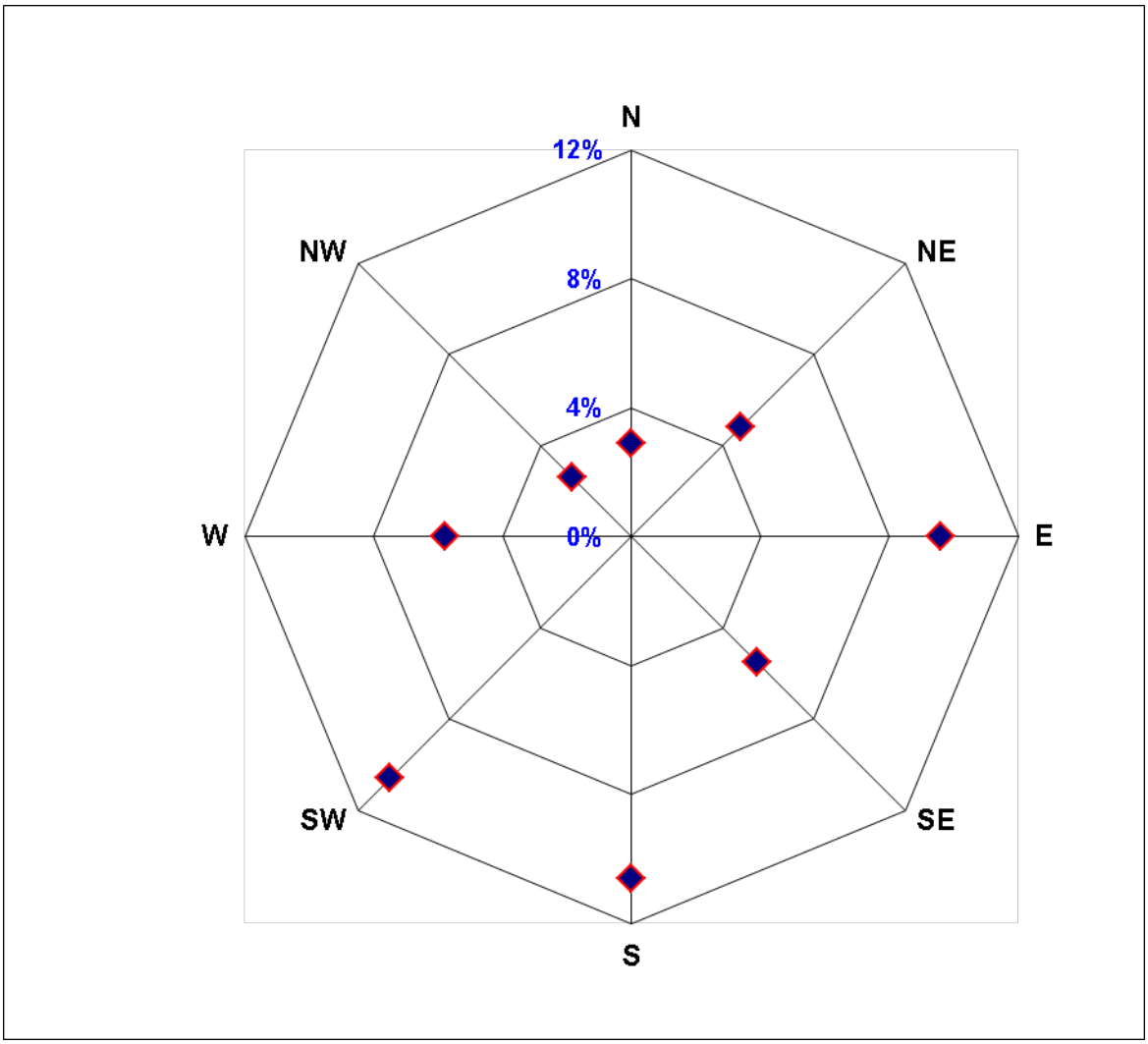



**Stream and Fish Figure 2. Frequency of cumulative percent windthrow**




**Stream and Fish Figure 3. Cumulative annual average rate of windthrow mortality**

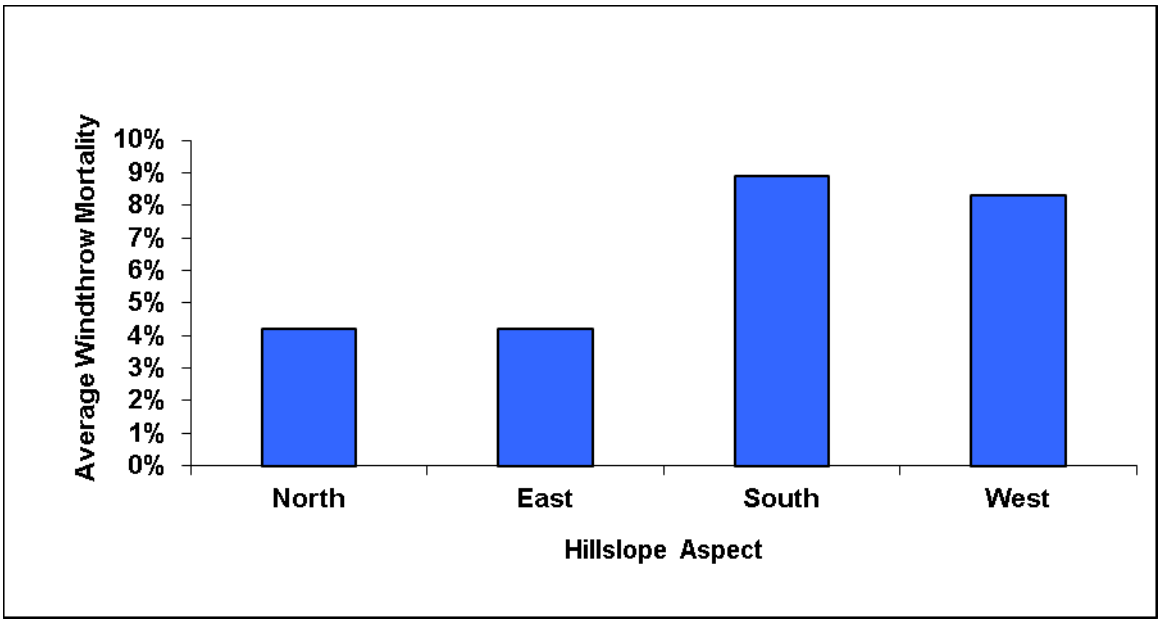
A comparison of average cumulative windthrow to the orientation of the face of the buffer generally indicates that buffers with a northern hemisphere exposure orientation tend to experience less windthrow than those with southern hemisphere exposure orientation. Buffer exposure orientation is the direction that the face of the buffer is exposed to across the fetch of the harvest unit. The greatest percent of windthrow was measured in buffers facing and exposed toward the southwest and south with an average cumulative windthrow of 10.6 percent, while the least amount measured was in buffers facing northwest and had a cumulative average windthrow amount of 2.6 percent (Figure 4).




**Stream and Fish Figure 4. Average windthrow mortality by buffer exposure orientation**

A greater susceptibility to windthrow was observed in buffers located on hill slopes with southern and western hill slope aspects versus northern and eastern aspects. The comparison of average windthrow mortality by hill slope aspect (per 60 meter digital elevation model) indicated that the average windthrow mortality in buffers located on north and east facing hill slopes was approximately one-half of the amount measured on south and west facing slopes (Figure 5).

The average percent of windthrow in the buffers adjacent to stream Class I or II channels is 5.5 percent while the average amount of windthrow in the buffers adjacent to Class III channels is 7.2 percent.




**Stream and Fish Figure 5. Average cumulative windthrow mortality by hillslope aspect**

## Evaluation of Results

The Tongass National Forest Land Management Plan Riparian Buffer Standards and Guidelines established buffer width design elements for riparian area protection based on stream process groups. Stream process groups are based on the geomorphic characteristics of the stream channel and riparian area. For most process groups the design elements are followed by the phrase "Manage an appropriate distance beyond the no-harvest zone to provide for a reasonable assurance of windfirmness of the RMA. Pay special attention to the area within one site-potential tree height on the RMA." The area beyond the no-harvest zone has become known as the RAW zone, short for Reasonable Assurance of Windfirmness.

As part of this monitoring timber sale unit implementation cards were reviewed for buffer width information and RAW zone characteristics. Most unit cards associated with the monitored RMAs did not include RAW zone prescriptions, widths or characteristics. This lack of information is an impediment to clearly distinguishing between windthrow in the RMA and RAW zone. Due to this omission the monitoring results in this report, currently, do not consistently distinguish between windthrow in the RMA and in the adjacent and potential RAW zone.

By retaining riparian vegetation in a condition found within the range of natural variability it is anticipated that Forest Plan riparian objectives can be achieved. If windthrow is exacerbated beyond the range of natural variability its effect will need to be understood to assess if natural channel processes are maintained in a natural condition as desired in the Forest Plan Riparian Standards and Guidelines.

The windthrow mortality measured in buffers adjacent to harvest units has yet to be compared to that found naturally within riparian areas adjacent to un-harvested forest stands. Low elevation aerial images of un-harvested forest stands up and downstream of many of the monitored buffers have been obtained and will be used as control stands. Upon completion, this comparison will help determine if windthrow has been exacerbated beyond that found within the natural range of variability. Cursory observations of these control stands suggest that significantly less windthrow is present within them then in the treatment stands. Therefore, current windthrow abatement practices may not be completely 100 percent effective.

Based on the monitoring results to date, timber harvest has likely exacerbated the rate of windthrow in the monitored areas beyond that found within the natural range of variability. However, the data suggests that a large majority of the monitored buffers have remained mostly in natural conditions. No windthrow has

been detected in 44 percent of the monitored areas and the average amount of cumulative windthrow is 6.8 percent. The cumulative windthrow mortality in the buffers is highly variable and ranges from zero to 85 percent. To date, 72 percent of the buffers in which windthrow has been measured have less than five percent windthrow mortality, 82 percent have less than ten percent windthrow and 97 percent of the buffers have less than 50 percent windthrow.

Results from the long term nature of this monitoring suggest that the rate of windthrow diminishes over time. Others who have measured windthrow have found that most windthrow occurs within the first few years after harvest and that windthrow will diminish the longer the buffer is standing (Andrus and Froehlich 1992, Moore 1977, Alexander 1964). Trees within the edge of a buffer become more windfirm over time as their root structure adjusts (Stathers et al. 1994, Urban et al. 1994).

Wind and rain are major factors in windthrow. Southeast gales are the most damaging fall and winter storms that occur in Southeast Alaska. These storms originate in the northern Pacific and rotate counterclockwise as they move northeast across Southeast Alaska (Harris, 1989). Due to this dominant storm track the southeast and southwest outer edges of islands are more susceptible to windthrow than northeast edges of the islands (Harris 1989, Moore 1977, Kramer 2000, Nowacki and Kramer 1998). Inland stream buffers may be less susceptible to windthrow (Andrus and Froehlich 1992, Kramer 2000, Kramer et al. 2001, Harris 1989). Localized Bora or Glacier winds have also been known to cause windthrow in forests of Southeast Alaska. The Bora or Glacier winds are associated with major river valleys penetrating the coast range, or with the temperature difference associated with ice fields (Harris 1989, Moore 1977). The Stikine River Valley near Wrangell and the Taku winds near Juneau are two examples of more localized damaging winds (Harris 1989, Kramer 2000). With wind often come rain, and the saturated soil conditions that often accompany a windstorm reduce soil strength and increase the chance for wind throw (Moore 1977, Harris 1989).

Aspect is another factor in windthrow. Monitoring results indicate that the amount of windthrow in buffers with a general northerly exposure tended to be less than that within buffers with a general southerly exposure. This appears to be in concert with Southeast Alaska weather patterns. Other investigations have provided inconsistent findings in regards to the effect of buffer orientation on windthrow amount. Grizzell and Wolff (1998) found that buffer orientation was not a factor in the amount of windthrow in their study of buffers in the northern cascades. Conversely, other studies (Andrus and Froehlich, 1992, Moore 1977, Alexander 1964) indicated that buffers parallel to wind flow may be more windfirm than buffers perpendicular to wind flow. A greater susceptibility to windthrow was observed in buffers located on hill slopes with south and west hill slope aspects versus north and east aspects. The average windthrow mortality in buffers located on north and east facing hill slopes was approximately one-half of that measured on south and west facing slopes. Other studies support that stands with south exposures will be more susceptible to windthrow (Nowacki and Kramer 1998, Kramer 2000, Kramer et al. 2001, Moore 1977). Kramer et al. (2001) suggests that stands on slopes exposed to south facing azimuths between 160 and 220 degrees would be more susceptible to windthrow from cyclonic (southeast gale) wind events.

## Action Plan

No changes to Forest Plan standards and guidelines are recommended in response to monitoring results. A better understanding of the complex relationship between temporal, spatial and structural variables and riparian windthrow is expected to develop through the continuation of this monitoring effort which may facilitate more effective windthrow abatement prescriptions and move management closer to desired riparian conditions

Recommendations are to maintain the current monitoring effort and associated activities, implementing refinements and improvements as necessary. Continue to monitor the 260 buffers associated with harvest activity from 2000 thru 2007 as stipulated in the study plan. This schedule includes repeated

measurements of tree loss due to windthrow annually for the first five years after harvest and then again ten and fifteen years after harvest. 2015 will provide 15 year post harvest results for units harvested in 2000.

Low elevation imagery has been obtained and initial analysis has been mostly completed for the first five years following harvest for logging activity from 2000 thru 2007. In addition, imagery has been obtained and 10 year post harvest analysis has been partially completed on RMAs associated with 2000 thru 2004 harvest activity. Continue the analysis on the backlog of acquired imagery.

Continue to populate a GIS geodatabase containing polygons feature classes of RMAs, RAW zones and the harvest unit; a line feature class of the stream, and a point feature class of standing and fallen trees.

Analyze the monitoring results with more statistical rigor, and assess additional contributing variables including soil characteristic, topography, size of harvest unit, shape of harvest unit, quantity of tree retention in harvest unit, and buffer width.

Distinguish the amount of windthrow in the RMAs from that in adjacent RAW zones. Determine the amount of windthrow in adjacent control RMAs to determine if RMAs adjacent to harvested stands are being maintained in a condition found within the range of natural variability.

Continue to develop and improve the data acquisition, interpretation and analysis process.

Conduct on-the-ground monitoring of the consequences of the windthrow detected with the low elevation digital imagery. This monitoring would assess the degree that standards and guidelines addressing natural channel processes are maintained within buffers that have sustained windthrow.

Upon additional completion of this monitoring, update the Tongass National Forest white paper (Landwehr, 2007) that provides direction and guidance for designing RAW zones.

## Citations

Alexander, R.R. 1964. Minimizing windfall around clear cuttings in spruce-fir forests. Forest Science. 10(2): 130-142.

Andrus, C. and H. Froehlich. 1992. Wind damage in streamside buffers and its effect on accelerated sedimentation is coastal Oregon streams. Fundamental COPE Report 5-1: 7-9. Oregon State University, Corvallis.

Grizzell, J.D. and N.Wolff. 1998. Occurrence of windthrow in Forest buffer strips and its effect on small streams in Northwest Washington. Northwest Science. 72(3).

Harris, A.S. 1989. Wind in the Forests of Southeast Alaska and guides for reducing damage. General Report. PNW-GR-244. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

Kramer, M.G. 2000. Maritime windstorm influence of soil process in a temperate rainforest. Doctoral thesis, Oregon State University, Corvallis.

Kramer, M.G., A.J. Hanson, M.L. Taper and E.J. Kissinger. 2001. Abiotic controls on long-term windthrow disturbance and temperate rain forest dynamics in Southeast Alaska. Ecology. 82(10): 2749–2768.

Landwehr, D.J. 2007. Unpublished. Reasonable assurance of windfirmness guidelines. USDA Forest Service, Tongass National Forest.

Moore, M.K. 1977. Land management report 3: Factors contributing to blowdown in streamside leave strips on Vancouver Island. Province of British Columbia, Ministry of Forests, ISSN 0702-9861.

Stathers, R.J., T.P. Rollerson and S.J. Mitchell. 1994. Windthrow handbook for British Columbia Forests. Working Paper 9401. British Columbia Ministry Forest Research Branch. Victoria, BC, 34 p.

# 16. Wildlife Terrestrial Habitat: Management Indicator Species

**Goal:** Maintain the abundance and distribution of habitats, especially old-growth forests, to sustain viable populations. Also, maintain habitat capability sufficient to produce wildlife populations that support the use of wildlife resources for sport, subsistence, and recreational activities.

**Objectives:** In addition to objectives included in the "Biodiversity Ecosystem" section, include a young-growth management program to maintain, prolong, and/or improve understory forage production and to increase future old-growth characteristics in young-growth timber stands for wildlife.

**Background:** The National Forest Management Act requires that the Forest Service provide for the diversity of plants and animals, based upon the suitability and capability of each national forest, as a part of meeting overall multiple use objectives (16 U.S. Code [USC] 1604[g][3][B]). This direction requires that fish and wildlife habitat be managed to maintain viable populations of existing native and desired non-native vertebrate species. In order to ensure that viable populations will be maintained, habitat must be provided to support at least a minimum number of reproductive individuals and that habitat must be well distributed so that those individuals can interact with others (36 Code of Federal Regulations [CFR] 219.3 [September 30, 1982]).

MacDonald and Cook (2007) documented that 82 species of mammals and 8 amphibians are known to occur, or have recently occurred, in Southeast Alaska. Over 80 percent of this area is under Federal stewardship in the Tongass National Forest (MacDonald and Cook 2007, page 7). There are an additional 18 species of marine mammals found in Southeast Alaska waters that depend entirely on the ocean environment, and 45 bird species considered casual or accidental visitors to Southeast Alaska. The diversity of wildlife on the Forest provides many opportunities for consumptive and non-consumptive uses including commercial guide, sport, and subsistence hunting as well as photography and viewing (USDA Forest Service 2008b, page 3-219).

## Wildlife Question: *Are populations and habitat trends for management indicator species (MIS) consistent with expectations? Are these trends tied to changes in habitat conditions or other factors? If they are tied to habitat conditions, is there a direct relationship with forest management, climate change, or other factors? Terrestrial MIS include red squirrel, black bear, brown bear, marten, river otter, Sitka black-tailed deer, mountain goat, gray wolf, Vancouver Canada goose, bald eagle, red-breasted sapsucker, hairy woodpecker, and brown creeper.*

The 1982 regulations to implement the National Forest Management Act require that management indicator species (MIS) be identified as part of each forest plan. MIS serve multiple functions in forest planning; they: (1) establish explicit forest plan objectives for fish and wildlife habitat, (2) facilitate analysis of forest plan alternatives, and (3) provide a means to monitor the effect of forest plan implementation. Much of the direction for MIS is outlined in CFR 219.19, together with direction for ecosystem diversity and species diversity. As such, MIS represents one part of a broader fabric of biodiversity and species management.

A main criterion for the selection of the Tongass MIS was whether or not timber harvest activities potentially affect their key habitats. Another was the cumulative amount of activities that had occurred prior to the 1997 Forest Plan on the Tongass and in Southeast Alaska. In general, the selected species may be affected by timber harvest either directly or indirectly. Increased human access provided by roads

and/or logging camps may be the source of these potential affects.

The 13 MIS identified for the Tongass National Forest are primarily associated with the spruce and hemlock forests of Southeast Alaska that represent 98 percent of the productive old-growth forests of the Tongass. Productive old-growth (POG) habitat provides important habitat for many of the MIS. However, some species use a variety of different habitats but rely on prey species associated with old-growth (e.g., wolves).

## Evaluation Criteria

Determine whether habitat changes and population trends for the 13 Tongass MIS are consistent with expectations as defined in the 2008 Forest Plan Amendment Final Environmental Impact Statement (USDA Forest Service 2008b). This is done at 5-year intervals after implementation of the 2008 Forest Plan. For the most recent 5-year evaluation, see the 2012 Monitoring and Evaluation Report (USDA Forest Service 2013). Important habitats, as defined by the Suring habitat capability models (Suring 1993) and data sources for estimating population trends for the MIS are listed in Table 1.

Generally, habitat change is analyzed using the size density geographic information system (GIS) feature class, which classifies forested stands according to their average tree size and the density of trees in a stand. Productive old-growth forest is defined as size density (SD) classes 4H (hydric soils), SD4S (south aspect), 4N (north aspect), 5H, 5N, 5S, and 67, where the number in the class acronym corresponds to the timber volume class (4=8-20 MBF[1], 5=20-30 MBF, 6=30-50 MBF, 7>50 MBF) mean board feet per acre. Certain MIS (e.g., marten and brown creeper) prefer high volume productive old-growth (HPOG), which is defined as SD classes 5N, 5S, and 67. In addition, changes in road density are measured as an indicator of changing human access that can cause increased mortality in species such as wolf and marten.

The Alaska Department of Fish and Game (ADF&G) is the state regulatory agency for all game species in Alaska. The Federal Subsistence Board also regulates subsistence hunting on Federal lands in Alaska. In addition, the U.S. Fish and Wildlife Service (USFWS) regulates populations of migratory birds and bald eagles. Therefore, we rely on these entities for reporting population status and trends when possible. The Breeding Bird Survey and more recently, the Alaska Landbird Monitoring Survey, are our best sources for monitoring populations of songbirds. A description of each of the population data sources used in this report is included below.

### *Management and Harvest Reports*

ADF&G reports annually on trends in hunted and trapped wildlife species in Alaska. ADF&G biologists make estimates of population trends based on a combination of data sources including: conversations with trappers, hunters, pilots, and other biologists; anecdotal reports; incidental observations by ADF&G staff; harvest data; hunter and trapper questionnaires; sealing information; and suspected prey availability. Quantitative indicators are used for estimating trends in deer and mountain goat populations. Additionally quantitative estimates of local populations of mountain goat, black bear, brown bear, and wolves are periodically developed.

[1] MBF means thousands of board feet

**MIS Terrestrial Hab. Table 1. Relative abundance and trend of marten, river otter, and wolf populations for the Southeast Alaska 2012-2013 trapping season**

| MIS | Important Habitats | Population Data Sources |
|---|---|---|
| Alexander Archipelago Wolf (*Canis lupus ligoni*) | POG (productive old-growth): provides habitat for prey | ADF&G sealing records, research, reports, and trapper questionnaire |
| American Marten (*Martes americana*) | High volume POG: intercepts snow, provides cover and habitat for prey | ADF&G sealing records, reports, research and trapper questionnaire |
| Bald Eagle (*Haliaeetus leucocephalus*) | High volume POG near shorelines: provides nesting and perching habitat | USFWS population survey |
| Black Bear (*Ursus americanus*) | POG and salmon streams | ADF&G sealing records, reports, and research |
| Brown Bear (*Ursus arctos*) | POG and salmon streams | ADF&G sealing records, reports, research and hunter survey |
| Brown Creeper (*Certhia americana*) | High volume POG: tall, large diameter trees w/ plentiful snags and decadent timber | Breeding Bird Survey |
| Hairy Woodpecker (*Picoides villosus*) | High volume POG with snags and dying trees | Alaska Landbird Monitoring Survey, Breeding Bird Survey |
| Mountain Goat (*Oreamnos americanus*) | POG: intercepts snow and provides cover | ADF&G hunter survey and reports |
| Red-breasted Sapsucker (*Sphyrapicus ruber*) | Low volume POG and decadent trees and young snags for nesting | Alaska Landbird Monitoring Survey |
| Red Squirrel (*Tamiasciurus hudsonicus*) | POG: cone producing trees | ADF&G trapper questionnaire |
| River Otter (*Lutra canadensis*) | POG: adjacent to shoreline / streams | ADF&G sealing records and trapper questionnaire |
| Sitka Black-tailed Deer (*Odocoileus hemionus sitkensis*) | POG: low elevation, intercepts snow, provides cover | ADF&G/Tongass deer pellet count transects, subsistence harvest reports, and ADF&G hunter surveys |
| Vancouver Canada Goose (*Branta canadensis*) | Forested wetlands for nesting and brood rearing | USFWS waterfowl population survey |

**ADF&G Sealing Records:** The Convention on International Trade in Endangered Species (CITES) program in Alaska requires that certain furbearers (e.g., wolves, marten, river otter, black bear, and brown bear) taken by any means and for any purpose, be sealed by an authorized representative. The exception is brown bears that are taken under a subsistence permit and taken in and not removed from a subsistence area do not need to be sealed. Sealing involves tagging the hide with an identification number issued by the USFWS. This allows the USFWS to track the international trade of CITES species and ensure that they were taken within state-specified management regulations.

For each sealed animal, the ADF&G collects information about the take, such as the location where the animal was killed and the amount of time spent hunting/trapping the animal. If one assumes that fewer days are required to harvest an animal when hunting or trapping a more dense population then days per animal may be an index of the population. This assumption becomes invalid if hunters do not take the first animal they can harvest. In addition, the lack of data from unsuccessful hunts and trapping seasons may limit the utility of the data.

**Hunter/Trapper Questionnaires:** ADF&G also administers statewide hunter and trapper questionnaires and publishes these data annually. Hunters and trappers are asked whether they believe the species population has remained the same, increased, or decreased compared to the year before. Brown bear hunters provide additional details on their hunt, such as the number of days they hunted and whether they were successful. This provides more accurate data on hunter effort compared to the sealing data. Similar

problems are potential with the development of the population index as with the sealing data since bias may be introduced from success and opportunity.

### *Bird Surveys*

The Alaska Landbird Monitoring Survey (ALMS) and Breeding Bird Survey (BBS) data will be analyzed every 5 years to assess population trends for management indicator bird species. Because migratory birds are far ranging species that require a diversity of habitat for foraging, breeding, and wintering, population trends are generally detected at larger observational scales than those traditionally used to manage lands.

**Alaska Landbird Monitoring Survey:** The Tongass completes the Alaska Landbird Monitoring Survey (ALMS) annually. ALMS is administered by the U.S. Geological Survey (USGS) in Anchorage, Alaska, and is designed to monitor long-term trends in breeding populations of landbirds (and other bird species) within all ecoregions of Alaska. Variable circular point counts are used to survey bird species by sight and sound. The sampling design employs a 10 by 10 kilometer sampling grid laid over the entire state of Alaska. From this grid, survey blocks are chosen randomly within each ecoregion and Federal land management unit. Each block contains 25 survey points. This randomized, off-road grid design is intended to eliminate biases inherent in roadside surveys such as the Breeding Bird Survey. Habitat data aimed at keying out forest type and structure, and variables such as distance to water and snags, are collected at each point. Detailed survey methods can be found in Handel and Cady (2004).

**Breeding Bird Survey:** The Tongass also completes Breeding Bird Surveys (BBS) annually. BBS is administered by USGS staff from the Patuxent Wildlife Research Center in Maryland. The BBS is designed to provide a continent-wide perspective of population change in breeding birds. The survey produces an index of relative abundance rather than a complete count of breeding bird populations. The data analyses assume that fluctuations in these indices of abundance are representative of the population as a whole. BBS routes are 24.5 miles long, with a total of 50 stops located at 0.5-mile intervals along the route. Southeast Alaska has 18 established routes, many of which at least partially fall within the Tongass National Forest.

*MIS Terrestrial Hab. Photo 1. Brown creeper*

**USFWS Bald Eagle Surveys:** USFWS has been conducting aerial surveys of bald eagles in Southeast Alaska since 1967. Surveys are conducted on 30 randomly selected plots that are surveyed at 5-year intervals during the breeding season. Visual detection rates have been determined in separate studies and used in the population estimates. When extrapolated to the greater landscape, these surveys provide a reasonably accurate and precise estimate of the population and are effective for monitoring trends.

**USFWS Waterfowl Surveys:** USFWS censuses waterfowl including Vancouver Canada geese in southeast Alaska. These surveys generally take 5 years to complete. All saltwater shorelines are surveyed once in summer and in winter (Jack Hodges, personal communication). One-fifth of the total saltwater shoreline is surveyed per year. USFWS conducts surveys by air and uses results from surveys conducted by boat to correct their estimate. Three correction surveys are conducted by boat in the summer and winter.

### *Deer Pellet Group Surveys*

Estimating Sitka black-tailed deer population abundance in Southeast Alaska is difficult because much of the landscape is densely vegetated; therefore, estimation techniques based on seeing the animals do not

work well. For this reason, ADF&G uses fecal pellet counts as an index for deer population abundance. The assumption is that changes in the density of pellet groups reflect changes in the population. It is also assumed that a difference in these indices between areas reflects differences in the size of the respective populations. ADF&G reports that the pellet data surveys "are useful in looking at long-term trends and should detect population changes over a period of several years" (Person and Titus 2002). Data collection is a cooperative effort by the Tongass National Forest and ADF&G. Counts are conducted along permanent transects. Transects are not surveyed every year. Areas that receive high hunting pressure or areas where there is concern for the population are prioritized. Pellet group datasets date back to the early 1980s.

## Monitoring Results

Population and habitat trends of MIS are not included in this report. These analyses are scheduled to be completed every 5 years after implementation of the Forest Plan (see the 2012 Annual and 5 Year Monitoring and Evaluation Report for the most recent analyses of population and habitat trends). The following describes recent reports and work contributing towards monitoring abundance and population of MIS on the Tongass.

### *MIS Population Abundance and Trends*

Management and Harvest Reports

Reports for hunted and trapped MIS (brown bear, black bear, mountain goat, wolf, deer, river otter, and marten) are summarized in Tables 2 and 3. Table 2 shows the relative abundance and trend for marten, river otter, and wolf populations for Southeast Alaska by area for the 2012-2013 trapping season as reported by trappers in the Trapper Questionnaire Statewide Annual Report for the period 1 July 2012 to 30 June 2013 (ADF&G 2013a, page 29). Table 3 shows summary of population status information on abundance or trend. Positive trend indicates an increase from the previous season ADF&G harvest reports.

**MIS Terrestrial Hab. Table 2. Relative abundance and trend of marten, river otter, and wolf populations for the Southeast Alaska 2012-2013 trapping season**

| Trapper Questionnaire Annual Report | Ketchikan, Prince of Wales and vicinity (GMUs 1A & 2) | | Petersburg, Wrangell, Kupreanof, and vicinity (GMUs 1B & 3) | | Juneau, Douglas, Haines, Yakutat (GMUs 1C, 1D, & 5) | | Admiralty, Baranof, and Chichagof (GMU 4) | |
|---|---|---|---|---|---|---|---|---|
| | Relative Abundance n=17 | Trend n=15 | Relative Abundance n=12 | Trend n=10 | Relative Abundance n=19 | Trend n=18 | Relative Abundance n=25 | Trend n=24 |
| Marten | Common | n/c | Common | n/c | Common | - | Abundant | - |
| Otter | Abundant | n/c | Common | n/c | Common | n/c | Common | n/c |
| Wolf | Common | + | Abundant | n/c | Common | - | Scarce | n/c |

Note: n = total number of trappers who provided information; n/c = no change; + = increase; - = decrease

### *Deer Pellet Group Surveys*

The results are incorporated into ADF&G's deer population abundance and trend estimates in their management report of survey and inventory. This population status information is summarized in Table 3.

### *Bird Surveys*

**Alaska Landbird Monitoring Survey (ALMS):** This was the twelfth year of implementing this protocol. The common birds continue to be cataloged in a rigorous manner, and unusual birds, such as owls, are documented for general distributional information. Ten ALMS blocks on the Tongass were

planned to be visited this year. All grids were successfully accessed with point counts at most accessible points, contributing to a total of 170 points. Record rainfall for Southeast Alaska in June (weather minimums apply to survey protocol) limited the number of survey days. The following survey blocks received visits during FY2014:

- Skagway River, Lemon Creek, and Taku River alpine (Juneau Ranger District)
- Admiralty Island (Admiralty National Monument)
- Mitkof Island (Petersburg RD)
- North Prince of Wales and Kosciusko Island (Thorne Bay RD)
- Gravina Island (Ketchikan-Misty Fiords RD)
- Zarembo Island and Cleveland Peninsula (Wrangell RD)

All GPS points were collated into a GIS map to assist with relocating the points in future years and assist with conducting landscape level analyses. Photographs are also on file for each point. Point count data was compiled, entered into a Microsoft Access database designed specifically for this project, and sent to the USGS Alaska Science Center.

**Breeding Bird Surveys (BBS):** The following routes were surveyed during FY2014, either by Forest Service employees or community volunteers, in Southeast Alaska:

- Yakutat
- Harlequin Lake
- Stikine
- Zarembo Island
- Zimovia Strait
- Craig
- Whale Pass
- Sitka
- Chichagof
- Hoonah
- Juneau
- Skagway

**USFWS Bald Eagle Surveys:** The USFWS did not survey the Southeast Alaska bald eagle population in FY2014. For a report of bald eagle status trends in southeast Alaska, see Wildlife Question 1 of the Wildlife Terrestrial Habitat section of the 2012 5-Year Monitoring and Evaluation Report (USDA Forest Service 2013).

The Forest Service completed project-related eagle nest surveys. An area with historic nests was surveyed on the Hoonah Ranger District near the Eight Fathom Rock Pit. No nest activity was observed at two nests although there were eagles observed in the area, one was destroyed when the treetop was broken, and another nest could not be located and is believed to no longer exist. A survey was also done in Windfall Harbor on Admiralty Island National Monument. A pair of eagles was observed but a nest could not be located. Due to the inconclusive results of the survey, the project was postponed until later in the season to avoid potential disturbance to the pair. The Wrangell Ranger District completed a survey for the Zarkof Salvage Sale. Five historic nests could not be located; one nest was found and was determined to be active. The project barge was moved further from the nest to minimize disturbance and helicopter operations were shifted during the nesting season. The Thorne Bay Ranger District surveyed several eagle nests near free use permit locations and also for rock pit expansions.

**USFWS Waterfowl Surveys:** The USFWS did not survey the waterfowl population in Southeast Alaska in FY2014. For a report of status and trends of Vancouver Canada geese in Southeast Alaska, see Wildlife Question 1 of the Wildlife Terrestrial Habitat section of the 2012 5-Year Monitoring and Evaluation Report (USDA Forest Service 2013).

### *Population Survey Methodologies*

**Deer Pellet DNA Use in Population Estimation:** Pellet-group counts are an imprecise index for population trends and do not meet current ADF&G deer management needs. For this reason, the Tongass and ADF&G have collaborated to study the use of fecal DNA for broad-scale population monitoring of Sitka black-tailed deer in Southeast Alaska (Brinkman et al. 2009, 2010, and 2011). The methodology developed to date has been logistically complex with intensive sampling. Thus, most recently, this work has focused on gathering information that might improve these aspects of the final protocol. Specifically, ADF&G tested a "node and spoke" sampling design, to see if this design was more cost-effective and require less restrictive assumptions for estimating deer abundance and density over broad spatial scales and at varied deer densities. In addition, two different DNA sampling methods tested, the use of traditional and spatial mark-recapture models for population estimation was evaluated.

Preliminary results indicate that the node and spoke sampling design yielded good DNA estimates with coefficients of variation less than 21 percent, but evaluation shows the design logistically inefficient. This sampling design did not provide an advantage over other designs for density estimation. The node and spoke design required closely-spaced transect clusters or clusters covering a larger area, whereas, configurations such as circular, box, triangular, or grid transecting will better increase sampling efficiency. AD&G recommends using a clustered survey design with a high density of transects in each cluster, especially in low density areas (ADF&G 2014). In addition, ADF&G found the spatial mark-recapture models were more robust than more traditional mark-recapture techniques to changes in sampling intensity. While the spatial mark-recapture modeling yielded similar density estimates for a single-visit versus multiple visit sampling scheme, ADF&G cautions against single-visit approaches because the models likely would not work well in areas with lower deer densities, due to the lower fresh pellet encounter rates and recaptures (ADF&G 2014). Neither of the DNA sampling methods ADF&G tested (surface swabbing and dry storage versus whole-pellet storage in ethanol) were found to be preferred, but a combined use of both methods yielded an approximate 40 percent increase in genotyping success (ADF&G 2014).

**Mountain Goat Population Monitoring and Survey Technique Development:** ADF&G is developing techniques for estimating mountain goat population size. The Tongass became a cooperator on this project in 2009 to investigate sources of mountain goat aerial survey bias and develop statistical and field techniques needed to accurately estimate population size during routine monitoring surveys.

The goat monitoring involves conducting aerial surveys in areas known to have radio-marked goats. Population-level goat sighting probability (sightability) is determined by comparing the number of radio-collared goats seen in the area to the total number of radio-collared goats known to be in the area. In addition, data on potential behavioral and environmental factors influencing individual-level sightability is collected.

The ADF&G has been fitting mountain goats with radio collars in Southeast Alaska since 2005. A total of 354 goats were marked across four study sites (Haines, Lynn Canal, Baranof Island, and the Cleveland Peninsula). Data collected is being used to develop individual and population-level sighting probabilities. Sighting probabilities differ between the four study sites based on factors such as habitat type, terrain, group size, and time of day.

**Non-invasive Wolf Population Estimation Technique:** Game management unit 2 (GMU 2) reported a local wolf population decline and uncertainty remains about the level of harvest that is locally sustainable. Absent a more current and defensible estimate of the GMU 2 wolf populations, a sustainable harvest cap will be difficult to identify. Until recently, the annual harvest cap has been based on 30 percent of the population estimate derived in the 1990s (250 to 350 wolves), which resulted in a harvest cap of 90 wolves (ADF&G 2014). In 2010, the Board of Game adjusted the cap down to 60 wolves based on an assumption that wolf numbers were lower at that time than in the 1990s, but with uncertainty about the numbers (ADF&G 2014). Concurrent with anecdotal observations of fewer wolves, a decline in reported

seasonal wolf harvests was reported. Harvest data show that the 2008 – 2010 seasons had the lowest reported harvest for a three year period in the last 20 years (ADF&G 2012). There is recognition and concern that not all harvest is reported, which affects the quality of the data.

In response, ADF&G and the Tongass National Forest have initiated a study in central Prince of Wales Island to develop a means for evaluating wolf abundance, appropriate management levels, and sustainability. This project duplicates the study that was undertaken during the 1990s, with the capture, radio-collaring, and monitoring of a sufficient sample of wolves. In addition to the radio-collaring effort, wolf hair is being collected using non-invasive techniques (e.g., hair snares) to estimate numbers using mark-recapture methodologies. Data collected during 2013 was sufficient to use for a density estimate in the study area. When the density estimate was extrapolated to the GMU level, a population estimate of 221 wolves (95% CL = 130-378) was reached. This suggests a decline in wolf abundance but it is not possible to provide statistical certainty of a decline or a magnitude of any decline (ADF&G 2014). Regulatory actions are being reviewed to determine if changes are needed in the harvest cap, reporting guidelines or other associated regulations at the State level or in the Federal Subsistence Board rules.

### *Species Distributions*

**ISLES Medium and Large Mammal Salvage:** The University of New Mexico, in partnership with the Museum of Southwestern Biology, and in cooperation with the Forest Service and various Alaska agencies, completed field work on the Investigations of Southeast Landscapes including Endemic Species (ISLES) project in 2013 and turned in a final report during FY2014 (Cook, et al 2013). This project continued the effort started in 1991 to inventory small mammals to analyze the distribution, taxonomy, status, and genetic variability of potentially endemic mammals in Southeast Alaska; field collection occurred from 2009 through 2013. As part of the inventory, ISLES salvages medium and large mammal carcasses (including marten and black bear) from cooperating trappers and hunters. All specimens collected are identified using DNA techniques, vouchered and data entered into ARCTOS (http://arctos.database.museum/home.cfm), an online database of museum specimen data. Carcass salvage focused primarily on the Prince of Wales archipelago. Additional samples collected via the University of Alaska included Baranof, Chichagof, Kruzof, and Partofshikof Islands (all in the Sitka area) and the mainland.

**MIS Terrestrial Hab. Table 3. Summary of population status information from the most recently available ADF&G management and harvest reports**

| ADF&G Management Report of Survey & Inventory[2] | 1A | 1B | 1C | 1D | GMU 2 | GMU 3 | GMU 4 | GMU 5 |
|---|---|---|---|---|---|---|---|---|
| Brown bear: 1 July 2010–30 June 2012 | Stable | | | | Not present | Stable at low levels | Stable | No notable changes: appears stable |
| Black bear: 1 July 2010–30 June 2013 | Stable | Stable at low levels | No significant changes | Unknown, appears stable | Appears stable but monitoring is needed for potential decline | Suspected decline | Not present | No concerns |
| Wolf: 1 July 2008–30 June 2011 (ADF&G 2012) | Stable (p. 2) | Stable at high density (p. 10) | Appear to be increasing in Chilkat Range and Gustavus Forelands; continue to reside in all of the traditional areas (p. 18) | Stable (p. 25) | Fairly confident that numbers declined during the reporting period (p. 32) | Sustained at relatively high numbers (p. 41) | Not present | Stable (p. 49) |
| Deer: 1 July 2010–June 30 2012 (ADF&G 2013) | Very low abundance (p. 1) | Stable, low densities overall with localized variations (p. 15) | Mainland – stable but low density (p. 25); islands – rebounding from the 2006-07 severe winter (p. 23-25) | Not reported: prior report said abundant and stable to increasing | Stable to increasing (p. 38) | Declining; density well below carrying capacity with the possible exception of a few small islands (p. 52) | Rebounding from harsh winters of 2006-2008 (p. 66, 69) | Slight increases but weather conditions, limited habitat, and predation will hold to low population (p. 79) |
| Mountain goat: 1 July 2011 – June 30 2013 | Stable at moderate levels, except for Cleveland Peninsula which remains closed to hunting due to low population | Stable, except the Cleveland Peninsula which remains closed to hunting due to low population and Thunder Mountain which has increased | Medium to high densities | Low levels but appear stable to slightly increasing | Not present | Not present | Declining | Nunatak Bench population depressed / west of Harlequin Lake declining – both areas closed to hunting; east of Harlequin Lake appears sufficient |

[2] Brown bear, black bear, mountain goat, and furbearer management reports are in draft format for publication later in 2015 and are not in the "Citations" list

| ADF&G Management Report of Survey & Inventory[2] | 1A | 1B | 1C | 1D | GMU 2 | GMU 3 | GMU 4 | GMU 5 |
|---|---|---|---|---|---|---|---|---|
| Marten: 1 July 2009–30 June 2012 | Furbearers in 1A appear healthy and thriving | Common to abundant | Common along mainland drainages, absent from islands except occasionally seen on Douglas Island | Healthy | Furbearers in Unit 2 appear stable | Abundant or common and stable; exception is Kuiu Island where population is extremely low | Common | Common and relatively stable |
| Otter: 1 July 2009–30 June 2012 | Furbearers in 1A appear healthy and thriving | Common and stable | Common | Healthy and widespread | Furbearers in Unit 2 appear stable | Abundant or common and stable | Abundant and stable | Common and relatively stable |

*Note:* Reports were acquired from the ADF&G website; draft reports were provided by ADF&G. Harvest reports were reviewed for game management units (GMUs) 1 (Southeast Alaska, Dixon Entrance to Cape Fairweather), 2 (Prince of Wales and adjacent Islands), 3 (Petersburg, Wrangell and adjacent islands), 4 (Admiralty Baranof, Chichagof, and adjacent islands), and 5 (Yakutat: Cape Fairweather to Icy Bay, Eastern Gulf Coast). Examples of other data include, but are not limited to, hunter surveys, trapper questionnaires, sealing records, and field observations.

### *MIS Habitat Change*

**Conservation Strategy:** Changes in non-development land use designations (LUDs) on the Tongass are reviewed yearly. There have been no changes in LUDs due to land exchange or conveyance since signing of the 2008 Forest Plan. The Forest Plan contains a comprehensive conservation strategy using a system of old-growth LUDs designed to provide old-growth habitats in combination with other non-development LUDs to maintain viable populations of native and desired non-native fish and wildlife species and subspecies that may be associated with old-growth forests (USDA 2008b, pages 3-174 through 3-175). This strategy, which includes wildlife Forest Plan standards and guidelines for the matrix, was developed to maintain species viability.

**Productive Old-growth Habitat:** Changes to productive old-growth habitat and effects to the viability of wildlife species, including MIS, are described in the "Biodiversity Ecosystem" section of the Monitoring and Evaluation Report. Based on analysis in GIS, 2,707 acres of productive old-growth were harvested in FY2014 (see Biodiversity Ecosystem Table 1 in the "Biodiversity Question 3" section, Biodiversity Ecosystem: Matrix).

**Young-growth Management:** Based on the Forest Service Activity Tracking System (FACTS) database, 5,814 acres of young-growth forest on the Tongass was precommercial thinned in FY2014. Of this, 303 acres were designed with a wildlife habitat enhancement focus (FACTS Activity Code 6103). An additional 5 acres of openings were created for wildlife (FACTS Activity Code 6130). No slash treatments were done in FY2014. Over the last ten years (2005 – 2014), a total of 57,798 acres have been precommercially thinned on the Tongass National Forest, including 4,085 acres with a wildlife emphasis. In that same time period, 680 acres of openings were created for wildlife and 392 acres of slash were treated.

Thinning is a tool used to manage young-growth stands to accelerate growth and develop a mature forest structure. After clearcut harvesting, rapid establishment and regeneration of conifers, shrubs, and herbaceous plants are expected. For the first 15 to 25 years after clearcutting tree harvest, the young-growth stands provide a greater understory plant biomass than old-growth stands. However, an increase in snow accumulation, due to reduced cover, makes them less useful as winter habitat for some wildlife species such as deer. After 20 to 30 years, the forest canopy closes and enters the stem exclusion stage (Alaback 1982). Canopy closure can last up to 100 years or longer and eliminates most herbs and shrubs (Alaback 1982). The stands that subsequently develop are even-aged. Thinning reduces the standing stock of trees to a level that encourages better growing conditions through increased light and reduced competition for light, growing space and nutrients within the stand. This benefits wildlife by diversifying the structure and increasing the understory vegetation of the residual stand.

### *Habitat Studies*

**Monitoring the Effects of Young-growth Treatments:** The Tongass-wide young-growth studies (TWYGS) and the Prince of Wales commercial thinning study comprise the core of this monitoring. In addition to re-measurement of thinned and pruned second-growth experimental plots, work by the University of Wyoming on small mammal response to young-growth will provide evaluation of the effects of young-growth treatments on wildlife. Descriptions of these studies and the work in FY2014 are summarized for "Biodiversity Question 2" in the "Young-Growth Habitat" section of the 2014 Monitoring and Evaluation Report.

TWYGS experiments 1, 2, 3, and 4 have received a five-year post-treatment measurement. In May 2013, a research paper (Hanley et al. 2013) was published that disclosed and discussed the initial results from the first cycle of re-measurements. Initial results suggest that thinning in older young-growth stands provides a delayed understory response as compared to the TWYGS 2 and 3 modules. Modules 2 and 3 have also received a ten-year post-treatment measurement. It is expected that the 10-year results will be published in the next few years.

The 5-year first post-treatment measurement of the Prince of Wales commercial thinning stands was completed in 2014 and the data is currently being analyzed.

### *Habitat Monitoring Tools*

*MIS Terrestrial Hab. Photo 2. Sitka black-tailed deer*

**FRESH-Deer Model GIS Application:** The Forage Resource Evaluation System for Habitat, also known as FRESH-Deer (Hanley et al. 2012), evaluates habitat quality for deer on the basis of available food, its nutritional quality, and the nutritional requirements of the adult female segment of the population. The GIS application of FRESH-Deer is a stand-alone GIS and runs on a classified vegetation layer that is linked to class specific species composition, biomass, and nutrition data. These spatially linked forage data are analyzed in the application using the moving windows method.

This tool has potential for use in incorporating foraged-based deer habitat capability into landscape planning, project analyses, and monitoring. The Tongass has contracted with ESRI to bring the FRESH GIS application into a commonly used GIS environment. Specifically, FRESH will be programmed as an add-in for ArcMap. This will significantly improve the workflow of the spatial model by allowing the manipulation of both input and output data to occur in a single environment.

**Relationship of Wildlife Habitat to SDM Land Cover Classes:** The Tongass Size Density Model (SDM) uses tree density and mean tree diameter to describe and map forest structure. To incorporate the SDM into planning and management of wildlife habitat and populations, information was needed on the relationship of the size density map land cover classes and habitat for wildlife species of conservation concern. The Tongass worked with Northern Ecologic, L.L.C. to model the selection of size density land cover classes by several species including the following MIS: black bear, brown bear, river otter, mountain goat, red squirrel, Vancouver Canada goose, hairy woodpecker, red-breasted sapsucker, and brown creeper, based on information on habitat associations from published literature and agency reports. Additional variables, such as distance to streams and estuaries, distance to roads, and habitat fragmentation, were included in the models, when appropriate. Northern Ecologic, L.L.C. developed Bayesian Networks based on these models to facilitate application of the models. Models indicate that the species evaluated are associated with a wide range of habitat from less productive old-growth forests with open canopies to highly productive forests with large trees and moderate to closed canopies. Application of these results during planning can provided a basis to incorporate quality of habitat into management strategies.

## Evaluation of Results

Population and habitat trends are currently consistent with Forest Plan expectations. Forest Plan standards and guidelines maintain productive old-growth habitats in non-development LUDs and within the matrix in development LUDs (that include portions of the Tongass open to consideration for potential timber harvest). Habitat retained in beach, estuary, and riparian buffers is important to many MIS species, especially the bald eagle, brown bear, black bear, deer, goshawk, marten, and river otter. In addition, thinning activities have the potential to improve wildlife habitat.

A non-significant Forest Plan Amendment was included in the Big Thorne Project Record of Decision for modification of seven small old-growth reserves (OGRs). The net result of these changes is an increase of 645 acres being added to the OGR system as well as an increase of 107 acres of POG (USDA Forest Service 2014). All modified VCUs meet the criteria established by Appendix K of the 2008 Forest Plan and provide comparable achievement of the goals and objectives of the Old-Growth Habitat LUD.

The reduction in POG habitat in development LUDs has been less than projected in the Forest Plan. Since 2008, total volume harvested has averaged 32 MMBF annually, only 12 percent of the allowable harvest level of 267 MMBF. The 2008 Forest Plan ROD (USDA Forest Service 2008a, page 20) states there is no expectation that timber will be harvested at a continuous rate of 267 MMBF over the next planning cycle of 15 years. Even if management occurs at maximum allowable levels for 100 years, the implementation of the Forest Plan would result in a moderate to very high degree of assurance that there would still be sufficient habitat to support long-term viability of wildlife species. The conservation strategy provides a good to very good distribution of high quality old-growth reserves over the long term (USDA Forest Service 2008a, page 47).

## Action Plan

Recommendations for follow up on the management indicator species (MIS) monitoring include:

- Continue monitoring and assessment efforts that are currently in place. Continue to assess population status for MIS. Data sources should be reviewed at least every 5 years to assess trends in populations and habitats changes for MIS.
- Field data collection for ISLES was completed in the FY2013 field season, and the final report from University of New Mexico was received in FY 2014. This included a list of the reports, professional publications, and book chapters based on ISLES and on specimens collected as part of the ISLES project. All specimen data (over 2300 specimens) are available online through the ARCTOS specimen database. The Tongass will review the information developed to date by ISLES during FY2015.
- Evaluate the size density habitat models for use in Forest Plan monitoring and project analyses.
- Continue to monitor changes to the conservation strategy and productive old-growth habitat to assess effects to the population viability of MIS. Continue assessments of habitat trend methods.
- Continue assessing methods for estimating population abundance and trends. Finalize report for the DNA-based population estimation protocol for Sitka black-tailed deer; review and consider for future use in monitoring deer populations on the Tongass. Continue working with ADF&G to develop and implement non-invasive methods of estimating wolf populations and evaluating movements on GMU2 and elsewhere.
- Continue to monitor the implementation and effects of young-growth treatments. The TWYGS analysis of 10-year post-treatment measurement of TWYGS experiments is expected in the next few years. Data from the first post-treatment measurement for the Prince of Wales commercial thinning study will be analyzed in FY2015. Data analyses for the long-term response to thinning and pruning trials will be completed and reviewed. Data analysis for the small mammal and carnivore response to Tongass second-growth thinning is underway.

## Citations

Alaska Department of Fish and Game. 2013a. Trapper questionnaire stateside annual report, 1 July 2012-30 June 2013. Wildlife Management Report ADF&G/DWC/WMR-2013-5. Juneau, AK.

Alaska Department of Fish and Game. 2013. Deer management report of survey-inventory activities, 1 July 2010–30 June 2012. Harper, P., editor. Juneau, AK.

Alaska Department of Fish and Game. 2014. The status and outlook of Southeast Alaska's unit 2 wolves. Wildlife Management Report ADF&G/DWC/WMR-2014-2. Juneau, AK.

Alaska Department of Fish and Game. 2012. Wolf management report of survey-inventory activities, 1 July 2008–30 June 2011. Harper, P., editor. Juneau, AK.

Brinkman, T.J., D.K. Person, F.S. Chapin III, [and others]. 2011. Estimating abundance of Sitka black-tailed deer using DNA from fecal pellets. Journal Wildlife Management. 75: 232–242.

Brinkman, T.J., D.K. Person, M.K.Schwartz, [and others]. 2010. Individual identification of Sitka black-tailed deer (*Odocoileus hemionus sitkensis*) using DNA from fecal pellets. Conservation Genetics Resources, DOI 10.1007/s12686-010-9176-7.

Brinkman, T.J., M.K. Schwartz, D.K. Person, [and others]. 2009. Effects of time and rainfall on PCR success using DNA extracted from deer fecal pellets. Conservation Genetics Resources, DOI 10.1007/s10592-09-9928-7.

Cook J. A. and S.O. MacDonald. 2013. ISLES project final report September 2013. Museum of Southwestern Biology, University of New Mexico, Albuquerque. 29 p.

Handel, C.M. and M.N. Cady. 2004. Unpublished protocol. Alaska landbird monitoring survey: Protocol for setting up and conducting point count surveys. Sponsored by Boreal Partners in Flight. USGS Alaska Science Center, Anchorage.

Hanley, T.A., M.H. McClellan, J.C. Barnard and M.A. Friberg. 2013. Precommercial thinning: Implications of early results from the Tongass-wide young-growth studies experiments for deer habitat in Southeast Alaska. Research Paper. PNW-RP-593. USDA Forest Service, Pacific Northwest Research Station.

MacDonald, S.O. and J.A. Cook. 2007. Mammals and amphibians of Southeast Alaska. Special publication number 8. Museum of Southwestern Biology, University of New Mexico, Albuquerque. 191 p.

Person, D.K. and K. Titus. 2002. Unpublished data. Synopsis of ADF&G deer pellet group survey data for management unit 2. Alaska Department of Fish and Game. Douglas, AK. 11 p.

Suring, L.H. 1993. Habitat capability model for wildlife in Southeast Alaska. USDA Forest Service, Alaska Region, Juneau.

USDA Forest Service. 2013. Tongass National Forest five-year review of the 2008 land and resource management plan: Public outreach and comment analysis report. USDA Forest Service, Alaska Region Tongass National Forest.

USDA Forest Service. 2008a. Tongass Land and Resource Management Plan, Final Environmental Impact Statement, Plan Amendment, Record of Decision. Management Bulletin. R10-MB-603a. Juneau, AK: USDA Forest Service, Alaska Region Tongass National Forest.

USDA Forest Service. 2008b. Tongass Land and Resource Management Plan, Final Environmental Impact Statement, Plan Amendment, Volume 1. Management Bulletin. R10-MB-603c. Juneau, AK: USDA Forest Service, Alaska Region Tongass National Forest.

# 17. Wildlife Terrestrial Habitat: Special Status Species

**Goal:** Maintain the abundance and distribution of habitats, especially old-growth forests, to sustain viable populations. Also maintain habitat capability sufficient to produce wildlife populations that support the use of wildlife resources for sport, subsistence, and recreational activities.

**Objectives:** Provide sufficient habitat to preclude the need for listing species under the Endangered Species Act, or from becoming listed as sensitive due to national forest habitat conditions.

## Background

The National Forest Management Act requires that the Forest Service provide for the diversity of plants and animals, based upon the suitability and capability of each National Forest, as a part of meeting overall multiple use objectives (16 USC 1604(g)(3)(B)).

Further direction requires that fish and wildlife habitat be managed to maintain viable populations of existing native and desired non-native vertebrate species. In order to insure that viable populations will be maintained, habitat must be provided to support, at least, a minimum number of reproductive individuals and that habitat must be well-distributed so that those individuals can interact with others (36 CFR 219.3 [September 30, 1982]).

### *Sensitive Species*

In 2009, the sensitive species list for the Alaska Region of the Forest Service was revised in response to extensive coordination and consultation with other agencies and organizations, review and synthesis of the latest scientific information, and participation by staff of the Chugach and Tongass National Forests and the regional office. Forest Service sensitive species are defined as: "Those plant and animal species identified by a Regional Forester for which population viability is a concern, as evidenced by:

1. Significant current or predicted downward trends in population numbers or density
2. Significant current or predicted downward trends in habitat capability that would reduce a species existing distribution" (Forest Service Manual [FSM] 2670.5.19)

Per FSM 2672.11 (May 31, 1991), the following sources were examined for candidates for listing as sensitive species:

- State lists of endangered, threatened, rare, endemic, unique, or vanishing species, especially those listed as threatened under state law.
- Other sources as appropriate in order to focus conservation management strategies and to avert the need for Federal or state listing as a result of national forest management activities.

In addition, per USDA Alaska Region of the Forest Service manual supplement (2670-2672.11), the identification of sensitive species was based on the following:

- The species identified as candidates by the U.S. Fish and Wildlife Service (USFWS) and/or the National Marine Fisheries Service (NMFS) will be automatically designated as sensitive species in the Alaska Region. Candidate species are those species for which the USFWS has sufficient information on biological vulnerability and threat(s) to support a proposal to list, but working on a proposed rule is precluded by higher priority listing actions.
- The species (or subspecies, variety, or stock) must be recognized by taxonomic experts and must be known or likely to occur on national forest system lands within the Alaska Region. Sensitive species status applies throughout the range of the species on national forest system lands within the Alaska Region.

- The species warrants sensitive status (FSM 2670.5) based on eight evaluation factors in the Forest Service manual supplement:
    1. Geographic distribution within the Alaska Region
    2. Geographic distribution outside the Alaska Region
    3. Capability of the species to disperse
    4. Abundance in Alaska Region
    5. Population trend in Alaska Region
    6. Habitat trend in Alaska Region
    7. Vulnerability of habitats in the Alaska Region (recent and potential effects of habitat modification based on the historical range of variation [HRV])
    8. Life history and demographic characteristics

The following animal species were identified as Alaska Region of the Forest Service Sensitive Species:

- Kittlitz's murrelet (*Brachyramphus brevirostris*),
- Queen Charlotte goshawk (*Accipiter gentilis laingi*),
- Black oystercatcher (*Haematopus bachmani*),
- Aleutian tern (*Sterna aleutica*), and
- Dusky Canada goose (*Branta canadensis occidentalis*).

The USFWS released a "not warranted" finding for the Kittlitz's murrelet October 3, 2013. It is no longer being evaluated for that reason.

Although not on the 2009 Alaska Region Sensitive Species list, the yellow-billed loon (*Gavia adamsii*) was listed by the USFWS as a candidate species. The Tongass National Forest was therefore including this species when evaluating project effects. The USFWS released a "not warranted" finding October 1, 2014, after the period covered by this report (October 1, 2013 through September 30, 2014). The yellow-billed loon is included in this report but will no longer be evaluated in the future.

All species occur on the Tongass except the dusky Canada goose (although it may occur during migration).

**Yellow-billed Loon.** This species was designated a candidate species by the USFWS shortly after (March 2009) the Alaska Region Sensitive Species list was revised. According to the Forest Service Manual (Alaska Region Supplement R-10 2600-2005-1) all USWFS candidate species are automatically designated as Alaska Region sensitive.

The breeding range of the yellow-billed loon includes coastal the Arctic Coastal Plain, northwestern Alaska, and St. Lawrence Island. They nest in the Mackenzie Delta and west of Hudson Bay in Canada and along two relatively narrow strips of coastal tundra in Russia. They nest exclusively in coastal and inland low-lying tundra, in association with permanent, fish-bearing lakes. Their wintering range includes coastal waters of southern Alaska to Puget Sound; the Pacific coast of Asia from the Sea of Okhotsk south to the Yellow Sea, the Rants Sea and the coast of the Kola Peninsula; coastal waters of Norway; and possibly Great Britain.

The global breeding population for yellow-billed loons is estimated to be 16,000 to 32,000 individuals. The Alaska population is estimated at 3,000 to 4,000. Based on summer marine boat-based surveys, Earnst (2004) estimated the yellow-billed loon population in Southeast Alaska, Lower Cook Inlet, and Prince William Sound was 339 birds. However, this includes birds not identified to species. During boat-based surveys in 2002-2004 for murrelets from Icy Bay to LeConte Bay in Southeast Alaska, Kissling et al. (2007) counted 20 yellow-billed loons.

In their species assessment and listing priority assignment form for the yellow-billed loon, the USFWS (DOI species profile for yellow-billed loon (2012) at the USFWS Internet Website http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B0DQ 2014) reviewed the present or potential threats to yellow-billed loons throughout their range and concluded the collective impact of several stressors (such as oil and gas exploration and development, collisions, marine pollution, the effects of climate change, inadequacy of existing regulations, and fishing by-catch), when taken collectively could rise to the level of population-level effects. Aspects of the species ecology and demography including low and variable productivity, adult survival, and low population numbers are likely also relevant to its status. Populations of K-selected species such as the yellow-billed loon are stable when annual productivity rates are low, but annual survival rates are high. Thus, individuals must live a long time to replace themselves with offspring that survive to be recruited into the breeding population. If enough adults are removed from the population prior to replacing themselves, then the population will decline. If population size declines then recover and re-colonization would likely occur slowly, despite the fact that the species continues to be widely distributed across its range.

**Northern Goshawk (including the Queen Charlotte subspecies).** The northern goshawk favors dense stands of productive old-growth forest for nesting habitat. The USFWS was petitioned to list the Queen Charlotte goshawk subspecies of the northern goshawk as endangered in May 1994. Listing was found to not be warranted in 1997 due to the Tongass conservation strategy contributing substantially to goshawk habitat through the old-growth reserved system (and other non-development land-use designations) and through standards and guidelines protecting goshawk habitat in portions of the Forest open to timber harvest. In 2004 the finding that listing is not warranted was remanded back to the USFWS for further review to determine whether the Vancouver Island, British Columbia population is a significant portion of the subspecies' range and if so is listing warranted. In 2007 the USFWS published their finding that the Alaska and British Columbia populations of the Queen Charlotte goshawk constitute distinct population segments under the ESA, thus qualify for individual consideration as threatened or endangered. In addition, they concluded that again, they did not support listing the Alaska segment as threatened or endangered under the ESA because of protections provided by the Tongass conservation strategy. In 2012 the USFWS listed the British Columbia distinct population segment of the Queen Charlotte goshawk as threatened under the ESA.

Still, the Queen Charlotte goshawk is an Alaska Region sensitive species because (a) there is continued uncertainty about goshawks in some geographic areas with concentrated past timber harvest (e.g., Prince of Wales Island) which has resulted in a vulnerability of habitat conditions in those areas, (b) the goshawk population trend is unknown, and (c) management of the Tongass continues to play a large role in the conservation of this species (USDA Forest Service 2009).

The legacy standard and guideline of the 2008 Tongass Forest Plan replaces standards in the 1997 Forest Plan (USDA Forest Service 1997) related to northern goshawk foraging habitat. The legacy standard requires that old-growth forest structure (i.e., live trees, dead trees, and clumps of trees) be retained after timber harvest in Value Comparison Units (VCUs) that have had considerable past harvest (USDA Forest Service 2008b). The benefits of leaving clumps of forest structure within timber harvest units, compared to single trees, is well documented in the scientific literature, including studies on goshawk and their primary prey species. Clumps receive more use by wildlife and are more wind-firm than scattered residual trees. Applying the legacy standard and guideline in required VCUs is expected to contribute to the effectiveness of the matrix as part of the overall Forest conservation strategy (USDA Forest Service 2008a).

The TES wildlife species standard and guideline for northern goshawk (including the Queen Charlotte goshawk subspecies) provides further protections in the matrix: Maintain an area of no less than 100 acres of productive old-growth forest (if it exists) generally centered over the next tree or probable nest site (WILD4 II.A.1.C; USDA 2008b). Some management flexibility is allowed in stands where goshawks have been observed but no direct or indirect evidence of a confirmed nest is documented after 2 years of monitoring (WILD4 II.A.1; USDA 2008b).

**Black Oystercatcher.** The black oystercatcher is an intertidal obligate that favors rocky shorelines and forages in sheltered low-sloping gravel or rock beaches with abundant prey. It is listed by the U.S., Canada, Alaska, British Columbia, Washington, Oregon, and California shorebird plans as a species of high concern by Audubon as a watch list species, by USFWS as a focal species, and is a Chugach National Forest management indicator species. The greatest threats to this species are thought to be development of their habitat, oil spills, and sea level rise associated with climate change. Black oystercatchers have a small global population (estimates of 8,500 to 11,000 individuals) with distribution from the Aleutian Islands down the Pacific Coast to Baja California. The majority (65 percent) of the population breeds in Alaska. Populations were affected by the 1989 Exxon Valdez oil spill in Prince William Sound, recovery has been slow, and oil still lingers in nesting areas. Extensive data collection has occurred the past 5 years from Kodiak Island to British Columbia showing these long-lived birds have high site fidelity, but low reproductive rates and high inter-annual variability in nest success. Chick survival is low due to several natural and human-induced factors, including snow conditions, timing, prey availability, nest predation, and human use. Because viability of this species remains a concern and populations in some areas have dramatically declined due to unknown causes (from 48 pairs to 2 pairs in Sitka Sound), and there is high overlap between nest sites and areas permitted for recreational use (e.g., Prince William Sound), the black oystercatcher is an Alaska Region sensitive species (USDA Forest Service 2009).

**Aleutian Tern.** The Aleutian tern relies on islands, shrub-tundra, grass or sedge meadows, and freshwater and coastal marshes for nesting. Aleutian terns breed in Alaska and Siberia. Viability concerns for this species stem from the loss or size reduction of colonies in Kodiak, Prince William Sound, Yakutat, and Icy Bay. The largest colonies on record exist or existed on the Cordova (Chugach National Forest) and Yakutat Ranger Districts. Some colonies are in remote sites, whereas others are in areas where the Forest Service can manage perturbations of sites (e.g., Black Sand Spit in Yakutat). The Aleutian Tern Working Group recently reviewed the species status, natural history, uses, and threats; the data suggest to the Working Group a range-wide population decline. Suspected causes are both natural and human-induced (e.g., isostatic rebound, structural changes in vegetation, shifts in forage prey populations, disturbances from human activities, access allowed through special use permits). Little is known about migratory routes, wintering range, diet, and chick provisioning. Possible migration routes include coastal south China, Taiwan, Korea, Philippines and other parts of Southeast Asia. Based on steep declines in the population of the large breeding areas on Forest Service lands, and the potential for overlap of management activities with those breeding sites, the Aleutian tern is an Alaska Region sensitive species.

*Special Status Species Photo 1. Stellar sea lion,* Eumetopias jubatus*, aerial surveys on Yakutat Ranger District in 2007*

### *Threatened and Endangered*

**Steller Sea Lion.** Based on demographic and genetic dissimilarities, the NMFS divides the Steller sea lion population into eastern and western distinct population segments (DPSs) with the dividing line at 144° W. The western DPS (WDPS) is listed as endangered and consists of Steller sea lions from breeding colonies west of the line. Breeding colonies in Southeast Alaska are within the eastern

DPS (EDPS) and during a portion of this reporting period were listed as threatened. The eastern DPS was delisted by the NMFS effective December 4, 2013. The Tongass National Forest will continue to evaluate for five years after the delisting. This report shows sea lion eastern DPS as threatened if analyzed prior to the delisting and as sensitive if analyzed post-delisting.

There is evidence that the EDPS and WDPS travel across the DPS boundary to varying degrees based on sex and the location of their natal rookery (Jemison et al. 2013). In their study of the sightings of over 4,000 sea lions that had been branded as pups from year 2000-2010 Jemison et al. (2013) found that male sea lions regularly traveled across the DPS boundary. The probability of females from the WDPS being in the east at age 5 was 0.67, but EDPS females were rarely in the west. In addition, there is strong evidence of WDPS females permanently emigrating to the east and reproduced at two mixing zone rookeries in northern Southeast Alaska. WDPS animals began moving east in the 1990s, following steep population declines in the central Gulf of Alaska (Jemison et al. 2013). However, the cause for the movement east is unknown. The WDPS remains listed as endangered.

The estimated growth rate for the total EDPS is about 3 percent using non-pup counts or more when pup counts are used. This data was based on the most recent survey data available to NMFS at the time of delisting (Federal Register, Vol. 78, Number 213, November 4, 2013). Regulatory mechanisms under the Marine Mammal Protection Act (MMPA) and other laws will continue to reduce or minimize possible adverse effects of disturbance from human activity. The NMFS review of listing factors and associated criteria did not find any threats significant enough to prevent the EDPS delisting.

The increasing population trend and robust reproduction indicate that global warming and ocean acidification are not impeding recovery. There is no indication that commercial, recreational, and subsistence fisheries are threatening survival or recovery. Incidental take by commercial fisheries is relatively small as well as entanglement wand illegal take. There are currently no commercial harvest or predator control programs in the US that authorize the take of Steller sea lions. Noise and disturbance from coastal development, tourism, and industry will still be regulated under the MMPA which will minimize adverse effects from human activity. Toxic substances that bioaccumulate may pose a threat but current evidence suggests that at this time, they are not placing sealions in danger of extinction. Pollution from the petroleum industry, particularly spills near a large rookery, could affect portions of the population but are unlikely to threaten a significant portion of the species range. The risk of disease is a growing concern and likely higher than was known when the Recovery Plan was written. However, available information does not indicate population level effects at this time.

Most of the factors associated with threats to sea lions are not within the jurisdiction of the Forest Service. Threatened, endangered, and sensitive species standards and guidelines for the Tongass National Forest are designed to prevent and/or reduce potential harassment due to activities carried out by or under the jurisdiction of the Tongass.

**Humpback Whale.** NMFS recently released a proposed revision of the species-wide listing for humpback whales (Federal Register, Vol. 80, Number 76, April 21, 2015). A comprehensive status review was completed and NMFS is proposing to divide the global population into 14 distinct DPSs, remove the species-wide listing and in its place list 2 DPSs as threatened and 2 DPSs as endangered. In October 2014, the Committee on Taxonomy of the Society for Marine Mammalogy (SMM) updated its species and subspecies list to recognize a North Atlantic, North Pacific, and Southern Hemisphere humpback whale populations as subspecies.

There is strong evidence that the humpbacks in Southeast Alaska belong to the Hawaii DPS, which is part of the newly recognized North Pacific subspecies (*Megaptera novaeangliae kuzira*). About half of the North Pacific humpback whales breed and calve in the waters off Hawaii. Summer feeding areas include northern British Columbia, Southeast Alaska, and the Gulf of Alaska. There is strong fidelity to both feeding and breeding sites. The estimated population of humpback whales frequenting Hawaii is about 10,000 to 12,000 individuals with the most recent growth rate estimates between 5.5 percent and 6

percent (moderately increasing).

Fishing gear entangled is a medium threat to humpback whales in this DPS. The highest rates of interaction with fishing gear are in Southeast Alaska and northern British Columbia. Fatal entanglements have been recorded in all areas and may be underestimated due to the isolated nature of their range. However, with the overall DPS abundance and increasing population trend, this threat does not appear to pose a significant risk of extinction to the DPS now or in the foreseeable future (approximately 60 years).

All other threats are considered likely to have no or minor impacts on population size and/or growth rate, or are unknown but assumed to be minor because of the abundance and increasing population trend. Other potential threats analyzed include: continued coastal development activities since the Hawaii DPS inhabits some of the least populated areas along the Alaska and Canada coasts; pollutants and toxins, both human-caused and naturally occurring; commercial whaling, aboriginal hunting, and take for research purposes; disturbance from increased whale-watching; disease and predation; impacts from commercial fishing and aquaculture; underwater noise from human activities such as vessel traffic, coastal construction, and Naval testing; ship strikes; and climate change.

Tongass management activities that may have an effect on whale habitats or populations generally fall in the acoustic disturbance and habitat degradation categories. These management activities include: the development of log transfer facilities (LTF) and associated camps, the movement of log rafts from LTFs to mills, and the development of docks associated with mining, recreation, and other forest uses and activities (USDA Forest Service 2008c). Potential effects of LTFs and other docks on humpback habitat are the reduction of prey through disturbance of their habitat and disturbance to whales by boat traffic associated with the LTFs and docks (USDA Forest Service 2008c). The final EIS for the 2008 Forest Plan estimated less than 2 acres of benthic habitat would be disturbed per LTF because many sales require that logs be loaded on barges rather than placed in the water.

**Fin Whale.** The fin whale is rare in offshore waters of Southeast Alaska. Once common in inshore areas of Southeast Alaska, they have not been seen there after they were removed by commercial whaling (Dahlheim et al. 2009; Allen and Angliss 2012). Between 1991 and 2007, researchers from the Alaska Fisheries Science Center's National Marine Mammal Laboratory conducted cetacean surveys throughout the inland waters of Southeast Alaska (Dahlheim et al. 2009). Fin whales were first observed during this study off the southern tip of Prince of Wales Island in 2004 and again in 2005 in lower Clarence Strait (near Gravina Island). Fin whale observations occurred in areas exposed to the open ocean or in channels in proximity to the open ocean areas exposed to the open ocean or in channels in close proximity to open ocean.

Like the humpback whale, they have baleen plates that they use to prey upon a wide variety of small schooling fish and invertebrates. In fact, fin, humpback, and minke whales along with Atlantic white-sided dolphins are often seen feeding in large groups in the North Atlantic (Jefferson et al. 2008 [in the National Oceanic and Atmospheric Administration Internet Website http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/finwhale.htm 2013]). Prey (particularly krill and herring) distribution, density, and seasonality in Southeast Alaska appear to be correlated with the local distribution of humpbacks.

The fin whales in U.S. waters are split into four stocks for management purposes: Hawaii, California/Oregon/Washington, Alaska (Northeast Pacific), and Western North Atlantic. Although portions of the Alaska area have been surveyed, reliable estimates of current and historical abundance of fin whales throughout their Alaska range do not exist (NOAA Internet Website http://www.nmfs.noaa.gov/pr/species/finwhale.htm 2013). Current threats to fins whales include vessel strikes, entanglement in fishing gear, reduced prey abundance due to overfishing, habitat degradation, and disturbance from low frequency noise. Changes to prey distribution from climate change, oil and gas activities in the Chukchi and Beaufort Seas, and increased shipping in higher latitudes with sea ice changes are also potential impacts to habitat.

# Wildlife Question: *Is current management providing for sufficient habitat of federally listed threatened and endangered species and Alaska Region sensitive species?*

## Evaluation Criteria

We summarize the effects determinations made in fiscal year 2014 to fulfill the section 7 (a)(c) of the Endangered Species Act mandate. In the case of the Queen Charlotte goshawk, we also report the implementation of goshawk nest surveys. See the Biodiversity Ecosystem Question for a report of the implementation of the legacy standard and guideline.

## Monitoring Results

### *Section 7 Consultation*

Tables 1 and 2 summarize the number of effects determinations by species made for Tongass proposed projects in FY2014. Direction for the determination language is provided by the Endangered Species Consultation Handbook (http://www.nmfs.noaa.gov/pr/pdfs/laws/esa_section7_handbook.pdf) for threatened and endangered species and by FSM 2670 for Forest Service Sensitive species. ESA threatened and endangered species and Forest Service sensitive species are summarized separately. Only effects determination for species, or their habitats, that may occur in the project area are listed.

No projects proposed in FY2014 on the Tongass are likely to have an adverse effect to threatened or endangered species. Most of the projects proposed in FY2014 are expected to have no effect on threatened and endangered wildlife or their habitat. Projects include special use permit renewals, trail maintenance, boat launch improvements, two small timber sales, precommercial thinning, fishpass maintenance, and communication site maintenance.

Only one proposed project may affect listed species or their habitat but the effects are expected to be insignificant or discountable. Vessel traffic and related Marine Access Facility activity associated with the action alternatives of the Saddle Lakes Timber Sale EIS, located near Ketchikan on Revillagigedo Island, could have short-term minor effects to humpback whales. Forest Service operations, including those of permit holders and contractors, are required to follow the Marine Mammal Protection Act, further reducing anticipated effects. Saddle Lakes Timber Sale is the largest project analyzed in FY2014 on the Tongass.

**Special Status Species Table 1. The number of proposed projects on the Tongass National Forest in FY2014 for which the biological assessment made a "no effect", "may affect but not likely to adversely affect", and "likely to adversely affect" determination for federally listed threatened and endangered wildlife species or their habitat**

| | Threatened and Endangered Wildlife Species | | | | |
|---|---|---|---|---|---|
| | | | Steller Sea Lion | | |
| Determination | Humpback Whale | Listed Salmon Species | East DPS | West DPS | Fin Whale |
| # No effect | 10 | 2 | 1 | 8 | 5 |
| # May affect, but not likely to adversely affect – beneficial | 0 | 0 | 0 | 0 | 0 |
| # May affect, but not likely to adversely affect – insignificant or discountable | 1 | 0 | 0 | 0 | 0 |
| # Likely to adversely affect | 0 | 0 | 0 | 0 | 0 |

*Note*: The number of determinations of "may affect but not likely to adversely affect" are further split by whether the likely response would be "insignificant" or discountable" versus "beneficial".

No proposed projects are likely to cause a loss of viability of Alaska Region sensitive species (Table 2). The majority of "may adversely impact individuals, but not likely to result in a loss of viability in the planning area, nor cause a trend toward Federal listing" determinations were for the Queen Charlotte goshawk. These projects included the Saddle Lakes Timber Sale, fishpass maintenance, precommercial thinning, trail work, and tree removal at a communication site. An additional seven projects are expected to have no impact on goshawks.

**Special Status Species Table 2. The number of proposed projects on the Tongass National Forest in FY2014 for which the biological evaluation made a "no impact", "beneficial impact", "may adversely affect individuals but not populations" and "likely to result in loss of viability" determination for Alaska Region sensitive wildlife species or their habitat**

| | Alaska Region Sensitive Wildlife Species | | | | | |
|---|---|---|---|---|---|---|
| **Determination** | **Northern Goshawk** | **Black Oyster-catcher** | **Steller Sea Lion eastern DPS** | **Aleutian Tern** | **Yellow-billed Loon** | **Dusky Canada Goose** |
| # No impact | 7 | 8 | 7 | 8 | 11 | 8 |
| # Beneficial impact | 0 | 0 | 0 | 0 | 0 | 0 |
| # May adversely affect individuals, but not likely to result in loss of viability in the planning area, nor cause a trend toward Federal listing | 5 | 0 | 1 | 0 | 0 | 0 |
| # Likely to result in a loss of viability in the planning area or in a trend toward Federal listing | 0 | 0 | 0 | 0 | 0 | 0 |

### *Northern Goshawk Nest Surveys*

A total of 25 goshawk call station surveys were conducted across three districts in FY2014 (Table 3). No responses to calls were detected. No new active goshawk nests were found. One historic nest location was surveyed on the Juneau Ranger District and found the nest in usable condition. In addition, an area about 0.6 acres surrounding a potential drill site at the Hecla/Greens Creek Mine had a tree-by-tree inspection for nests and nesting activity using binoculars; no nests or nesting activity was observed.

**Special Status Species Table 3. Goshawk call station surveys were conducted across two districts including two projects in FY2014**

| Ranger District | Project / Location | Number of Broadcast Call Station Surveys | Number of Active Nests N = New H = Historic |
|---|---|---|---|
| Juneau | MGRA | 10 | 0 |
| Thorne Bay | Kosiusko IRMP | 12 | 0 |
| Sitka | Kruzof Island | 3 | 0 |
| Total | | 25 | 0 |

## Evaluation

Forest Plan standards and guidelines were developed to minimize or eliminate adverse impacts to the humpback whale, Steller sea lion, and northern goshawk (including the Queen Charlotte goshawk) and maintain island, beach, and estuary habitat important to the Aleutian tern and black oystercatcher. Standards and guidelines for the humpback whale minimize or eliminate adverse impacts to fin whales as well.

The current 2008 Forest Plan standards and guidelines for northern goshawk were based on knowledge that goshawks preferentially nest in productive old-growth. Goshawks are also known to nest in young-growth where they will generally choose the largest diameter tree of stands with canopy cover greater than 50 percent (McClaren 2004). Recommendations by the British Columbia Ministry of Water, Land, and Air Protection (BC Ministry) for harvesting and silviculture related to managing the Queen Charlotte goshawk are for "no commercial thinning within the core area" (McClaren 2004). Core areas are defined by the BC Ministry as areas that are "protected from habitat alteration" and for goshawk they equate the core area to the post fledgling area [PFA]). The BC Ministry guidance does allow for commercial thinning "within the management zone provided the activities promote the structural characteristics of forest for goshawk foraging (e.g., low density thinning of young seral stages to promote older structural attributes)." Management zones are defined by the BC Ministry as areas where disturbances during critical times, or disturbances to the core area, is to be minimized (McClaren 2004).

Based on the above, the FY2012 Monitoring and Evaluation Report indicated that a review of the 2008 Forest Plan standards and guidelines in relation to young-growth management and goshawk ecology and conservation that includes a review of BC Ministry guidance is warranted. This information was submitted as part of the 5-year review of the Forest Plan and captured in the Public Outreach and Comment Analysis Report (USDA Forest Service 2013). Based on conditions on the land and demands of the public, the Tongass has determined that it will modify the Forest Plan. Among other things, the modification is expected to focus on identifying the timber base suitable to support a transition to young-growth management, in a way that supports the continued viability of the forest industry in Southeast Alaska, per the direction of Secretary of Agriculture Tom Vilsack.

Since implementation of the 2008 Forest Plan, the legacy standards and guidelines or the 1997 Forest Plan goshawk and marten standards and guidelines have been implemented where applicable and have contributed towards the overall conservation strategy for goshawk. The category 1 timber sales, which were exempted in the 2008 Forest Plan ROD from application of the legacy standards and guidelines, have largely been completed. Category 2 timber projects, for which application of the legacy standards and guidelines is encouraged, but not required, will continue to adopt the standards and guidelines where it will not disrupt their implementation. The 2008 Forest Plan legacy standards and guidelines and northern goshawk standards and guidelines, as well as the 1997 Forest Plan goshawk and marten standards and guidelines, along with the old-growth-reserve network of the conservation strategy coupled with the 1,000-foot-wide beach buffers and other features that provide habitat connectivity, provide a strong foundation for maintaining goshawk populations across the Tongass. Overall, at least 91 percent of the existing productive old-growth (83 percent of all old-growth that ever existed on the Tongass) would remain on the Tongass, even if timber were harvested at the maximum level allowed by the Forest Plan for 100 consecutive years.

The Forest Service activities that result in "may affect" determinations are related either to potential disturbance associated with the connected actions of marine traffic (acoustic disturbance and increased potential for vessel strikes) and LTF reconstruction activities (possibility of acoustic disturbance and pollution). Forest Plan standards and guidelines direct the Tongass to prevent and/or reduce potential harassment of Steller sea lions and humpback whales due to activities carried out by or under the jurisdiction of the Forest Service (USDA Forest Service 2008b). Construction and operation of all LTFs and similar facilities require U.S. Army Corps of Engineers and U.S. Environmental Protection Agency permits and State of Alaska Tidelands permits. The permitting process provides that construction and operations maintain water quality in the specific facility locations, and that marine circulation and flushing are maintained. All facilities must conform to permit standards. In addition, the section 7 of the ESA directs each Federal agency to, in consultation with and with the assistance of the Secretary of the Interior, insure that any action authorized, funded, or carried out by such agency (the "agency action") is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species. No effects to the marine environment

which would adversely affect whale prey species are expected (USDA Forest Service 2008c). In addition, the amount of human activity in the marine environment associated with Forest management activities is only a fraction of the total amount of overall human activity occurring in Southeast Alaska. The Forest Service does not regulate many of these activities (e.g., commercial fishing, sport fishing, hunting, and mariculture). However, it will be important to continue to monitor our section 7 effects determination for these species so that we are aware should this change.

## Action Plan

- The Forest Plan amendment team has reviewed the 2008 Forest Plan northern goshawk standards and guidelines in light of goshawk nesting in young-growth stands and recommendations will be incorporated into standards and guidelines in the amendment. The Forest Plan amendment team also incorporates recommendations to include VCUs 5770 and 6220 in the legacy standards and guidelines.
- Review biological evaluations and assessments annually to determine effects of agency actions that may affect TES species.
- Review new research, inventories, and monitoring related to TES wildlife species habitat every 5 years.

## Citations

Allen, B.M. and R.P. Angliss. 2012. Alaska marine mammal stock assessments, 2011. U.S. Department of Commerce, NOAA. Technical Memo. NMFS-AFSC-234. 288 p.

Dahlheim, M.E., P.A White, and J.M. Waite. 2009. Cetaceans of Southeast Alaska: Distribution and seasonal occurrence. Journal of Biogeography. 36: 410-416.

Earnst, S.L. 2004. Status assessment and conservation plan for the yellow-billed loon (*Gavia adamsii*). U.S. Geological Survey. Scientific Investigations Report 2004-5258. 42 p.

Jemison, L.A., G.W. Pendleton, L.W. Fritz [and others]. 2013. Inter-population movement of Steller sea lions in Alaska with implications for population separation. PLoS ONE 8(8): e70167. Doi:10.1371/journal.pone.0070167.

Kissling, M.L., K.J. Kuletz, S.P. Brockman, N.R. Hatch. 2007. Unpublished report. Distribution and abundance of *Brachyramphus* murrelets and other marine species from Icy Bay to Leconte Bay, Southeast Alaska, 2002-2004. Juneau, AK: U.S. Department of Interior, Fish and Wildlife Service. 72 p. + appendices.

McClaren, E. 2004. Queen Charlotte Goshawk. *In* British Columbia Ministry of Water, Land and Air Protection. 2004. Accounts and Measures for Managing Identified Wildlife. Version 2004. Biodiversity Branch, Identified Wildlife Management Strategy, Victoria, BC. http://www.env.gov.bc.ca/wld/documents/identified/iwABNKC12062.pdf [Accessed May 6, 2015]

National Marine Fisheries Service. 2013. Endangered and Threatened Species; Delisting of the Eastern distinct population segment of Steller sea lion under the Endangered Species Act; Amendment to special protection measures for endangered marine mammals. Federal Register. 78 (213). November 4, 2013.

National Marine Fisheries Service. 2015. Endangered and Threatened Species; Identification of 14 distinct population segments of humpback whale (*Megaptera novaeangliae*) and proposed revision of species-wide listing. Federal Register. 80 (76). April 21, 2015.

USDA Forest Service. 2013. Tongass National Forest five-year review of the 2008 land and resource

management plan: Public outreach and comment analysis report. Juneau, AK: USDA Forest Service, Tongass National Forest.

USDA Forest Service. 2009. 2009 Forest Service Alaska Region sensitive species list: Assessment and proposed revisions to the 2002 list. Alaska Region, Juneau.

USDA Forest Service. 2008a. Tongass Land and Resource Management Plan, Final Environmental Impact Statement, Record of Decision. Management Bulletin. R10-MB-603a. Juneau, AK: USDA Forest Service, Alaska Region, Tongass National Forest.

USDA Forest Service. 2008b. Tongass Land and Resource Management Plan. Management Bulletin. R10-MB-603b. Juneau, AK: USDA Forest Service, Alaska Region, Tongass National Forest.

USDA Forest Service. 1997. Tongass Land and Resource Management Plan Revision: Final Environmental Impact Statement. Management Bulletin. R10-MB-338b. USDA Forest Service, Alaska Region, Tongass National Forest.

# 18. Wildlife Terrestrial Habitat: Endemic Mammals

**Goal:** Maintain the abundance and distribution of habitats, especially old-growth forests, to sustain viable populations. Also, maintain habitat capability sufficient to produce wildlife populations that support the use of wildlife resources for sport, subsistence, and recreational activities. Maintain ecosystems capable of supporting the full range of native and desired non-native species and ecological processes. Maintain a mix of representative habitats at different spatial and temporal scales (USDA Forest Service 2008).

**Objectives:** Provide sufficient habitat to preclude the need for listing species under the Endangered Species Act, or from becoming listed as sensitive due to National Forest habitat conditions. Manage young-growth to improve habitat for wildlife and commercial timber products. Include a young-growth management program to maintain, prolong, and/or improve understory forage production and to increase future old-growth characteristics in young-growth timber stands for wildlife (USDA Forest Service 2008).

**Background:** The National Forest Management Act requires that the Forest Service provide for the diversity of plants and animals, based upon the suitability and capability of each National Forest, as a part of meeting overall multiple use objectives (16 USC 1604(g)(3)(B)). This direction requires that fish and wildlife habitat be managed to maintain viable populations of existing native and desired non-native vertebrate species. In order to insure that viable populations will be maintained, habitat must be provided to support, at least, a minimum number of reproductive individuals and that habitat must be well distributed so that those individuals can interact with others (36 CFR 219.3).

Due to its historic isolation, ecological complexity, and narrow distribution between the Pacific Ocean and coastal mountain ranges, the North Pacific Coast is considered a hot spot for endemism (Demboski et al. 1999; Cook and MacDonald 2001; Cook et al. 2006). The Endangered Species Act defines endemic as "a species native and confined to a certain region; having comparatively restricted distribution." Southeast Alaska has an especially high degree of endemism in its small mammal fauna, principally because of the combination of its archipelago geography and its highly dynamic glacial history (Demboski et al. 1998). Roughly 23 percent of the mammal taxa in Southeast Alaska (species and subspecies) are endemic to the region. Recent molecular genetic analyses have enabled a more accurate look at the level of genetic divergence among island and the mainland populations than previously possible. These analyses have refuted the classification of some taxa previously believed to be endemic and identified other taxa as endemic (see Dawson et al. [2007] for a current list of species and associated ranges).

Much of our understanding of endemism in Southeast Alaska is based on sampling conducted in the 1990s, much of which was conducted by the Museum of Southwestern Biology, University of New Mexico (UNM) and in collaboration with the Tongass (Cook et al. 2006). A little over 100 of the more than 2,000 named islands in Southeast Alaska were surveyed during this time. Thus, there continues to be a gap in knowledge about the natural history and ecology of wildlife subspecies indigenous to Southeast Alaska and conclusive geographic ranges of many endemics could not be produced (Hanley et al. 2005).

The Prince of Wales Island complex appears to be an endemic hotspot based on evidence that it was an area of refugia during the last glacial event (Cook et al. 2001). This has implications for management because there is notable overlap between this area, past timber harvest, and the potential for future timber harvest (Cook et al. 2006). The island archipelago setting of the Tongass and the naturally fragmented landscapes of Southeast Alaska create challenges for management as natural interactions between subpopulations and individuals is problematic, especially for species that cannot move between islands. This is illustrated by the lower genetic variability documented in island populations of northern flying squirrel (*Glaucomys sabrinus*) compared to those on the mainland (Bidlack and Cook 2001, 2002).

Other recent research on the demography, systematics, phylogeography, and post-glacial expansion of Southeast Alaska endemics has focused on the red backed vole (*Myodes rutilus* and *M. gapperi*) (Runck 2001; Cook et al. 2004; Smith and Nichols 2004; Runck and Cook 2005; Smith et al. 2005), long-tailed

vole (*Microtus longicaudus*) (Conroy and Cook 2000), Keen's mouse (*Peromyscus keeni*) (Lucid and Cook 2004; Smith et al. 2005), dusky shrew (*Sorex monticolus*) (Demboski and Cook 2001), cinereus shrew (*Sorex cinereus*) (Demboski and Cook 2003), ermine (*Mustela erminea*) (Fleming and Cook 2002), marten (*Martes* spp.) (Stone and Cook 2002; Stone et al. 2002), wolverine (*Gulo gulo*) (not endemic, but isolated populations with limited dispersal capability occur in Southeast Alaska [Tomasik and Cook 2005]), and black bear (*Ursus americanus*) (Stone and Cook 2000; Peacock et al. 2007).

Major factors identified by these studies include reduced genetic diversity, limited dispersal capabilities, and the existence of highly divergent or relatively restricted western or Pacific coastal lineages of some species. This last factor was due to the existence of eastern and western forest refugia in North America during past glacial advances, all resulting in populations that are especially vulnerable to environmental stochastisity and anthropogenic disturbances.

Due to their isolation, island archipelagos themselves are more sensitive to the effects of introduced exotics, emerging pathogens and disease (e.g., canine distemper), and natural events, than other managed landscapes. Therefore, there is a higher probability of extinction on islands due to the restricted ranges of species, patterns of extinction are dynamic (i.e., in higher latitude archipelagos geographic ranges of mammals and recolonization abilities fluctuate with glacial advances and retreats), and the effects of management activities are magnified. In fact, more than 81 percent of mammalian extinctions in the last 500 years have been insular, endemic mammals (Ceballos and Brown 1995; as cited in Dawson et al. 2007). Notably, while the distribution of mammalian species in Southeast Alaska is a function of the size of the island on which they occur and distance to the mainland, the distribution of endemic mammals is not (Conroy et al. 1999; Dawson et al. 2007). Thus, designing conservation measures based on island size or location will not effectively maintain the endemic diversity found in this region. Because of the uniqueness of this type of geographic setting and the vulnerability of species within it, some researchers have proposed structuring conservation efforts and land management planning along the North Pacific Coast around the issue of endemism (Cook and MacDonald 2001; Cook et al. 2001).

## Wildlife Question: *What is the geographic distribution and habitat relationship of mammalian endemic species on the Tongass?*

### Evaluation Criteria

The geographic distribution and habitat relationship of mammalian endemic species on the Tongass is be determined by reviewing new information. Recent research helps assess the distribution and habitat relationship of endemic mammal species.

### Monitoring Results

The University of New Mexico (UNM) and the Tongass collaborated to inventory mammals and their distribution on the Tongass through the ISLES (Island Surveys to Locate Endemic Species) project between 2009 and 2013. This work was a continuation of mammal inventory work that started in 1991. The final report on their research was received in FY2014.

Work with the University of Wyoming (UW) to identify the understory vegetation most important to small mammal (including endemic species) diversity and abundance in young-growth forests on Prince of Wales Island occurred from 2010 through 2012, with a final report being received in FY2014.

#### *Island Surveys to Locate Endemic Species*

Small mammals were collected using traplines of snap and pitfall traps. In some cases, live-traps were used (for animals to be karyotyped) and rat traps were employed when targeting larger species (like ermine and flying squirrels). UNM also salvaged mammal carcasses from cooperating trappers and hunters. All specimens collected were identified using DNA techniques, vouchered, and the information

was entered into ARCTOS (an online database of museum specimen data http://arctos.database.museum/home.cfm) (Cook and MacDonald 2012). The specimens and associated information are geo-referenced for use in a geographic information system (GIS).

Highlights of their efforts include:

- A total of 2,056 small mammals were captured from 2009 through 2013.
- Over 500 black bear (*Ursus americana*) specimens from previous research were processed, data based and archived.
- More than 2300 small mammals and salvaged furbearer specimens can be accessed in the ARCTOS database.
- Eight endemic mammalian lineages have been identified within the Alexander Archipelago; 24 of 107 mammal taxa were recognized as endemic based on morphological characteristics.
- Preliminary Niche Modeling efforts (species distribution model) suggest habitat capability will change throughout the region under climate warming scenarios, particularly on the southern outer islands (Prince of Wales group).
- Multiple education presentations given during a Scientist in Residency program in Sitka during the fall of 2013.
- Numerous journal articles, books or book chapters, graduate research work, and scientific presentations (symposia and general public audiences).
- Participation in a National Science Foundation funded Research Coordination Network called Advancing Integration of Museums into Undergraduate Programs (AIM-UP). This led to a web-based educational module for use in college courses: http://www.aim-up.org/educational-modules/educational-module-1-island-biogeography.

For a complete list of the publications, see the final report (MacDonald and Cook 2013). Additional information about the ISLES project, including links to publications, can be found at http://msb.unm.edu/divisions/mammals/research/projects/isles.html.

The final report also contains five recommendations for future work on Tongass biodiversity:

- Comprehensive management plan aimed at preserving the endemic biota and natural ecosystems of the Alexander Archipelago,
- Rigorous, integrated inventories of all islands over 500 hectares,
- Monitoring efforts to provide information and sampling to assess environmental change,
- Build partnerships to investigate and monitor the region, and
- Thoroughly regulate introduced species.

### *Small Mammal and Carnivore Response to Tongass Young-growth Treatments*

This study assesses vegetation and structural features of young-growth that influence small mammal abundance. This is relevant to marten, which rely on small mammals as prey. Study objectives include determining:

- Which TWYGS treatments enhance the abundance of small mammals,
- The habitat variables the populations respond to, and
- The response of marten and ermine to small mammal abundance.

Four habitat types were studied: young-growth (control group), thinned young-growth, old-growth, and clearcut. Mark-recapture methods were used to estimate small mammal and marten abundance. Small mammals were live trapped and marten and ermine were trapped using hair-snares. DNA was extracted from the hair samples and used to identify individual marten. Trapped small mammals were weighed, measured, sexed, aged, assessed for reproductive status, and marked with a passive integrated transponder tag for permanent identification. Blood samples were taken from small mammals and, in combination

with plant samples, stable isotope analyses was used to identify small mammal diets. Small mammal feces were also collected opportunistically for diet analyses. In addition, vegetation was sampled to assess food availability (Flaherty and Ben-David 2012).

Mice and shrew densities varied across the years and exhibited no relation to forestry treatments. Ermine captures were correlated with the density of Keen's mice in the same year. Marten captures were correlated with the density of mice the previous year.

Samples of mice and shrew tissues, along with diet items, were analyzed by the University of Wyoming Stable Isotope Facility. The isotope niches of Keen's mice and dusky shrews are distinct; however, the choice of trophic discrimination factors will influence the interpretation of their diets. Values of carbon and nitrogen for mice varied considerably between habitat types, contributing to their relatively broad isotopic niche. In contrast, the isotopic niche of shrews was constant and relatively narrow. The relatively wide isotopic niche of mice suggests either specialized foraging behavior of individuals within a generalist species or faithfulness to specific foraging habitats (Flaherty and Ben-David 2010). In the future, multi-source dual-isotope mixing models will be used to determine the range of possible contributions of each food source to small mammal diets in each of the 21 trapping grids used in this project. This will be used to explore how diet composition influences population and community dynamics (Ben-David et al. 2013).

Sixteen progress reports and a final report were produced during the course of the study. In addition, a manuscript entitled "Estimating Leaf Area Index in Southeast Alaska: A Comparison of Two Techniques" was published in *PLOS One* in November 2013. Three educational modules were also designed as part of the cooperative agreement. These modules follow the guidelines of the National Center for Case Study Teaching in Science and include a case study, answer key, and teaching notes. The three case studies are:

- Seeing the Forest for the Trees: Managing for Multiple Use in National Forests
- Fur Trapping and Management of Old-Growth Forests: Survival, Reproduction and Population Forecasts of Marten
- Big Thorne Timber Sale: Managers Stumped Searching for Common Ground

## Evaluation of Results

Assessing biotic change begins with modern inventory studies and long-term monitoring programs that can be used to develop more rigorous databases. Ideally, these databases will be based on permanently archived museum specimens that have been collected over many years and contain representatives from environmental gradients throughout a given region. The Tongass continues to work towards filling these information gaps as funding becomes available. In addition, work will continue to identify habitat relationships and the effects of young-growth and young-growth treatments on small mammals and their predators. This work will inform our management of young-growth as well as our monitoring of management effects on wildlife habitat and forages in the understory.

Often the benefit of geographically extensive and site intensive collections is not immediately apparent, but over time, the value of specimen archives increases as these materials present a prime opportunity to view past environmental conditions. Specimens also provide the physical evidence for species identification and associated data on reproduction, habitat, pathogens and parasites, among others.

## Action Plan

### *Island Surveys to Locate Endemic Species*

Field data collection for ISLES ended with the FY2013 field seasons. The final report from UNM was received in FY2014. This included a list of the reports, professional publications and book chapters based

on ISLES and on specimens collected as part of ISLES. However, due to personnel shortages, a thorough review of the final report and associated literature was not undertaken and will occur in FY2015.

### *Small Mammal and Carnivore Response to Young-growth Treatments*

Field sampling is complete and analysis of data continues. Near-term plans are as follows:

- Data analysis of habitat and vegetation characteristics of all sampling stands, including tree height, diameter at breast height (DBH), basal area, and plant and fungi biomass was completed. Data summaries will be included in a Random Forest modeling framework to assess the effects of landscape and local scale factors on population dynamics of mice and shrews.
- Resubmit a proposal to the National Science Foundation Mathematical Biology for the project "Modeling 2 prey-2 predator cycles in a heterogeneous landscape" in 2015. Modeling work continues. The Tongass will receive any additional papers on the subject.
- Carolyn Eckrich will complete data analyses and her dissertation. She is expected to defend her dissertation in fall 2015 and the Tongass will be provided a copy of the final work.

## Citations

Ben-David, M., E.A. Flaherty and C. Eckrich. 2013. Progress report: Implementation and effectiveness monitoring of small mammal response to biodiversity wildlife thinning. Agreement 10JV-11100500-021, USDA Forest Service, Tongass National Forest.

Ben-David, M., E.A. Flaherty, C. Eckrich and R.K. Mayes. 2012. Progress report: Implementation and effectiveness monitoring of small mammal response to biodiversity wildlife thinning. Agreement 10JV-11100500-021, USDA Forest Service, Tongass National Forest.

Bidlack, A.L. and J.A. Cook. 2002. A nuclear perspective on endemism in northern flying squirrels (*Glaucomys sabrinus*) of the Alexander Archipelago, Alaska.

Bidlack, A.L. and J.A. Cook. 2001. Reduced genetic variation in insular northern flying squirrels (*Glaucomys sabrinus*) along the North Pacific Coast. Animal Conservation. 4: 283–290.

Conroy, C.J. and J.A. Cook. 2000. Phylogeography of a post-glacial colonizer: *Microtus longicaudus* (Rodentia: Muridae).

Conroy, C.J., J.R. Demoski, and J.A. Cook. 1999. Mammalian biogeography of the Alexander Archipelago of Alaska: A north temperate nested fauna. Journal of Biogeography. 26: 343–352.

Cook J.A. and S.O. MacDonald. 2013. ISLES project final report September 2013. Museum of Southwestern Biology, University of New Mexico, Albuquerque. 29 p.

Cook J.A. and S.O. MacDonald. 2012. ISLES project third quarter report. Museum of Southwestern Biology, University of New Mexico, Albuquerque.

Cook J.A. and S.O. MacDonald. 2001. Should endemism be the focus of conservation efforts along the North Pacific Coast of North America? Biological Conservation. 97: 207–213.

Cook, J.A., N.G. Dawson, and S.O. MacDonald. 2006. Conservation of highly fragmented systems: The north temperate Alexander Archipelago. Biological Conservation. 133: 1–15.

Cook, J.A., A.M. Runk and C.J. Conroy. 2004. Historical biogeography at the crossroads of the northern continents: Molecular phylogenetics of the red-backed vole (Rodentia: Arvicolinae).

Cook, J.A., A.L. Bidlack, C.J. Conroy [and others]. 2001. A phylogeographic perspective on endemism in the Alexander Archipelago of southeast Alaska. Biological Conservation. 97: 215–227.

Dawson, N.G., S.O. MacDonald and J.A. Cook. 2007. Endemic mammals of the Alexander Archipelago. (Chapter 6.7) *In:* Schoen, J.W. and E. Dovichin, editors. The Coastal Forests and Mountains Ecoregion of Southeastern Alaska and the Tongass National Forest: A conservation assessment and resource synthesis. The Nature Conservancy and Audubon Alaska.

Demboski, J.R. and J.A. Cook. 2003. Phylogenetic diversification within the *Sorex Cinereus* group (Soricidae). Journal of Mammalogy. 84: 144–158.

Demboski, J.R. and J.A. Cook. 2001. Phylogeography of the dusky shrew, *Sorex monticolus* (Insectivora, Soricidae): Insight into deep and shallow history in northwestern North America. Molecular Ecology. 10: 1227–1240.

Demboski, J.R., K.D. Stone and J.A. Cook. 1999. Further perspectives on the Haida Gwaii glacial refugium hypothesis. Evolution. 53: 2008–2012.

Demboski, J.R., B.K. Jacobsen and J.A. Cook. 1998. Implications of cytochrome b sequence variation for biogeography and conservation of the northern flying squirrel (*Glaucomys sabrinus*) of the Alexander Archipelago, Alaska. Canadian Journal of Zoology. 76: 1771–1776.

Fleming, M.A. and J.A. Cook. 2002. Phylogeography of endemic ermine (*Mustela erminea*) in Southeast Alaska. Molecular Ecology. 11: 795–807.

Hanley, T.A., W.P. Smith and S.M. Gende. 2005. Maintaining wildlife habitat in Southeastern Alaska: Implications of new knowledge for forest management and research. Landscape and Urban Planning. 72: 113–133.

Lucid, M. and J. Cook. 2004. Phylogeography of Keen's mouse (*Peromyscus keeni*) in a naturally fragmented landscape. Journal of Mammalogy. 85: 1149–1159.

Peacock, E., M.M. Peacock and K. Titus. 2007. Black bears in Southeast Alaska: The fate of two ancient lineages in the face of contemporary movement. Journal of Zoology. 271(4): 445–454.

Runck, A.M. 2001. Molecular and morphological perspectives on post-glacial colonization of *Clethrionomys rutilus* and *Clethrionomys gapperi* in Southeast Alaska. M.S. Thesis, University of Alaska-Fairbanks.

Runck, A.M. and J.A. Cook. 2005. Postglacial expansion of the southern redbacked vole (*Clethrionomys gapperi*) in North America. Molecular Ecology. 14: 1445–1456.

Smith, W.P. and J.F. Nichols. 2004. Demography of two endemic forest-floor mammals of southeastern Alaskan temperate rain forest. Journal of Mammology. 85(3): 540–551.

Smith, W.P., S.M. Gende and J.V. Nichols. 2005. Correlates of microhabitat use and density of *Clethrionomys gapperi* and *Peromyscus keeni* in temperate rain forests of Southeast Alaska. Acta-Zoologica-Sinica. 51(6): 973–988.

Stone, K.D. and J.A. Cook. 2002. Molecular evolution of the Holarctic genus *Martes*. Molecular Phylogenetics and Evolution. 24: 169–179.

Stone, K.D., R. Flynn and J.A. Cook. 2002. Post-glacial colonization of northwestern North America by the forest associated American marten (*Martes americana*). Molecular Ecology. 11: 2049–2064.

Stone, K. and J. Cook. 2000. Phylogeography of black bears (*Ursus americanus*) of the Pacific Northwest. Canadian Journal of Zoology. 78(7): 1218–1223.

Tomasik, E. and J.A. Cook. 2005. Mitochondrial phylogeography and conservation genetics of wolverine (*Gulo gulo*) of northwestern North America. Journal of Mammalogy. 86: 386–396.

USDA Forest Service. 2008. Tongass Land and Resource Management Plan. Management Bulletin. R10-MB-603b. Juneau, AK: USDA Forest Service, Alaska Region, Tongass National Forest.

# 19. Soil and Water: Productivity and Quality

**Goals:** Maintain soil productivity and minimize soil erosion from land-disturbing activities. Minimize sediment transported to streams from land-disturbing activities. Maintain and restore the biological, physical, and chemical integrity of Tongass National Forest waters.

**Objectives**: Attain Alaska Region (R-10) Soil Quality Standards. Attain State of Alaska Water Quality Standards.

**Background:** Implementation of Soil and Water standards and guidelines is necessary to maintain soil productivity and water quality. The Soil and Water standards and guidelines are implemented as Best Management Practices (BMPs) described in FSH 2509.22. Region 10 Soil Quality standards are documented in FSM 2554. Soil conservation practices are used to ensure that ground-disturbing activities will meet the R-10 Soil Quality standards. Typical soil conservation practices include log suspension requirements in timber harvest units and the use of full-bench and end-haul road construction techniques on landslide-prone terrain. Implementation monitoring evaluates whether or not soil conservation practices were required and implemented. Effectiveness monitoring determines whether or not the soil conservation practice used kept the ground-disturbing activity within the R-10 Soil Quality standard.

The State of Alaska water quality standards set standards for chemical, physical, and biologic parameters of waters on national forest system lands. The Forest Service in Region 10 uses best management practices and site-specific prescriptions to meet State of Alaska water quality standards when implementing ground-disturbing activities on national forest system lands.

## Soil and Water Question: *Are the soil conservation practices implemented and effective in meeting Alaska Regional Soil Quality Standards and maintaining soil productivity?*

Soil quality monitoring in FY2014 focused on 1) monitoring soil conditions following the use of ground-based yarding equipment on slopes over 30 percent gradient, 2) monitoring soil compaction on the North Kuiu Stream Restoration Project equipment access trails, and 3) monitoring the amount of soil disturbance caused by off-highway vehicle (OHV) use for meat (game) retrieval on the Yakutat forelands. Monitoring reports were written for each of these three projects. Those reports are Landwehr 2014, Landwehr and Foss 2014, and Catterson 2014.

### Ground-based equipment operation on slopes over 30 percent gradient

Between 1990 and 2010, most of the ground-based equipment used on the forest was operated on a slash mat on slopes less than 30 percent gradient. Under these conditions soil disturbance and detrimental soil conditions are minimized. Monitoring through the 1990s (Landwehr and Nowacki 1999) showed that, if shovel yarding followed the Soil and Water Conservation Handbook Guidelines, Region 10 Soil Quality Standards could be met and soil disturbance was typically less than 5 percent in a harvest unit. Between the year 2000 and the present day, shovel yarding that followed the guidelines resulted in an average of 3 percent soil disturbance (unpublished data).

In recent years, there has been a desire by many loggers to employ shovel yarding on steeper slopes to reduce logging costs. Shovel yarding costs are approximately half the cost of logging with a short span cable system, and approximately one third of the cost of helicopter logging (USDA Forest Service 2012). Rutting, soil displacement, and soil erosion have been noted on some shovel trails where shovel yarding has been used on steep slopes. There is a need to understand the effects to the soil resource from the use of ground-based equipment on soils on steeper slopes.

*Soil and Water Photo 1. Shovel yarder on a steep slope in the Diesel Timber Sale Area.*

### *Monitoring Results*

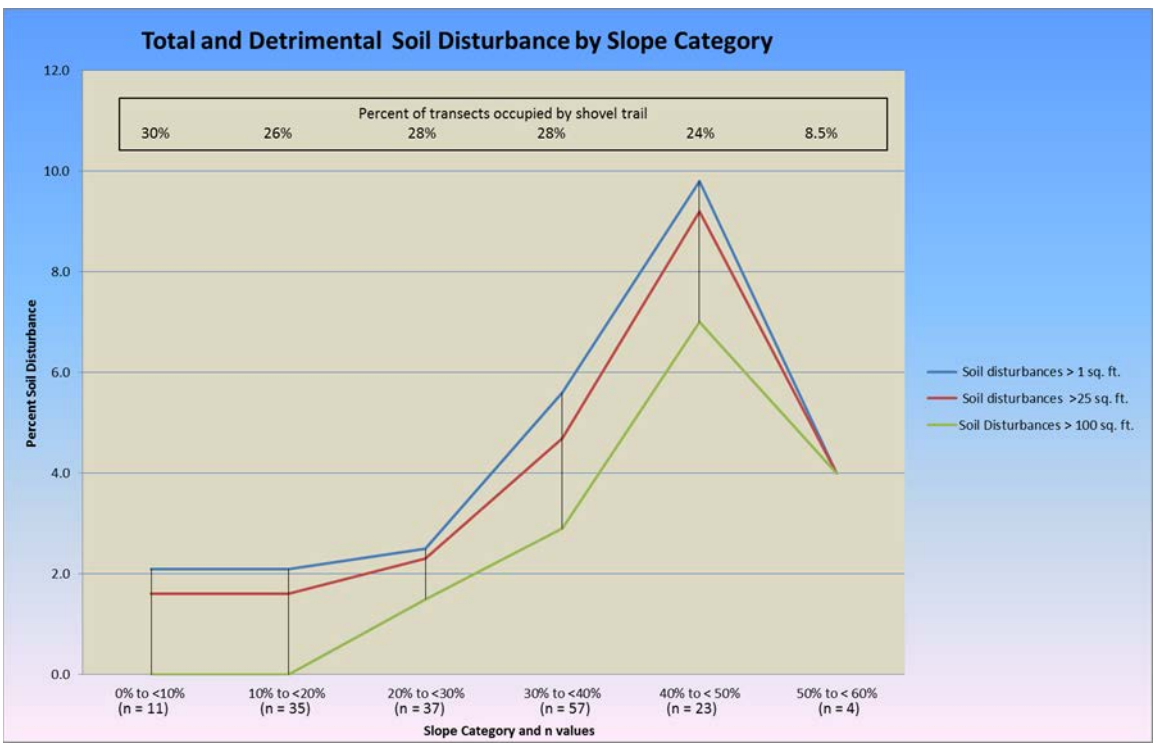
One hundred sixty-seven soil disturbance transects were completed in 10 shovel yard harvest units. Seventy-two transects were on slopes over 30 percent gradient. Based on previous work, soil disturbances were determined to be detrimental to soil productivity based on three different minimum size criteria. The minimum soil disturbance size classes used for analysis are: 1) greater than 1 square foot (Landwehr 1993), 2) greater than 25 square feet (Landwehr 2008), and 3) greater than 100 square feet (Landwehr et al. 2012). Please see the full report (Landwehr 2014) for further discussion regarding the use of the different minimum size criteria for analysis, and the methods used for analysis.

The mean values indicate that all 10 harvest units met the Region 10 soil quality standards for soil productivity based on any of the three minimum size criteria (Table 1). The averages for soil disturbances from shovel yarding in this group of steep slope units is higher (about 6 percent) than average soil disturbance previously documented for shovel yarding on gentler slopes (about 3 percent).

**Soil and Water Table 1. Harvest unit mean soil disturbance for portions of 10 steep-slope-shovel-harvest units. All disturbance values include temporary roads, if present.**

| Sale | Unit | Number of transects | Soil disturbance >1 sq. ft. with temp road | Soil disturbance >25 sq. ft. with temp road | Soil disturbance >100 sq. ft. with temp road |
|---|---|---|---|---|---|
| Backline | Backline 4++ | 52 | 7.6 | 7.2 | 6.7 |
| Backline | Backline 11 | 10 | 12.7 | 10.1 | 9.6 |
| Tonka | Tonka 207* | 14 | 11.6 | 10.3 | 3.4 |
| Diesel | 573-10 | 2 | 1 | 0 | 0 |
| Diesel | 573-83*++ | 9 | 4.2 | 3.8 | 3 |
| Diesel | 577-17 | 14 | 0.8 | 0.6 | 0 |
| Diesel | 577-18 | 21 | 1.6 | 1 | 0.3 |
| Diesel | 577-21++ | 25 | 2.2 | 1.6 | 1 |
| Diesel | 577-37 | 10 | 5.6 | 5.4 | 1 |
| Setter Lake | 598-310* | 10 | 13.9 | 12.8 | 10.5 |
| | | AVE | 6.1 | 5.3 | 3.6 |

*Entire harvest unit was sampled.
++ Temporary roads are included in the disturbance values for these harvest units




**Soil and Water Figure 1. Soil disturbance by slope class and percent of each slope class occupied by shovel trails.**

When the transect data from this monitoring are sorted by 10 percent slope-classes, the data clearly shows an increase in the amount of soil disturbance with increasing slope (Figure 1). In the 50 to 60 percent slope class, data is very limited (n = 4) but all soil disturbances we documented in this slope class were greater than 100 square feet in size. Figure 1 shows only 4 percent detrimental soil conditions in this slope class versus more than 8 percent in the 40 to 50 percent slope class. This is because only 8.5 percent of the transects crossed shovel trails in this slope class versus 24 percent in the 40 to 49 percent slope class.

The text box in Figure 1 shows the percent of the slope class area occupied by shovel trails.

If shovel yarding is restricted to slopes less than 30 percent gradient, soil disturbance and detrimental soil conditions can be kept very low, typically less than 3 to 4 percent of a harvest area (Figure 1).

The soil disturbance data was also evaluated using harvest unit mean soil disturbance as a data point (versus using each transect as a data point), the preferred method based on Landwehr and Nowacki (1999). Table 2 displays the mean soil disturbance based on 6 harvest unit areas with slopes less than 30 percent gradient and 6 harvest unit areas with slopes over 30 percent gradient.

Operator skill level, slope length, and soils play a role in the amount of soil disturbance from shovel yard operations, especially on steeper slopes. All operators caused 2 to 8 times as much soil disturbance on slopes over 30 percent when compared to operations on slopes less than 30 percent gradient.

**Soil and Water Table 2. Soil disturbance by slope class using harvest unit means as data points.**

| Slope class | Number of harvest units | Soil disturbances > 1 square foot (percent of unit) | Soil disturbances > 25 square feet (percent of unit) | Soil disturbances > 100 square feet (percent of unit) |
|---|---|---|---|---|
| 0 to 29% | 6 | 2.3 | 2.0 | 1.2 |
| 30 to 55% | 6 | 8.4 | 7.4 | 4.8 |

Validation of Landwehr's 1993 and 2009 definitions of detrimental soil conditions began in 2007 and continues today. After re-monitoring soil disturbance in 7 harvest units after 15 years of recovery, Landwehr (2008) stated that soil disturbances less than 25 square feet in size are difficult to find after 15 years and are likely not detrimental to soil productivity. Based on these results, the transect data collected for this report documented the size of each soil disturbance and reported detrimental soil conditions based on the 25 square foot minimum size criteria.

Further retrospective monitoring by Landwehr et al. (2012) found that after 50 years of recovery, it is doubtful that soil disturbances less than 100 square feet in size are affecting soil productivity on most productive soils. Based on these findings, the soil disturbance data presented in this report was also analyzed based on a 100 square foot minimum size criteria (Table 2).

*Soil and Water Photo 2. Pictures of a cut slope on a shovel trail in Backline Unit 11 (left). Re-contoured cut and fill shovel trail on the steep slope in the Setter Lake harvest unit (right).*

Shovel trails typically occupy 25 to 30 percent of the area shovel yarded. If one-third of the trails result in detrimental soil conditions like we have seen on slopes over 40 percent gradient (Figure 1), then the

harvest area will likely experience detrimental soil conditions occupying at least 10 percent of the harvest area. If the harvest unit also has temporary roads, the total amount of detrimental soil conditions will be greater.

### *Action Plan*

If a decision is made for economic and logistical reasons to allow ground-based equipment on slopes over about 35 percent gradient, the trails should be agreed upon by the shovel operator and sale administrator and/or in consultation with a soil scientist. If allowed, a plan should be made for rehabilitating detrimental soil conditions on trails approved on slopes over approximately 35 percent gradient.

This monitoring identified differences in detrimental soil conditions as a result of shovel yarding on different slope classes. The differences appear to be significant at 90 percent confidence; however, the variability is wide in several slope classes and our values for precision were not met in several slope classes. Soil disturbance monitoring should continue to add more transect data to the database to reduce the standard error of the mean in most slope classes.

It seems prudent at this time that the forest could adopt minimum size criteria of 25 square feet with a very low risk of missing any detrimental soil conditions. On slopes less than 30 percent gradient and on highly productive soils, disturbances up to 100 square feet are likely not detrimental. Thus until further retrospective monitoring is accomplished and soil specific detrimental soil conditions are identified, this report recommends using the 25 square foot minimum size criteria for detrimental soil conditions with the exception of detrimental erosion and detrimental displacement, which are already identified as a minimum of 100 square feet.

Additional work should be done to identify soil conditions that are reducing growth of desired vegetation in older young-growth stands. This work will help define minimum size criteria for detrimental soil conditions on soils with different inherent productivities. As the forest transitions to young-growth management, it will be important to understand soil conditions that limit or reduce soil productivity and conditions that promote recovery of soil productivity. Recovery of soils damaged by ground-based equipment is being monitored with photo points at several sites on Prince of Wales Island (see the 2013 Annual Tongass National Forest Monitoring and Evaluation Report).

## North Kuiu Stream Restoration access trails compaction study

Stream restoration on the Tongass National Forest often requires placement of large woody debris in the stream channel, along stream banks, and on the floodplain. The process involves identifying a source of large woody debris, harvesting the trees, transporting them to the stream and placing them in strategic locations to simulate natural stream structural components. Transporting the logs or logs with root-wads attached is often accomplished with heavy-lift helicopters. When heavy-lift helicopters are not available or are too expensive, the large woody debris is moved to the stream by ground-based equipment.

The North Kuiu Island stream restoration project required about 1,200 pieces of wood. Most of this wood was moved to the stream with ground-based equipment. To move the wood to the stream, six access trails approximately 10 meters wide were cut through 46 year old young-growth. The wide trails were needed for the machines to skid or swing the wood to the stream, similar to a shovel yarding scenario. Unlike shovel yarding, where 1 or 2 passes are made over a shovel trail, the number of passes required to move wood to the stream for the Kuiu project was typically more than 50 with some trails receiving more than 100 passes (Whitacre 2014).

Ground-based equipment operating on wet soil conditions can result in soil compaction. Soil compaction can lead to a decline in the productivity of a site. Fine-textured soils are more susceptible to soil compaction than coarse-textured soils. The access trails created for the North Kuiu Stream Restoration Project crossed alluvial soils belonging to the Tonowek and Tuxekan Soil Series. These alluvial soils are typically well-drained and coarse-loamy in texture (silt loam or fine sandy loam surface textures), often

free of gravels in the upper part, moist year round, and can be considered somewhat susceptible to soil compaction when wet. The Tonowek soils are younger soils (Entisols) and typically occur in a floodplain location. The Tuxekan soils are older more developed soils (Spodosols) and typically occur on a terrace or stable spot on a floodplain.

### *Monitoring Results*

We monitored soil bulk density on about 1,000 meters of equipment trails used to deliver wood to the west fork and mainstem Saginaw creeks. The trails average about 10 meters in width and were created by felling 46 year old young-growth trees and laying down a nearly continuous mat of cull logs and slash. Under repeated passes with equipment the cull logs and slash were forced into the soil to a depth of 20 to 30 centimeters, altering the structure of the O, E, and upper B horizons. The puncheon trail was fluffed after stream restoration was complete. Fluffing broke up the dense slash mat and likely loosened the upper layers of soil that the slash had penetrated. Fluffing did not move all of the slash and some slash is still evident in the upper mineral soil horizons.

*Soil and Water Photo 3. Access trail at sample point FP1 (left). Access trail at sample point FP3 (right).*

Soil bulk density samples indicate that overall the soils under the access trails are not compacted (Table 3). Bulk density values from three of the individual sites on floodplain soils did indicate a 34 percent increase in bulk density under the access trails at a depth of 7.62 to 15.24 centimeters. At the depth of 15.24 to 22.86 centimeters, only two of these sites showed a 47 percent increase in bulk density. The floodplain soils were typically wetter than the terrace soils and a water table was encountered at two of the floodplain sites we sampled. It is likely that soils under a small portion of the shovel trails are detrimentally compacted according to the Region 10 soil quality standards.

Similar to other bulk density sampling on the Tongass National Forest none of the samples we analyzed in this study had bulk density values that exceed published root restriction initiation values or root restriction values for these alluvial soils. There are several reasons for the lack of detrimental soil compaction in most Tongass forest soils. First is the inherent low natural bulk density values of Tongass soils due to relatively low clay content (less than 20 percent clay), the presence of thick duff layers and high organic matter content in the upper layers, and the relatively high rates of soil turbation[1] due to windthrow and rooting of trees and other vegetation.

The north Kuiu stream restoration access trails represent equipment trails with many passes of equipment on silt loam and fine sandy loam soils. The trails may be similar to what we can expect to see on a long primary skid trail used to yard timber from a large young-growth stand on similar soils. As the forest

[1] Soil mixing and turning due to disturbance

transitions to young-growth management, there is a need to understand the potential effects to soils from skid trails of this type. This monitoring contributes to that understanding.

**Soil and Water Table 3. Fine earth bulk density values for each depth class on and off access trails. Data shown for all 10 sites (40 samples), floodplain sites (16 samples) and terrace sites (24 samples) sorted by depth class.**

| Location access trail or undisturbed | Depth class (centimeters) | Mean fine earth bulk density (grams/cc) | Standard error | Standard error expressed as percent of mean | 90 percent confidence interval | Significantly different |
|---|---|---|---|---|---|---|
| All sites | n=10 | | | | | |
| Undisturbed | 7.6 to 15.2 | 0.66 | 0.04 | 6% | 0.06 | |
| Access trail | 7.6 to 15.2 | 0.71 | 0.06 | 8% | 0.09 | No |
| Undisturbed | 15.2 to 22.9 | 0.69 | 0.04 | 6% | 0.07 | |
| Access trail | 15.2 to 22.9 | 0.69 | 0.07 | 10% | 0.11 | No |
| Floodplain soils | n=4 | | | | | |
| Undisturbed | 7.6 to 15.2 | 0.60 | 0.06 | 9% | 0.09 | |
| Access trail | 7.6 to 15.2 | 0.81 | 0.08 | 10% | 0.13 | No |
| Undisturbed | 15.2 to 22.9 | 0.67 | 0.06 | 8% | 0.09 | |
| Skid trail | 15.2 to 22.9 | 0.82 | 0.13 | 16% | 0.21 | No |
| Terrace soils | n=6 | | | | | |
| Undisturbed | 7.6 to 15.2 | 0.69 | 0.05 | 8% | 0.09 | |
| Skid trail | 7.6 to 15.2 | 0.63 | 0.08 | 12% | 0.13 | No |
| Undisturbed | 15.2 to 22.9 | 0.70 | 0.05 | 8% | 0.10 | |
| Skid trail | 15.2 to 22.9 | 0.60 | 0.05 | 9% | 0.09 | No |

The use of cull logs and slash to blanket the soil under equipment routes appears to be very effective at preventing detrimental soil compaction. This monitoring, combined with other bulk density monitoring on the forest (Alexander 1990, Foss and Landwehr 2006, Landwehr and Silkworth 2011, Landwehr et al. 2012) support the statement that most Tongass soils are not susceptible to soil compaction from equipment under normal (where a puncheon mat is used) forestry practices.

### *Action Plan*

Re-vegetation of the access trails should be monitored after 5 years to determine if the high slash load is negatively affecting re-vegetation by the desired vegetation (in this case, conifers). After 10 years of growth, the conifers could be monitored to determine if the slash load is affecting growth of the desired vegetation. If tree growth is measured on the access trails, it could be compared to growth on similar soils at the root-wad and log harvested site on the Security Bay Road.

## Yakutat forelands meat retrieval OHV trails

The Access and Travel Management Plan for the Yakutat District restricts OHV use to designated trails with one exception. OHV use is allowed off trail for meat retrieval “if they can do so without causing resource damage.” Damage is described as “exposing soil or causing soil displacement on stream banks, cutting living vegetation to create a path, or the creation of ruts 3 inches deep and 20 feet long” (USFS 2008). This monitoring project used a GPS to map OHV trails and create photo points to document soil disturbance and recovery (Catterson 2014).

### *Monitoring Results*

We do not have enough information yet to make management recommendations regarding game retrieval. It is clear that vegetation and soil disturbance can occur from the limited ATV use associated with game retrieval, but it also seems likely that better-drained areas where sweet gale and willow are dominant can support game retrieval. More resilient plant communities were located adjacent to all the resource damage we observed. User education may be a way to reduce resource damage. Due to the government shut down, we were unable to monitor other sites along the road where game retrieval had occurred. Our sample may be biased in that only the worst trails were easy to find.

### *Action Plan*

1. Continue to monitor game retrieval sites on the forelands including both new trails and those already inventoried.
2. Use the information we collect to make recommendations to users, perhaps in the form of a pamphlet, about how to avoid resource damage.
3. Use the new Yakutat vegetation map to identify areas vulnerable to resource damage and consider additional restrictions in those areas.
4. Consider restoration projects in areas where resource damage has occurred as a result of off designated trail OHV use.

## Citations

Catterson, N. 2014. Unpublished. 2013 game retrieval monitoring. USDA Forest Service, Alaska Region, Tongass National Forest Yakutat Ranger District.

Landwehr, D.J. 1993. Unpublished. Soil disturbance monitoring on the 89-94 KPC long-term sale area. Revised methodologies and emphasis areas. USDA Forest Service, Alaska Region, Ketchikan Area.

Landwehr, D.J. and G. Nowacki. 1999. Unpublished. Statistical review of soil disturbance transect data collected on the Ketchikan area, Tongass National Forest. USDA Forest Service, Alaska Region, Tongass National Forest.

Landwehr, D.J. 2008. Unpublished. Soil quality monitoring on the Tongass National Forest. The Tongass' interpretation of the Region 10 soil quality standards. USDA Forest Service, Alaska Region, Tongass National Forest.

Landwehr, D.J. 2009. Unpublished. Soil quality monitoring on the Tongass National Forest. Protocols updated from 1993. USDA Forest Service, Alaska Region, Tongass National Forest.

Landwehr, D.J., D.R. Silkworth and J.V. Foss. 2012. Unpublished. Soil quality monitoring on the Tongass National Forest. The Tongass' Interpretation of the Region 10 soil quality standards. Part 2. Summarizing 4 years of data collection. USDA Forest Service, Alaska Region, Tongass National Forest.

Landwehr, D.J. and J.V. Foss. 2014. Unpublished. Soil quality on the Tongass National Forest. Results of compaction studies conducted on the Kuiu Stream Restoration access trails. USDA Forest Service, Alaska Region, Tongass National Forest.

Whitacre, H. 2014. Unpublished. North Kuiu Stream Restoration Project updates. USDA Forest Service, Tongass National Forest, Petersburg Ranger District.

USDA Forest Service. 2012. Big Thorne draft environmental impact statement. Management Bulletin. R10-MB-736. Thorne Bay, AK: USDA Forest Service, Tongass National Forest, Thorne Bay Ranger District, p. 3-25.

# 20a. Soil and Water: BMP Monitoring

**Goals:** Maintain soil productivity and minimize soil erosion from land-disturbing activities. Minimize sediment transported to streams from land-disturbing activities. Maintain and restore the biological, physical and chemical integrity of Tongass National Forest waters.

**Objectives:** Attain Alaska Region (R-10) Soil Quality Standards. Attain State of Alaska Water Quality Standards.

**Background:** Implementation of soil and water standards and guidelines is necessary to maintain soil productivity and water quality. The soil and water standards and guidelines are implemented as best management practices (BMPs) described in the Alaska Region Supplement to FSH 2509.22 and the National Core BMPs (USDA Forest Service 2012).

Alaska Region soil quality standards are documented in FSM 2554. Soil conservation practices are used to ensure that ground-disturbing activities will meet the Alaska Region soil quality standards. Typical soil conservation practices include log suspension requirements in timber harvest units and the use of full-bench and end-haul road construction techniques on landslide-prone terrain. Implementation monitoring evaluates whether or not soil conservation practices were required and implemented. Effectiveness monitoring determines whether or not the soil conservation practice used kept the ground-disturbing activity within the Alaska Region soil quality standard.

## Soil and Water Question: *Are the soil and water conservation practices as described through the best management practices and site-specific prescriptions implemented and effective in minimizing soil erosion and maintaining the State water quality standards?*

### Evaluation Criteria

The Forest Plan describes the evaluation criteria as “compliance and implementation of BMPs and the State Water Quality Standards.” The specific protocols for BMP effectiveness the National Core BMP Field Evaluations were pilot tested and adopted (USDA Forest Service 2013).

### Sampling/Reporting Period

The sampling and reporting period is annual.

#### *BMP Field Evaluations*

The best management practices (BMPs), described in the Soil and Water Conservation Handbook (Alaska Region Supplement to Forest Service Handbook 2509.22, 2006), define practices that protect soil and water resources. The Soil and Water standards and guidelines define site-specific measures to protect the resources. These standards and guidelines were monitored using national forms and protocols. The FY2014 BMP Monitoring Report provides details on how the monitoring was conducted.

Interdisciplinary Team Review trip reports detail individual reviews (Appendix D).

#### *Monitoring Context*

The Forest Plan BMP monitoring program to date has emphasized evaluation of timber harvest units and roads. The National BMP monitoring program places equal emphasis on all resource activities. A regional target of seven resource activities was assigned to the Tongass National Forest and accomplished in 2014. Four randomly selected activities (timber harvest, facilities, recreation, and aquatic restoration) were monitored. Two other activities (minerals and roads) were not required to be randomly selected.

The timber sales, roads, and recreation projects monitored in 2014 were developed under standards and guidelines consistent with the 2008 Forest Plan. The roads monitored were a combination of roads constructed for timber sales and closed roads. The powerlines, facilities, roads and OHV travel areas monitored in FY2014 were selected using INFRA[1] to define the selection pool. In addition to the regional target, some activities were randomly selected to follow national protocols. Other activities were randomly selected from district pools, opportunistically monitored near randomly selected activities, or deliberately selected for training or pilot-testing purposes.

Although the monitoring context and activity selection method varied in 2014, consistency was provided by using national forms and protocols for field evaluations. Data were entered into a corporate database for accountability and scoring purposes.

### *Monitoring Overview*

The timber units monitored in 2014 were harvested under contracts included in environmental documents signed after the 1997 Forest Plan and 2008 Amendment. Units and roads in the FY2014 monitoring subset are listed below with their respective environmental impact statement (EIS) or environmental assessment (EA) or contracts. The public works contracts were all implemented under the Forest Plan standards and guidelines that were current when their record of decision was signed.

**Soil and Water BMPs Table 1. Timber harvest units monitored in FY2014**

| Units | Timber Sale; EIS / EA (decision year) |
|---|---|
| Single Pit Area 1 | Goose Creek Environmental Assessment (EA) (2006) |
| North Pole 1 | Goose Creek Environmental Assessment (EA) (2006) |
| Tonka Stewardship Contract, Units 609* and 610 | Tonka Timber Sale (EIS) (2012) |

*Activities randomly selected according to national protocols to accomplish regional target.

**Soil and Water BMPs Table 2. Roads monitored in FY2014**

| Roads | Road Contract; EA / EIS |
|---|---|
| 7576 | Harbor Mountain Road maintenance (CE) |
| 7513 in Starrigavan Recreation Area | Harbor Mountain Road maintenance (CE) |
| 3015, MP 1.773 and 8.743 | Road maintenance (CE) |
| 6208 (Frenchy) | Road maintenance (CE) |
| 8448, MP 0.380 | Access and Travel Management Plan (EA) |
| 6351 | Tonka Timber Sale (EIS) (2012) |

**Soil and Water BMPs Table 3. Recreation activities monitored in FY2014**

| Trails & Recreation Sites | District Plan; CE |
|---|---|
| Kruzof North Beach ATV Area* | Sitka District Access and Travel Management Plan (ATM) Environmental Assessment (EA) in (2006) |
| Raven Trail Construction | CE – (2010) |

*Activities randomly selected according to national protocols to accomplish regional target.

**Soil and Water BMPs Table 4. Other activities monitoring in FY2014**

| Facilities and Other projects | District Plan; CE |
|---|---|
| Corner Bay Facility Maintenance* | Alaska Department of Environmental Conservation (ADEC) public water #AK2131139 and AK2131140 (ADEC) public water #AK2131139 and AK2131140 |

[1] INFRA is a Forest Service database used to manage information on national resources, such as buildings, trails, roads, wilderness areas, and water systems.

| Facilities and Other projects | District Plan; CE |
|---|---|
| Kensington Gold Mine | Kensington Mine Supplemental Environment Impact Statement and Record of Decision (2004) |
| Aquatic Habitat Improvement, Mainstem of Saginaw Creek* | Saginaw Creek CE (2012) |
| Construction of Transmission Lines* | Shrimp road system by the Swan-Tyee Intertie ROD (1997) |
| Tonka Sort Yard and LTF | Tonka Timber Sale (ROD) (2012) |

*Activities randomly selected according to national protocols to accomplish regional target.

### *Interdisciplinary Team (IDT) Monitoring*

For Forest Plan monitoring purposes, the BMP implementation and effectiveness monitoring was completed through IDT monitoring of a stratified sample of 10-15 percent of the roads constructed, stored and decommissioned over the past 4 years, as well as timber sale units harvested in 2014. Due to a low level of timber harvest and associated road construction, the number of units harvested and roads constructed/reconstructed in fiscal year 2014 were limited. BMP monitoring was also conducted on recent trail construction and an ATV use area. Representatives from the Forest Service and State and federal agencies conducted the IDT monitoring. This team included sale administrators, engineers, foresters, planners and resource specialists from soils, water, fisheries and recreation. The IDT monitoring provides opportunity to discuss the implementation of the best management practices across resource and agency groups.

Harvest units, roads and recreation sites monitored in FY 2014 by the IDT are listed below by district.

**Juneau Ranger District:** September 10 and 11, 2014; Kensington Gold Mine, Berners Bay

**Ketchikan Misty Fiords Ranger District:** August 20, 2014; Road 8448, MP 0.380, Upper Carroll

**Ketchikan Misty Fiords Ranger District:** August 21, 2014; Swan-Tyee Intertie, Shrimp Road System Crossing

**Petersburg Ranger District:** July 17, 2014; Saginaw Creek Aquatic Ecosystem Improvement, Kuiu Island

**Petersburg Ranger District:** September 8, 2014; Raven Trail Construction, Mitkof Island

**Petersburg Ranger District:** September 10, 2014; Tonka Road 6351; Tonka units 609 and 610

*Soil and Water BMPs Photo 1. Corner Bay fuel tank*

**Petersburg Ranger District:** September 11, 2014; Road 6208, Frenchy Road, Mitkof Island

**Sitka Ranger District:** August 11, 2014; Corner Bay Facility Maintenance; Road 7576, Harbor Mountain; Road 7513, Starrigavan Recreation Area

**Sitka Ranger District:** September 9, 2014; Kruzof North Beach ATV Area

**Thorne Bay Ranger District:** September 16, 2014; Single Pit Area 1, Goose Creek Unit; North Pole 1, Goose Creek Unit; Road 3015, MP 1.773 and 8.743

## Monitoring Results

The IDT monitored four timber harvest units, six road segments, two recreation projects, one stream restoration project, an active mine, and two facilities. Since the road pool was expanded to the past five years, the number of roads in the pool was significant. Roads were stratified by stream crossings with Class I, II, and III weighted respectively, as well as slope gradient.

Roads were also stratified by district so the monitoring over the past few years is distributed geographically. Units were stratified by the number of Class I, II and III streams, slope gradient, harvest prescription and district. Roughly 10 percent of the annual harvested units and roads closed/decommissioned, and constructed were monitored. The 2014 monitoring results show that the Tongass National Forest is fully implementing the standards and guidelines for protection of soil and water resources in most cases. Corrective actions are needed at the Kensington Gold Mine Improvements; erosion control measures were identified at several activities. BMP effectiveness is evaluated in the field by visual observations of sediment or other pollutants entering water bodies. Corrective actions for both implementation and effectiveness are summarized.

### *Timber Harvest Units*

North Pole 1 is a clearcut shovel logged unit on the Thorne Bay Ranger District. BMPs were fully implemented and effective.

Single Pit Area 1 is a clearcut shovel logged unit on the Thorne Bay Ranger District. The BMPs seem effective in limiting potential or current impacts to water quality. No adaptive management actions were noted.

Tonka units 609 and 610 had unit boundaries adjusted to conform to local terrain, adjacent stream buffer requirements and logical settings. BMPs in both units were fully implemented and effective. During implementation of the Tonka Timber Sale, minor changes were made on the stream mapping. Changes were documented relative to the temporary and specified road/stream crossings. The road locations were adjusted to minimize stream crossings. Some additional steep ground was added to the harvest units and a minimal increase of soil disturbance was anticipated.

*Soil and Water BMPs Photo 2. Single Pit Area 1 unit*

Unit 609, 9 acres, shovel yarding was completed with minor impact to the soils. There had been more shovel ruts shown in the unit than anticipated on the relatively flat ground; however, the ruts were slash covered to prevent erosion. The detrimental soil conditions were shown in 1- 2 percent of the unit. Partial suspension was implemented to meet soil quality standards.

Supplemental erosion control through slashing and fluffing was applied. Stream buffers met or exceeded unit design.

Unit 610 is a 6 acre unit comprised of three connected segments; two segments below the road and one segment above the road bound by stream channels. Due to the configuration of the streams and buffer requirements, and configuration of the terrain, the boundaries of the unit were changed during lay out. The unit harvest and yarding completed meets the soil quality standards.

**Action Plans for Units Summary**

In the future, consider adding water bars and cross drains to temporary roads.

### *Roads*

Portions of the Harbor Mountain Road were covered with a landslide so part of the contract included removing debris from the road surface and surrounding ditches. Before the work was contracted, sediments did enter the streams at and near the landslide. This was out of control of the district, an act of nature. Corrective actions were implemented. After the contract, there was no evidence of erosion or sedimentation in the water bodies or their approaches.

Culverts on Road 3015, Thorne Bay Ranger District, were designed using the simplified stream simulation surcharges with suitably sized shotrock placed above the pipe to naturally fill the pipe during flow events. This material was not always placed correctly, so it took longer to fill the pipe with material than planned. Although BMPs were fully implemented, the remaining surcharge material on the stream banks led to recommendations for future improvement of BMP effectiveness for this activity.

The IDT surveyed a drivable dip on Road 6351, Petersburg Ranger District. Although BMPs were fully implemented, one practice related to surface erosion was not effective. Minor, localized sediment deposition was noted in a water body crossing at the drivable water bar and will be remedied by minor road maintenance. This resulted in an action plan, listed below, to increase running surface stability. The drivable dip on the road served to drain water from the beaver pond and with minor modification will provide a hardened travel surface.

*Soil and Water BMPs Photo 3. Harbor Mountain road 7576 after road maintenance.*

On Road 8448, corrective actions were required and applied during road reconstruction to improve erosion control.

On Road 6208, road surface erosion contributed to sedimentation near (but not entering) a water body. Improved road surfacing was recommended.

**Action Plans for Roads Summary**

In the future, place surcharge material in the stream or further down on the banks so it moves into the pipe at lower flow events.

Road 6351 changes recommended by the group included adding armoring rock to the crossing and removing fines from the road surface in the dip. This minor modification should contribute to more effective implementation of the BMPs. Road surfacing and improved erosion control measures were also recommended for individual roads.

### *Recreation*

Kruzof North Beach ATV Area was one of the two recreation activities monitored in FY2014. The OHV use area was established in 1993 as a way to separate OHV users from non-motorized users. The North Beach cabin is near the use area and users have access to the beach. A small Class II stream runs along the southern end of the use area that changes outlets annually due to shifting sands and wave action. This stream is eroding the bluff at a rapid rate. The bluff is habitat for the rare dune tansy. Users are not supposed to ride on any vegetated areas, but since the beach was eroding they were using the bluff for access. Some fencing and signs were placed to protect the rare plant. There is evidence that OHVs use areas outside the designated use area. There are several, at least five, user created trails in the area. This is the first time the Tongass has attempted to evaluate BMPs at a motorized vehicle use area. There was no plan to evaluate what BMPs should have been implemented at this site. There was evidence of sediment

transported from user trails into wetlands and estuary crossings.

The Raven's Roost Trail was constructed in the 1970s to access the Raven's Roost Cabin. In 2014, work was completed to rebuild the first 2,600 feet of the trail to make it safer and address accessibility. The newly constructed trail is free of barriers and fully accessible. Although some BMPs weren't clearly identified in the project CE, the contract specifications ensured applicable BMPs were implemented at the trail. Special care was taken to dispose of materials off-site, minimize rutting and erosion by using construction mats, installing corduroy or geotextile, grading trail bed and installing temporary drainage. To provide sediment control, filter cloth was installed during construction. The site was re-vegetated using plugs that were originally removed from site during the clearing and grubbing stage.

At a very small wetland stream, a culvert was installed to transport water across the trail. There was evidence of localized sediment transport as noted in very minor pedestal erosion in isolated locations adjacent to the water flow from the muskeg (Photo 4). The sediment transport amounted to an area two feet by one foot adjacent to a culvert on the fill slope. The low energy water did not transport the sediment beyond the immediate area. This erosion resulted from unhardened crossing approaches on the bare ground from heavy rains. Soil was placed along the fill slope of the trail to provide soil structure for vegetation growth, later was determined contained residual amounts of non-native plant seed.

*Soil and Water BMPs Photo 4. Raven's Roost trail, small sediment transport*

**Action Plans for Recreation Summary**

To prevent further resource damage at the Kruzof North Beach site, the IDT had these suggestions:

- Map and survey the Class II stream near the North Beach Cabin.
- Add language to the MVUM that clarifies what exactly is open along the anadromous stream at the northern portion of the use area.
- Create a management plan that clears up some of the vague language in the ATM and MVUM.
- Add one or more restroom facilities near designated campsites.

For the Raven Trail, one corrective action was suggested during the monitoring trip. Specific BMPs in the NEPA document would have been helpful in implementing trail construction.

### *Facilities and Other Projects*

**Corner Bay Administrative Facility**

The IDT visited the Corner Bay administration facility. The potable water pump house collapsed into the impoundment. This site needs to have material from the creek removed because bedload filled in the impoundment, limiting water collection. This stream is labelled a Class I, anadromous fish stream. Before corrective actions can be taken to fix the pump house and remove bedload from the impoundment, permits will be needed from the

*Soil and Water BMPs Photo 5. Kruzof North Beach user trail created*

Corps of Engineers (COE) and concurrence must be received from the Alaska Department of Fish and Game (ADF&G) for maintaining this water system in the stream. We may also need the Alaska Department of Natural Resources (ADNR) water rights approval for the stream.

The septic system at the site is operational with no corrective actions needed.

There are two 1,000 gallon double-walled fuel tanks filled with sludge. These tanks do not affect water quality or aquatic health. There are no leaks from the tanks.

### Action Plans for Corner Bay Administrative Site

The Sitka Ranger District needs to work with the COE, ADF&G, and ADNR to fix the potable water pump house and impoundment at the Corner Bay facility. They also need to determine what to do with the fuel tanks filled with sludge before they pose a water quality hazard.

### Kensington Gold Mine

This is the first time the Tongass National Forest has attempted to evaluate BMPs at an active mine using the national protocol. A draft monitoring form was pilot-tested by the IDT. At Kensington, road runoff and stormwater are addressed in the Stormwater Protection Plan (SWPP), which identifies freshwater and stormwater routing, settling ponds, outfalls and other erosion control items. Most settling ponds were functioning well and preventing sedimentation. The settling pond used for snow was an exception – no filter, geotextile, nor stilling well (Photo 6). Several sections of silt fencing were full or failing, and in need of maintenance. Sediment accumulated in the diversion ditch near Bridge 2 (Johnson Creek) had been cleaned out; however, the sediment was placed along the ditch.

In one location there is a culvert which flows directly into Johnson Creek. There is a silt fence across the stream mid-way down the slope. The silt fence was put in place to reduce the velocity of the water and prevent erosion from occurring early in the spring when there is no vegetation present. The SWPP shows no direct runoff (freshwater nor stormwater drainage) going into Johnson Creek at this location. Instead, stormwater is routed to the Batch Plant fines pond then outfall 5, and freshwater routed to Outlet #5.

Turbid waters were identified in wetland ponds downstream of a settling pond and adjacent to Johnson Creek. The source of the sediment was not confirmed; however, likely sources included the road or the settling pond (both located within 50 feet of turbid waters). The turbid waters were within the riparian area of Johnson Creek.

All bridges had filter material across the entire bridge; however, sediment was reaching surface waters (below the bridge) in two locations. In both cases, road runoff was directed to the bridge with no relief, hence the runoff transports sediments to the bridge, where it settles out and may work its way through the filter.

The log stringer bridges on the Comet side (No Name Creek and Sherman Creek) were in various stages of structural failure (which could be lending to the sedimentation under the bridge). A 2013 report (Quentin Smith) indicates structural concerns of these bridges and suggests replacement for both safety and water quality purposes. Coeur did not receive copies of the 2013 report and have not seen water quality impacts in their routine water quality testing, so they assumed the bridges were not of an immediate concern, but they are identified for replacement.

*Soil and Water BMPs Photo 6. An old settling pond no longer sealed and leaking is used for snow dumping. The sediments from the snow are not properly filtered.*

Turbidity and road sedimentation was seen at the termination of the inboard ditch in the Slate Cove area. The ditch ended in the parking lot for the marine facility.

Stormwater drainage in this area is designed (per SWPP) to terminate into a French drain infiltration area. It appeared to be either not implemented or not fully effective because runoff and sediment were entering the marine waters of Slate Cove in this location.

Sediment and waste rock from the Comet portal development rock pile extend into Ophir Creek. A topographic bench was evident; however, there was no buffer between the surface waters of Ophir Creek and the base of the development pile. There was some silt fencing in this location; however, it was not maintained and had partially fallen down. The extent of the silt fencing appeared to be less than the designed length in Figure 12 of the SWPP. Stormwater drainage is supposed to be routed across the base of the Comet development pile to a catchment basin near the Comet settling ponds. There was no evidence of an effective stormwater diversion across the base of the development pile; rather it appears that drainage from the development pile flows downhill into Ophir Creek and the adjacent wetlands.

All of the fuel storage areas seen on the field trip included secondary containment. However, in some cases the secondary containment contained water which minimizes the volume of secondary containment available.

A fuel spill reported on July 24, 2014 occurred on the ramp leading to Lynn Canal beach on the Comet side. The contaminated material had been excavated and was stockpiled nearby. The contaminated soils were covered and Coeur is waiting for agency direction regarding disposal of the material.

Solids are removed from the water treatment system by a filter press are temporarily stored near the water treatment facility until they can be deposited underground. The solids were contained on three sides; however, open to one side and covered by a plastic tarp. The tarp was not maintained and water was getting into the solids storage area. While these solids are classified as non-hazardous, they should be better contained to reduce exposure to rainfall and potential for transport into local waters.

Leachate was seen visually around the southern portion of the lake on the west side. There was no evidence of leachate from the east side which was designed as storage for graphitic phyllite material. The west side was covered with shotcrete to minimize the exposure to water and air. Lines of leachate were seen along the shotcrete. Surface water runoff from both sides were collected below the dam and transported to the lime treatment facility for treatment.

High rainfalls, and possibly underestimated seasonal runoff, have resulted in flooding of the road and diversion pipe in the Lower Slate Lake area. The road had been inundated with water on at least two occasions and Coeur representatives had commented that flow capacity through the diversion pipe had been exceeded.

Treated water is diverted to Sherman Creek outfall. At the time of the visit, there was visual sediment at the outfall; however, it was fairly localized in extent.

Canada thistle, an invasive weed, was seen on the Comet Beach near the old administrative site. A white paper identifies additional invasive species seen in the Comet Beach and Slate Creek Marine areas, and suggests strategies for eradication. It is currently in review at the Juneau Ranger District.

### Action Plans Kensington Gold Mine

The Juneau Ranger District needs to work with Kensington Mine on the following items:

- Remove the sediment placed along the diversion ditch near Bridge 2 (Johnson Creek) and dispose of appropriately (BMP Plan C-64).
- Fix water flow at the silt fence across the stream mid-way down the slope from the culvert on Johnson Creek.
- Look at the areas where sediment is reaching wetland ponds and other water surfaces and determine how to prevent further sedimentation.

- Determine when the log stringer bridges on the Comet side can be replaced.
- Assure that Coeur receives copies of the BMP monitoring report and the 2014 Tongass Monitoring and Evaluation Report.
- A settling pond or some sort of improved filtration where the French drain is located in the parking lot for the marine facility would reduce sedimentation into Slate Cove.
- The Comet portal development rock pile silt fencing is not maintained and has partially fallen down. The extent of the silt fencing appears to be less than the designed length in Figure 12 of the SWPP. Maintenance of the silt fencing may reduce potential for silts and sediment to enter Ophir Creek.
- Route stormwater drainage across the base of the Comet development pile to a catchment basin near the Comet settling ponds as shown in the SWPP.
- Drain fuel storage secondary containment sites daily or cover from rainfall to maintain effective use of the secondary containment.
- Give Coeur agency direction regarding contaminated soils from a spill on the ramp leading to the Lynn Canal Beach.
- Develop a better way to store solids removed from the water treatment filter press system so they are not exposed to the elements from under a tarp.
- Increase flow capacity of the diversion pipe in the Lower Slate Lake area so flooding of the road does not occur during high flow events.
- Monitor sedimentation in the treated water diverted to Sherman Creek outfall.
- Eradication of invasive plants seed at the Comet Beach administrative site and the Slate Creek marine area.

**Saginaw Creek Aquatic Habitat Improvement**

Stream restoration on the mainstem of Saginaw Creek included aquatic habitat improvement and bank stabilization with locally sourced logs. Instream and floodplain restoration on 2.4 miles of anadromous fish streams. The project required heavy equipment to place approximately 1,000 large wood (LW) pieces in four streams and their floodplains. The contractor implemented 30-minute rest periods where no machines were working in the water to let the sediment settle out and give the fish a break.

Puncheon trails were used for the heavy equipment to operate on, to prevent soil disturbance. Project maps for the puncheon trails were very helpful. The trails average about 10 meters in width and were created by felling 46-year old young-growth trees and laying down a nearly continuous mat of cull logs and slash. Under repeated passes with equipment the cull logs and slash were forced into the soil to a depth of 20 to 30 centimeters, altering the soil horizon structure. The puncheon trail was fluffed after stream restoration was complete. Fluffing broke up the dense slash mat and likely loosened the upper layers of soil that the slash had penetrated. Fluffing did not move all of the slash and some slash is still evident in the upper mineral soil horizons.

Erosion control seeding had not been completed at the time of monitoring, but was completed soon after.

There were hydraulic fluid leaks twice during project implementation. One leak occurred while working in the stream and one while working on a puncheon trail. The contractors' deployed absorbent pads immediately, replaced the o-ring, and the problem was fixed. The spills were not reported to the Alaska Department of Environmental Conservation (ADEC) because the contractors were using biodegradable, vegetable based hydraulic fluids.

**Action Plans for Saginaw Creek Aquatic Habitat Improvement**
Puncheon trail rehabilitation needed hand-slash and seed for bare areas as recommended by the soil scientist. Seeding was not mentioned in the NEPA but is going to occur with force account funds.

An erosion control plan needs to be required in the contract. Consider including seeding in the contract as part of the erosion control plan, so it can be done immediately after work is completed.

Consider using a log loader for this type of project instead of an excavator; this will allow for narrower clearing limits on puncheon trails and less time working in the stream due to easier handling of the wood.

Clearing limit widths should be defined for puncheon trails in the contract, so they are not larger than they need to be.

Staging decks of logs should not occur on puncheon trails in the riparian management areas (RMAs) to minimize disturbance to the RMA and to minimize the footprint of the puncheon trail in the RMA.

Consider trade-offs of rock roads instead of puncheon trails for this type of project in the future.

**Construction of Transmission Lines, Swan-Tyee Intertie, Shrimp Road System Crossing**
During implementation, provisions were made for protecting water, aquatic and riparian resources including the site where the Swan-Tyee Intertie crossed the Shrimp Road System.

No problems occurred, so no corrective actions were needed. No spills or leaks occurred during past five years. BMPs were fully implemented and effective.

**Action Plans for Swan-Tyee Intertie, Shrimp Road System Crossing**
Although unrelated to BMPs, contract specifications required utilization of merchantable timber within 2 miles of an LTF. This segment was within the 2-mile limit, but it appears no merchantable timber was salvaged (Photo 7).

*Soil and Water BMPs Photo 7. Unused merchantable timber*

**Tonka Sort Yard and Log Transfer Facility (LTF)**
The Tonka sort yard and LTF was reviewed by the IDT. Some problems were found with the back wall of the sort yard raveling. The drainage and settling ponds were functioning but required sediment clean out. This clean out was completed after the end of the fiscal year but before the end of the field season in the fall of 2014.

Monitoring of bark accumulation is required annually when logs are place in the water at any logs are put in the water at a log transfer facility. This bark monitoring was not completed before the IDT review but before the end of the field season in the fall of 2014.

**Action Plans for Tonka Sort Yard and Log Transfer Facility**
Monitor the back wall of the sort yard to determine if the raveling is continuing. If it becomes problematic, determine what actions are needed to stop the raveling.

*Soil and Water BMPs Photo 8. Tonka sort yard*

## Evaluation of Results

Generally, the monitoring completed by the interdisciplinary teams showed that the BMPs were mostly or fully implemented during timber harvest, roads and facilities activities. Some BMP implementation improvements are needed in recreation, roads, aquatic restoration and minerals activities.

Field observations indicate that BMPs were generally effective in limiting or preventing sediment transport to water bodies during timber harvest and facility activities. Actions were identified to improve BMP effectiveness during roads, minerals, aquatic restoration, and recreation activities.

## Action Plans

The 2014 Tongass IDT monitoring shows that the sale administrators, engineering representatives, and contracting officer's representatives are implementing the BMPs in most cases. The departures noted identify some focal points for FY2015. Examining the IDT review relative to the departures and emphasis items, evaluation of the data shows that completion of the monitoring forms is important and highlights some significant issues.

Field participation by the district soil scientists, hydrologists and fish biologists throughout the planning and layout processes is necessary and was shown to improve the unit layout. Emphasis on detailed field review of contract-developed environmental assessment, as well as layout, is critical and should be continued. There were few discrepancies between the environmental documents, layout and implementation records noted in the BMP review of units this year.

Consistency with the Alaska Forest Resources and Practices Regulations should continue to be emphasized. The Alaska Region BMP handbook is outdated and inconsistent with the road terminology associated with road maintenance and practices of linear graded road specifications. Revisions to the Regional BMPs need to be further considered.

# 20b. Soil and Water: BMPs

**Goal:** Minimize soil mass movements as a result of management activities.

**Objectives:** Plan and conduct land use activities to avoid irreversible or serious and adverse effects on soil and water resources.

## Slope Stability Question: *Are the soil and water conservation practices as described through the best management practices and site-specific prescriptions implemented and effective in minimizing soil erosion and maintaining State water quality standards?*

### Landslide Inventory

In FY2000 the Tongass began a forest-wide landslide inventory effort. A forest-wide landslide inventory will be used for watershed assessment, timber harvest suitability and impacts and improvement of the mass movement index rating system for soil map units.

Landslide inventory is essential to understanding the effects of management activities on slope stability. The 1997 Forest Plan specifically described landslide inventory as a method for evaluating Region 10 Soil Quality Standards and Best Management Practice effectiveness. While not specifically mentioned in the 2008 Forest Plan, landslide inventory remains essential for documenting effectiveness of BMPs 13.5 and 14.7, Region 10 Soil Quality Standards, and evaluating watershed condition.

#### *Monitoring Results*

In FY 2014 initiation points were added to the landslide layer. Large storm events in January 2014 (40 new landslides on Prince of Wales) and 4 new landslides in a local storm in Starrigavan Valley resulted in additions to the landslide layer. Keeping the layer current with new landslide events is a challenge given the size of the forest and difficult or infrequent travel to many areas of the forest.

*Soil and Water Photo 1. One of four landslides that occurred in the Starrigavan Valley in 2014. Photo courtesy of John Reed, Harris Air pilot.*

#### *Evaluation of Results*

The goal of the once-over Tongass landslide inventory is to first map all landslides in all development land use designations and other areas where soil mapping exists. The once-over mapping was completed in FY 2012. The landslide inventory will be used for project and forest-wide watershed assessments.

The Forest Plan currently uses two metrics to assess slope stability in the tentatively suitable criteria for timber harvest. 1) slopes over 72 percent gradient are considered unsuitable pending an on-site analysis; and 2) soil map units with a mass movement index (MMI) of 4 are also considered unsuitable. Application of the two metrics does not create a similar map of potentially unstable areas. A few soil map units on slopes less than 72 percent gradient are

considered MMI 4 due to soil characteristics. And several soil map units on slopes over 72 percent gradient are considered MMI 3 due to soil characteristics. A further complicating factor is the lack of sufficient detail to be truly useful at the stand scale in both the digital elevation models (DEMs) and the soil map units. For these reasons the MMI is rarely discussed at the stand scale and stability analysis hinges on the identification and analysis of slopes over 72 percent gradient.

### *Action Plan*

A preliminary overlay of landslide initiation points and the new land-type association layer was completed, but time constraints did not allow a full evaluation of the results.

The current slope layer for the Forest (20 meter DEM) likely will not provide sufficient detail to identify the microsites where landslides often initiate. A mapping project is underway to produce 5 to 10 meter DEMs for the entire state of Alaska. The projected date for delivery of the 5 to 10 meter DEMs for Southeast Alaska is from spring 2015 to mid-2017. At that time, the landslide initiation points should be overlain with the new DEMs to calculate landslide frequency by slope class.

The landslide layer needs additional quality control and periodic updates. At this time, the landslide layer receives updates only in project areas where other forest management activities are occurring. In FY2014, we did update the layer with landslides caused by the January 2014 storm on POW and the September 2014 storm in Sitka.

Once the new and greatly improved DEMs are available for the Forest, a landslide frequency analysis based on slope class should be conducted. Data from slope and MMI analysis will help improve our ability to identify and map unstable terrain.

In FY2013 the Tongass National Forest purchased a product called NetMap (Earth Sciences Institute). NetMap is a terrain-based model used primarily to map drainage networks. The NetMap slope stability model uses slope steepness and slope confluence to identify landslide prone areas. The NetMap slope stability model holds promise for better identification of unstable areas especially with the 5 to 10 meter DEM. Forest slope stability specialists should begin familiarizing themselves with the model when the new DEMs become available.

## Harvest on Steep Slopes (>72 percent)

### *Evaluation of Results*

In 2014, approximately 30 acres of timber harvest occurred on slopes over 72 percent gradient. About 18 acres were in the Tonka Timber Sale project area. About 12 acres were in the Eight Fathom Project Area.

In the Tonka Timber Sale project area, approximately 3 acres of harvest on slopes over 72 percent occurred in each of the following units: 109, 129, and 199. About 9 acres of timber harvest occurred on slopes over 72 percent in unit 605. The steep slope areas were harvested according to mitigation defined in the Tonka Timber Sale EIS. All steep slope areas were partial harvest with 66 percent retention and log removal was via helicopter.

The Eight Fathom Timber Sale was planned in 1996 before the 1997 Forest Plan standards and guidelines required on-site analysis of timber harvest proposed on steep slopes. Based on the available 20 meter DEM, about 12 acres of timber harvest on slopes over 72 percent gradient occurred in 2014. The steep slope harvest occurred in two units: 2608 (4 acres) and 2915 (8 acres). The unit card for unit 2915 describes gentle slopes with good deflection. The 20 meter DEM may not be accurate for this this unit. The unit card for unit 2608 also describes good deflection.

### *Action Plan*

Regarding harvest on slopes over 72 percent gradient, no action is currently needed. The timber harvest activities discussed above are adhering to applicable standards and guidelines. Documentation in the

current suite of NEPA documents is describing proposed harvest on slopes over 72 percent gradient by harvest unit.

# 21. Soil and Water: Restoration

**Goal:** Maintain and restore the biological, physical and chemical integrity of the Tongass National Forest waters.

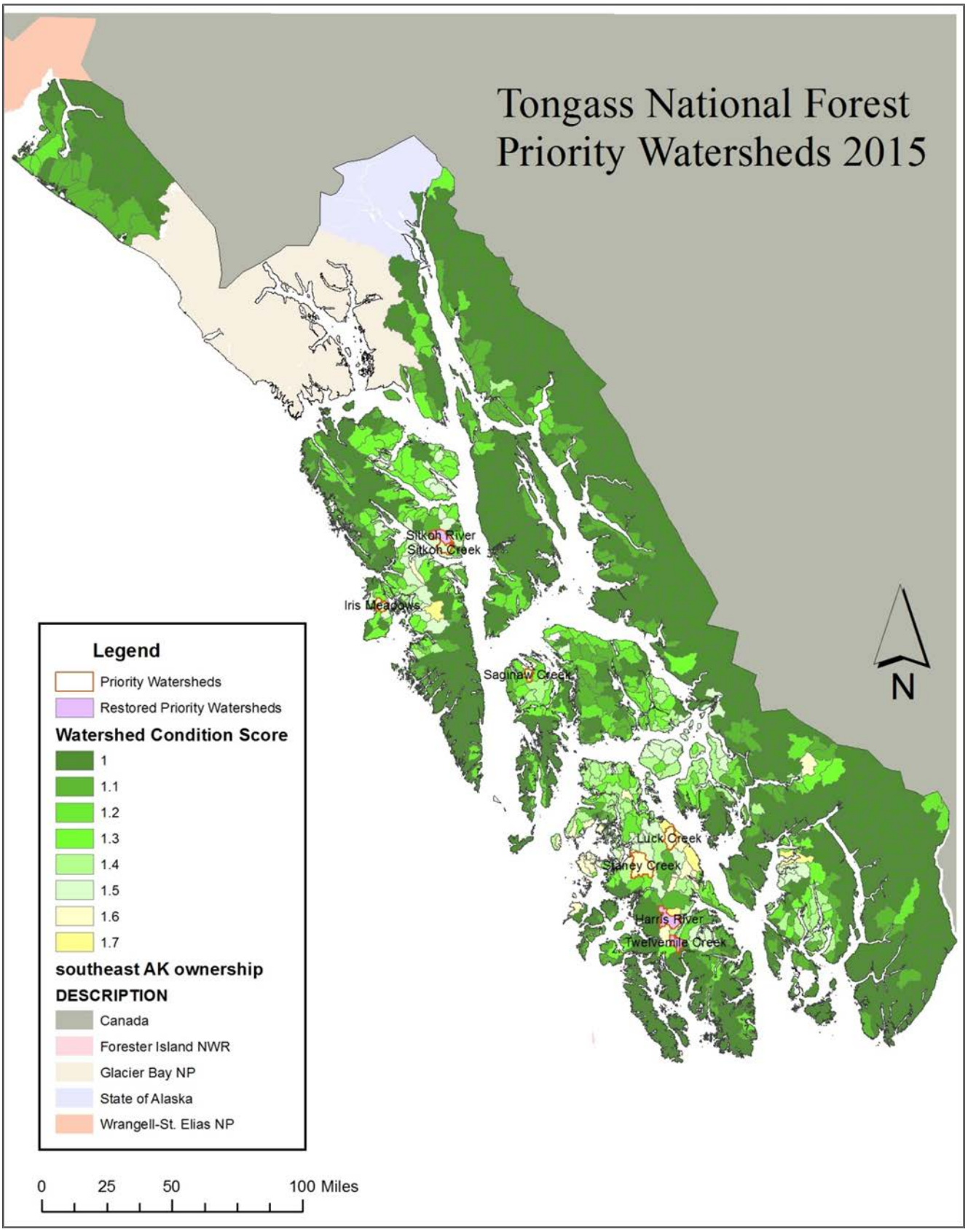
**Objectives:** Complete hydrologic condition assessments and restoration plans for priority watersheds. Complete watershed restoration plans in conjunction with Integrated Resource Program.

## Soil and Water Question: *What is the ecological condition and trend of watersheds in terms of key characteristics (such as soil productivity, water quality and quantity, invasive species, etc.) of watershed health identified in the desired condition (aquatic ecosystem potential) of the plan area? How effective are management actions in improving watershed health (maintaining or moving watersheds toward condition class I)?*

As part of the Forest Service National Watershed Condition Framework (USFS 2011), 12 core indicators were evaluated to classify watershed condition across the Tongass National Forest. Additional information on the National Watershed Condition Framework is at http://www.fs.fed.us/sites/default/files/media/types/publication/field_pdf/Watershed_Condition_Framework.pdf.

Most of the 900 watersheds within the Tongass are in near natural condition (condition class I). Sixty-eight watersheds were rated “at risk” for maintaining ecological functions and aquatic resources due to past management practices. Watershed health issues on the Tongass primarily result from historical timber harvest and road building that occurred between 1950 and 1979, prior to full understanding of the importance of watershed resources and processes. Measures are now in place (and incorporated into the Forest Plan) to protect and maintain watershed health.

The watershed condition ratings, along with use and aquatic value criteria, led to designation of priority watersheds for restoration. Following a review by Tongass staff, district rangers and stakeholders, the forest supervisor formally established seven priority watersheds (Harris River, Twelvemile Creek, Staney Creek, Luck/Eagle Creek, Saginaw Creek, Sitkoh River and Sitkoh Creek) (Figure 1). Restoration plans and activities to improve watershed health have been focused in these watersheds. Essential projects were completed and watershed condition has been restored in four watersheds - Harris, Twelvemile, Sitkoh River and Sitkoh Creek. Restoration continues in the other priority watersheds. Iris Meadows/Shelikof Creek on Kruzof Island was added to the priority watershed list in 2014.




**Soil and Water Figure 1. Tongass priority watersheds**

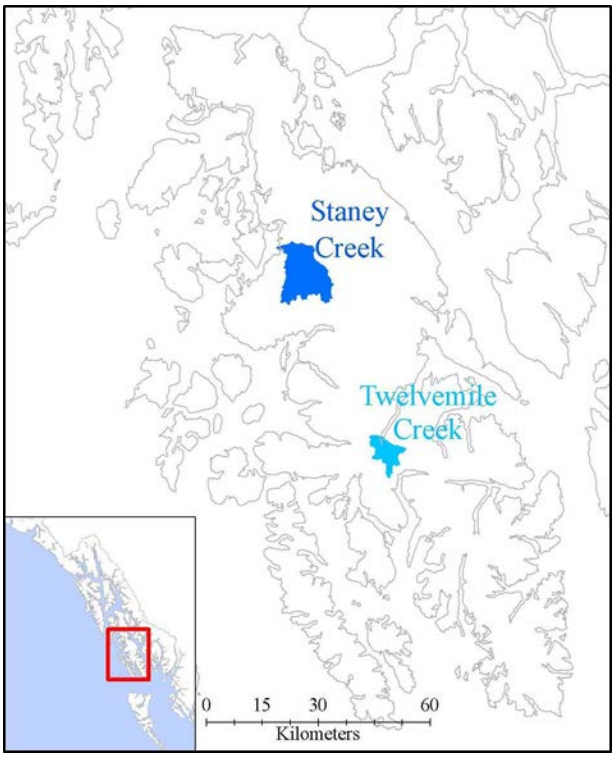
## Evaluation Criteria

The Forest Plan states that the evaluation criteria for this question are "effects of management activities on Watershed Condition Class." Beginning in fall 2015, the Tongass will reassess watershed condition following the protocols of the national Watershed Condition Framework.

A protocol was developed to evaluate the effects of forest management on stream flow; this effort has been deferred until a forest canopy density model has been developed for the Tongass. Refer to the action plan for recommendations on this topic.

In 2009, the Tongass and the Pacific Northwest (PNW) Research Station began collaborating on a protocol for watershed restoration effectiveness monitoring (WREM). Original objectives included development and testing of an integrated suite of monitoring tools to evaluate the effectiveness of management actions at improving watershed health. A specific goal of the original effort was to identify meaningful surrogates for salmon responses to restoration by quantifying relationships between salmonid populations and other (lower-cost) metrics of ecosystem recovery. Demonstrating positive changes in characteristics of target salmon populations has proven difficult because of the complex life history and multiplicity of influences on salmon throughout their life cycle. The metrics used in the original WREM strategy are designed to augment information collected about fish populations (primarily population structure, diversity and condition) and physical stream habitat, to improve the interpretation of fish responses and ecosystem function. An experimental design was proposed to evaluate riparian forest and in-stream restoration treatments at a stream reach scale.

A search for restoration sites failed to identify streams that met all study design criteria; ultimately some compromises were made to select six small stream reaches (three pairs) in two priority "functioning at risk" watersheds on Prince of Wales Island (Staney Creek and Twelvemile Creek – see Figure 2). Young-growth riparian forest adjacent to these streams had previously been treated. As a result, metrics related to riparian young-growth treatments were dropped from the initial study and instead a decision support tool for applying riparian thinning treatments in other project areas was developed and tested. Data collection within the six study reaches focused on physical habitat measures and juvenile fish sampling to determine population size, densities and growth trends. In-stream treatments (wood placement) completed in 2011 were monitored through summer 2013.




**Soil and Water Figure 2. Original watershed effectiveness monitoring locations**

The terrestrial riparian vegetation component of the WREM project, designed to address the question of how thinning treatments impact stand development and the functions associated with mixed species stands of diverse age and structure, continued in 2014 with additional field evaluation and outreach and education. PNW Research Station completed a retrospective study which evaluated five conifer release treatments to better understand the mixed success reported for those treatments. The Tongass young-growth management strategy – riparian emphasis exhibit was updated in 2014 by PNW Research Station and Tongass specialists to incorporate the latest approaches to assessment, treatments and monitoring of riparian stands.

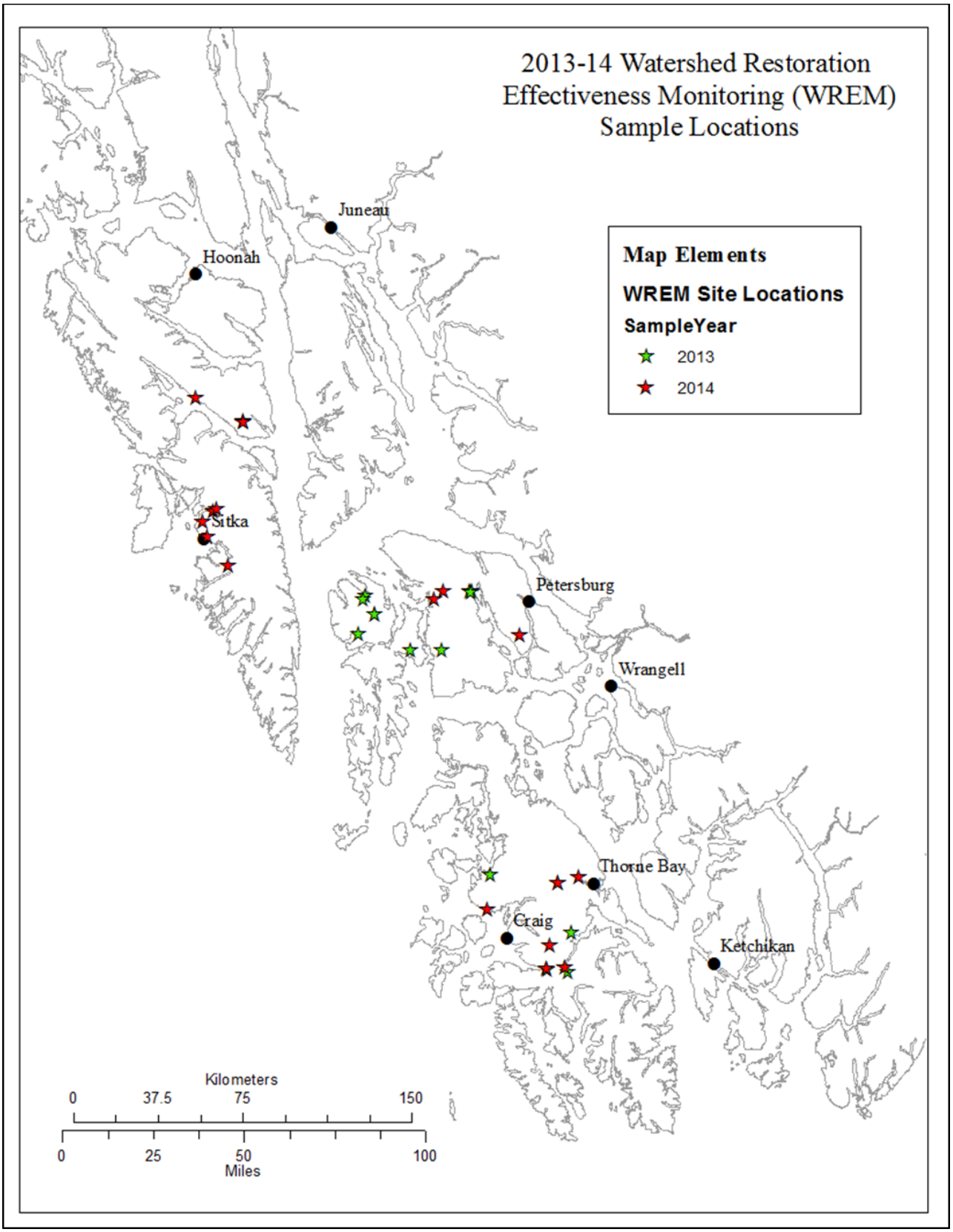
Program managers and monitoring principals met in November 2012 to review initial pre- and post-treatment data summaries (2011-2012) and discussed what had been learned since inception of the WREM program. Findings suggested that the effort, though informative with respect to protocol refinement and overall progress, was not on track to achieve monitoring objectives.

Three key findings were identified to drive an adaptive change to the strategy. First, the cost and time spent intensively sampling six small stream reaches prevented the programs forest-wide expansion to meet forest-level objectives. Second, the existing small sample size was not statistically rigorous, and the small streams sampled were not wholly relevant to broader scale and larger channel restoration treatments. Third, high variability in fish population data and tagging results between the six stream reaches and from one sampling event to the next in the same stream was bound to confound detection of responses to restoration treatments. The reformatted multi-faceted WREM strategy ensures a holistic package to look for trends across a broad scale and answer key restoration monitoring questions.

Beginning in FY2013, we expanded the original WREM study design from the two watersheds on Prince of Wales Island to include a broader range of channel sizes, and to better encompass forest-wide restoration projects, and to answer the following monitoring questions:

- Does large wood placement improve habitat in the restored reaches?
    - Does large wood placement increase frequency, areal extent, and quality of pools?
    - Does large wood placement increase channel complexity?
    - Does large wood placement improve stream bank stability?
- What are the fish characteristics (composition, relative abundance, diversity, and condition) in restored reaches?

*Soil and Water Photo 1. Spring Creek small channel treatment reach*




**Soil and Water Figure 3. 2013-2014 Tongass-wide watershed restoration effectiveness monitoring locations**

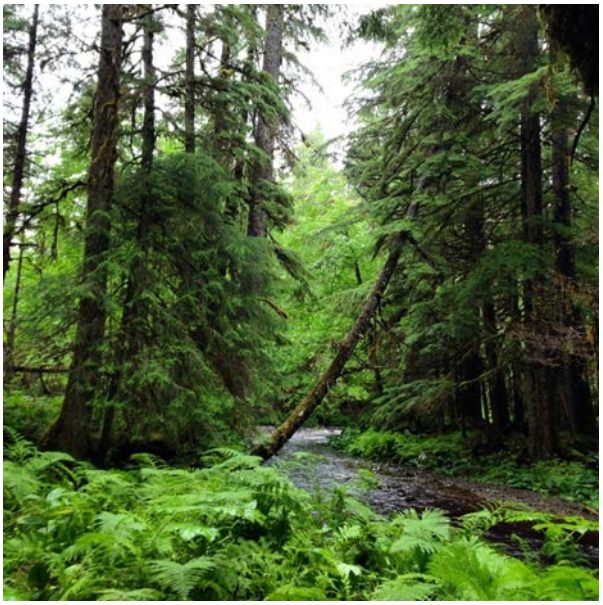
Under this expanded program and rotating panel sampling design, the intent is to sample a total of 72 stream reaches over a 4 year period and then return to these same reaches in the subsequent 4 year period. Reaches fall within one of three categories – reference, managed control (or un-restored) and treatment. Stream reaches are grouped into three categories based on channel width: small, medium and large channels. All are within alluvial stream process groups (floodplain and moderate-mixed gradient) and support salmon populations. The WREM sample design and objectives are detailed in the WREM monitoring plan.

We sampled a total of 35 reaches on islands throughout the north central, central and southern parts of the Forest in 2013 and 2014 (Figure 3). A total of 17 stream reaches were sampled in 2014. Photos 1-6 show representative sections of a subset of the 2014 sample reaches. We sampled physical habitat parameters and fish composition in each reach following the Alaska Region survey protocol (USFS 2001) and other accepted methodologies as outlined in the WREM study plan summary. We supplemented this protocol with a longitudinal profile survey to evaluate bedform complexity. The suite of physical habitat and biotic metrics will be used to quantify trends and conditions in treatment reaches, which will be compared to conditions in similar reference and managed reaches. Table 1 provides a summary of the suite of metrics used to address the WREM monitoring questions.

**Soil and Water Table 1. WREM monitoring questions and metrics utilized to address them**

| WREM Question | Metrics |
|---|---|
| Does large wood placement increase frequency, areal extent, and quality of pools? | Pool frequency expressed as pools per kilometer<br>Ratio of wetted pool area to wetted riffle and glide area<br>Average residual pool depth scaled by bedwidth |
| Does large wood placement increase channel complexity? | Mean square 'error' of thalweg profile (topographic variation about the mean slope) |
| Does large wood placement improve stream bank stability? | Length of undercut bank per meter<br>Reach-average bankfull width to depth ratio |
| What are the fish characteristics (composition, relative abundance, diversity, and condition) in the restored reaches? | Species counts expressed as percent of total<br>Fish per square meter broken out by species<br>Number of species<br>Fulton's K condition factor by species |

*Soil and Water Photo 2. Katlian River tributary small channel treatment reach*



*Soil and Water Photo 3. Newlundberry Creek small channel reference reach*

*Soil and Water Photo 4. Suntaheen Creek small channel managed control reach*

*Soil and Water Photo 5. Salmon Creek medium channel reference reach*

*Soil and Water Photo 6. Fubar Creek Phase 1 medium treatment reach*

In addition to the WREM Tongass-wide reach-scale extensive post-treatment (EPT) monitoring strategy and the ongoing terrestrial riparian vegetation strategy component, the Twelvemile Creek smolt investigation located on Prince of Wales Island continued for a third consecutive year. This component is intended as a tool to estimate watershed-scale effects of habitat restoration on anadromous fish production and survival. A rotary screw trap is annually deployed in mainstem Twelvemile Creek near the estuary to estimate coho salmon smolt abundance and provide insights on the timing, size and age distribution of coho salmon, steelhead trout, and Dolly Varden char (Photos 7-10). As part of the project, a large portion of coho smolt are coded wire tagged to better estimate smolt abundance and enable the determination of marine survival and harvest rates for this recently restored priority watershed.

## Sampling/Reporting Period

There is an annual sampling period with an 8-year rotating panel sample design for WREM extensive post-treatment (EPT) reach scale monitoring. Annual smolt sampling in Twelvemile Creek intended to run through 2015 with adult coho salmon re-capture work to continue into late 2016. The reporting and evaluation period is 5 years.

## Monitoring Results

Data collected as part of the Tongass-wide WREM strategy in 2014 included stream physical habitat coupled with fish response (WREM 2014 progress report). The Twelvemile Creek watershed scale smolt investigation was conducted for a third consecutive year. Data from the terrestrial riparian vegetation component has been synthesized and is in draft form as a PNW Research Station general technical report.

### *Stream Physical Habitat and Fish Response*

A total of 17 stream reaches were sampled during 2014. Interim results can be found in the WREM 2014 progress report. This is the second year of the eight year project using the rotating panel design; we do not have sufficient data for establishing trends at this time. Comparisons to the Tongass-wide fish habitat objectives (i.e., metrics) dataset show the relationship of individual sites and the natural range of variation. Group means will be compared for specific physical habitat and fish variables using standard statistical techniques, developed in consultation with a statistician.

### *Twelvemile Creek Smolt Investigation*

A 5-foot rotary screw trap was operated in mainstem Twelvemile Creek from April 15 through May 25, 2014 during the peak of the coho salmon smolt out-migrant season. Along with the screw trap, juvenile emigrants were also captured at remote locations in the lower Twelvemile drainage. Emigration timing appeared very similar to 2013, assuming the number of smolt captured is somewhat indicative of run timing. A total of 14,199 coho salmon smolt, 205 steelhead smolt, and 733 Dolly Varden smolt were captured in the screw trap. The total number of smolt captured by the screw trap was higher in 2014 than in 2013 for all three species of smolt; 14,199 vs 8,467 for coho, 205 vs 100 for steelhead, and 733 vs 595 for Dolly Varden. It is unclear at this point if this is due to increased abundance in 2014 or capturing a larger proportion of the emigration, or a combination of the two. A total of 18,309 coho salmon smolt were coded wire tagged in 2014 with 18 post-tagging mortalities for a total of 18,291 tagged coho released.

*Soil and Water Photo 7. Coded wire tagged coho salmon smolt*

*Soil and Water Photo 8. Coho salmon smolt*

This is the third consecutive year of operation for the smolt trap and operations will continue through 2015 for smolt work and into fall 2016 to complete the two-event mark-recapture experiment necessary to estimate the 2015 coho smolt abundance. See the 2014 Twelvemile Creek Smolt Investigation Project Summary for more information.

*Soil and Water Photo 10. Cuttthroat trout*

*Soil and Water Photo 9. Steelhead trout*

### *Soil Geomorphology and Terrestrial Riparian Vegetation*

The information obtained from the WREM terrestrial project provides initial guidance for assigning riparian treatments for the range of soil and geomorphic conditions through an adaptive management approach. Treatments considered for future treatment will utilize this guidance to array treatments in riparian forest stands by landform and stand structure to achieve desired future conditions in tree size and density. The intensive measurement protocol can be applied to evaluate the effectiveness of riparian stand treatments several years after treatment. The protocol can also be applied to sites that were treated in the past to expand the interpretive power and understanding of stand dynamics through a retrospective approach. A retrospective approach was utilized in 2014 within previously treated conifer release stands.

Because there has been some uncertainty about the effectiveness of the widely applied prescription of conifer release in riparian young-growth stands, yet no actual data to base a decision about the application of this treatment, a focused conifer release study was implemented in 2014. Individual release trees were measured, reach scale plots were established and trees within these plots were measured. A study plan was established and applied. Preliminary results of this study show that conifer release led to a growth response across the five observed stands for the period studied to date. A complete summary is in draft form as a PNW Research Station general technical report.

*Soil and Water Photo 11. Alder-dominated riparian stand*

*Soil and Water Photo 12. Salmon carcass retention observed in a treatment stream*

## Evaluation of Results

The evaluation of data collected through 2012 was described above and led to an expanded sample design which began in 2013. Sampling continued in 2014, the second year of an 8-year rotating sampling panel. Data collected in 2013-2014 has been summarized in the WREM 2013 Progress Report.

In fall, 2014, a thorough review of the WREM expanded strategy and rotating panel design was conducted by John Buffington, US Forest Service, Rocky Mountain Research Station hydrologist (Buffington 2015). The review included the study objectives, indices and metrics utilized, statistical recommendations, and intended outcomes. Findings from the review are being integrated into the 2015 WREM sampling and analysis.

Tongass stream restoration project monitoring guidance for project level, stream restoration projects, in priority watersheds was updated in 2014. This document defines several qualitative and quantitative tools to be used for evaluating channel response to restoration. Physical channel metrics can be measured pre- and post-restoration to evaluate the channel response and determine whether project objectives were met. By monitoring and reporting these outcomes, we can learn from our experiences, adapt our practices through time, and better communicate the effects of restoration. This project level monitoring compliments the larger scale, watershed restoration effectiveness monitoring (WREM extensive post-treatment evaluation), which is ongoing at a forest level.

Project monitoring reports were completed for the Harris River mainstem and Twelvemile Creek mainstem restoration projects.

Presentations on the Watershed Condition Framework, Forest Service channel habitat metrics, and WREM program were made at a fall 2013 Southeast Alaska Fish Habitat Partnership meeting. An interagency and stakeholder workshop was held in fall 2013 to further discuss and seek feedback on the Tongass WREM program strategy. Watershed restoration presentations were made at December 2013 gillnet and seiner gear group task force and/or board meetings.

## Action Plan

At this time, no changes to the Forest Plan are recommended. The following recommendations should be considered in the context of continued Watershed Restoration Effectiveness Monitoring (WREM) in the Tongass National Forest:

- Continue restoration plans and activities in priority watersheds in collaboration with partners and stakeholders. A reassessment of Tongass watershed conditions through the Watershed Condition Framework process is due to be completed by April 2016 and may incorporate an all-lands collaborative approach.
- Continue collaboration with Pacific Northwest Research Station to evaluate the effectiveness of restoration activities in improving watershed health.
- When a forest canopy density model is developed for the Tongass, consider its utility for evaluating the effects of forest management on streamflow. Incorporate recent findings on throughfall (Prussian 2010) and analysis of long-term streamflow records (personal communication with Ed Neal 2010).
- Continue to refine the Tongass Riparian Young-growth Strategy to reflect best science and ongoing retrospective monitoring results of riparian stand treatments. Ensure completion of a PNW Research Station general technical report which details field-based sampling and analysis in an experimental context across several riparian stands to better evaluate treatment options and predict future forest conditions in streamside forested communities.
- Compile a comprehensive database of historical riparian young-growth treatment areas to track

evolution of riparian forest stands. This database should include information on site conditions and treatment prescriptions across the forest. The riparian soil geomorphic guide can be used to predict the condition in the stand and its estimated trajectory toward future desired conditions.

- Continue with the broader Tongass-wide scope, more focused metrics with less sampling intensity WREM program for the duration of the 8-year rotating panel. Consider further testing of the hydrologic retention metric to determine its usefulness as a measure of channel complexity and nutrient retention in evaluating large wood placement projects.
- Continue smolt production monitoring in one restored Tongass watershed (Twelvemile Creek on Prince of Wales Island) to evaluate watershed scale effects of watershed restoration through 2015 with adult coded wire tagged coho salmon to be recaptured in fall 2016. Thereafter, adult coho salmon and steelhead escapement counts should continue as a tool for monitoring effectiveness of stream restoration actions.
- Continue with the forest requirement to collect a suite of routine physical metrics at all major watershed restoration projects as agreed upon in an updated 2014 version of the Alaska Region Core Aquatic Habitat Restoration Monitoring Guidance document.

## Citations

Buffington, J. 2015. A review of the Watershed Restoration Effectiveness Monitoring Program (WREM), Tongass National Forest.

Neal, E. 2010. USGS. Personal communication to Steve Paustian (US Forest Service) regarding updated comparative analyses of discharge data from Staney Creek (USGS station no. 15081497) and Old Tom Creek (USGS station no. 15085100) through the 2009 water year. December.

Prussian, K. 2010. Throughfall monitoring: Prince of Wales Island, Alaska.

USDA Forest Service. 2011. Watershed condition framework. FS-977. May.

# 22. Wetlands

**Goals:** Minimize the destruction, loss, or degradation of wetlands, and preserve and enhance wetland functions and values.

**Objectives:** Avoid alteration of, or new construction on wetlands, wherever there is a practicable, environmental preferred alternative. Implement Best Management Practices (BMPs) and Estuary, Riparian, Soil and Water Standards and Guidelines specific to wetlands.

## Wetlands Question: *Were wetland conservation practices implemented and effective to avoid and/or minimize impacts to wetlands to the extent practicable?*

Wetland-road monitoring has been on a two-year cycle, one year for field work and the second year for report writing.

As reported in the FY2012 monitoring and evaluation report and Landwehr 2011, a maidenhair fern was found in the wetland downslope of one of the three 30-year-old road segments monitored in 2011. Maidenhair fern typically grows on near-neutral pH substrates. The natural surface pH of the shore pine bog was measured at about 4.5 upslope of the road. Informal testing of soil surface pH indicated a pH of more than 7.0 up to ten meters down slope of the road. The 2011 report went on to recommend more formal sampling and testing of wetland pH was needed to understand the magnitude and extent of elevated pH levels associated with limestone roads across normally acidic wetlands.

In FY2013 a protocol was written to test the magnitude and extent of elevated pH associated with limestone roads across wetlands. In August of 2013 the protocol was implemented and pH and vegetation data collected in seven wetlands. Data collection included field pH measurements and documentation of vegetation (species and abundance) in 3 by 3 meter plots along a transect across the road prism. Data analysis and report writing was completed in FY2014 (Landwehr and Dillman 2014).

### Monitoring Results

#### *Soil Analysis*

Sixteen transects were completed across limestone roads in seven wetlands. Each transect included at least 6 pH monitoring points with accompanying 3 by 3 meter vegetation plots. The sample points were located 4, 7 and 10 meters upslope and downslope from the edge of the road fill. At each sample point pH was measured at 3 depths. If differences in pH were found between the upslope and downslope sample points, the transect was extended downslope. Additional sample points were added in 3 meter increments until pH measurements were similar to pH measurements upslope of the road. Using paired t-tests field pH measurements were compared upslope and downslope of the road.

pH was measured at three different depths at each sample point: surface, acrotelm, and catotelm. Surface pH and root zone pH are probably most important for plants. The upper part of the soils where most live plant roots occur is called the acrotelm. The third depth was the catotelm which consists of dead vegetation. The top of the catotelm typically coincides with the depth of the water table. Sample site selection included roads more than 30 years old, dominated by limestone rock (violent effervescence when contacted with hydrochloric acid), acidic, non-forested wetlands and the road located through the vegetation type and not on the edge. Road type, operational maintenance level, and amount of timber harvest beyond the wetland to end of the road system were used to sort roads based on traffic levels.

**Wetlands Table 1. Summary of selected road characteristics and wetland pH measurement differences upslope and downslope of limestone roads**

| Road number | Wetland name | Road age | Percent rocks with violent effervescence | Road type (traffic)*** | Road operational maintenance level | Harvest acres | Field pH increase downslope compared to upslope |
|---|---|---|---|---|---|---|---|
| 3036 | Logjam | Pre-1979 | 100 | Collector | ML 2 | 88 | 0.4 surface<br>0.2 acrotelm<br>1.2 catotelm |
| 3075600 | Lava Creek | Pre-1979 | 95 | Local | ML 2 | 245 | Not significant |
| 30 | Exchange Head | Pre-1978 | 100 | Arterial | ML 3 | 987 | Not significant |
| 20 | Red Bay | Pre-1982 | 90 | Arterial | ML 3 | Community connector Many 1,000s | 2.0 surface<br>1.3 acrotelm<br>0.8 catotelm |
| 2000810 | Mikes Road | Pre-1978 | 95 | Local | ML 2 | 322 | 1.4 surface<br>1.9 acrotelm<br>1.6 catotelm |
| 20 | Buster Creek | Pre-1979 | 90 | Arterial | ML 3 | Community connector Several 1,000s | 0.2 acrotelm<br>0.1 catotelm* |
| 20 | Turn Creek | Pre-1984 | 50 | Arterial | ML 3 | Community connector Several 1,000s | Not significant** |

* Both sides of this road 4 to 10 meters had elevated pH when compared to 50 meters from the road. Elevated pH associated with the road (both sides) is 0.5 surface, 1.0 acrotelm, and 0.6 catotelm.
** Both sides of the road had a slightly elevated pH when compared to 50 meters from the road. Elevated pH associated with the road is 0.4 surface, 0.1 acrotelm, and 0.3 catotelm.
*** Local roads are typically single purpose roads connecting the purpose to collector or arterial roads. Collector roads connect arterial roads to local roads. Arterial roads provide service to large areas and connect with other arterial roads or public highways.

Downslope pH was significantly elevated (90 percent confidence) in four of the seven wetlands sampled. Field pH measurements were as low as < 3.8 and as high as 8.2. The highest average pH measured was in a wetland downslope of the 20 road near Red Bay. That wetland had an average pH of 7.0 for the first 10 meters downslope of the road. In some cases the pH increase was as little as 0.1 pH units. In one wetland the increase was as high as 2.0 pH units. See Table 1.

Soil samples from three transects where field pH was notably different were sent to Oregon State University's Central Analytic Lab for analysis. The lab analysis included extractable potassium, calcium, magnesium, sodium and pH. The soil samples collected for this project were kept in a refrigerator for about 2 months due to the end of the government fiscal year and government shutdown in October 2013. Although stored in Ziploc bags with most of the air removed some decomposition may have occurred and changed pH of some of the samples. The results presented in Table 2 are best viewed as relative. All samples were treated the same. Field pH is provided in the second to the last column for reference.

**Wetlands Table 2. Extractable potassium, calcium, magnesium, sodium, and pH laboratory values for 18 samples from three transects in three different wetlands. The second to the last column displays our Truog field pH values for comparison. Shaded rows are corresponding downslope values to unshaded, upslope values.**

| Wetland, Transect number, Location and depth on Transect | K ppm | Ca ppm | Mg ppm | Na ppm | 10:20 ml (NH4OAc) pH | Truog Field pH | Acrotelm depth (cm) |
|---|---|---|---|---|---|---|---|
| Red Bay T3 10US surface | 63 | 618 | 55 | 8 | 4.9 | 4.3 | |
| Red Bay T3 10US acrotelm | < 1 | 548 | 60 | 5 | 4.4 | 4.3 | 20.0 |
| Red Bay T3 10US catotelm | < 1 | 386 | 78 | 7 | 4.2 | 4.3 | |
| Red Bay T3 10DS surface | < 1 | 1887 | 28 | 2 | 5.3 | 7.4 | |
| Red Bay T3 10DS acrotelm | < 1 | 1087 | 18 | 1 | 5.3 | 6.3 | 18.0 |
| Red Bay T3 10DS catotelm | < 1 | 799 | 21 | 1 | 4.8 | 6.3 | |
| | | | | | | | |
| Mikes Road T1 10US surface | < 1 | 198 | 25 | 2 | 4.6 | 4.2 | |
| Mikes Road T1 10US acrotelm | < 1 | 445 | 60 | 8 | 4.0 | 4.4 | 18.0 |
| Mikes Road T1 10US catotelm | < 1 | 390 | 24 | 4 | 4.4 | 4.4 | |
| Mikes Road T1 10DS surface | < 1 | 1340 | 29 | 2 | 7.0 | 8.2 | |
| Mikes Road T1 10DS acrotelm | < 1 | 655 | 21 | 6 | 7.1 | 8.2 | 14.0 |
| Mikes Road T1 10DS catotelm | < 1 | 521 | 12 | 2 | 6.9 | 8.2 | |
| | | | | | | | |
| Logjam T1 10US surface | < 1 | 69 | 12 | 3 | 4.8 | 4.4 | |
| Logjam T1 10US acrotelm | < 1 | 85 | 15 | 1 | 4.7 | 4.4 | 15.0 |
| Logjam T1 10US catotelm | < 1 | 77 | 16 | 3 | 4.5 | 5.0 | |
| Logjam T1 10DS surface | < 1 | 123 | 10 | 1 | 4.7 | 3.8 | |
| Logjam T1 10DS acrotelm | < 1 | 487 | 17 | 1 | 5.5 | 7.0 | 12.0 |
| Logjam T1 10DS catotelm | < 1 | 165 | 6 | < 1 | 6.3 | 6.8 | |

Extractable calcium values in Table 2 follow the hypothesis that calcium ions are replacing hydrogen ions on cation exchange sites downslope of the roads where these samples were collected. Extractable calcium ion concentrations downslope of these three road segments are 2.4 to 3.3 times higher than concentrations upslope of the road. The Central Analytical Lab did not provide a weight of the soil samples analyzed so the values provided for calcium concentrations cannot be directly compared to other studies. The data in Table 2 is best viewed as relative data, all samples were treated the same way and the relative values between upslope and downslope samples are true. The relative increase in extractable calcium does seem to correlate with lab and field pH values. If additional work is done, soil analysis should include samples further from the road prism, and the lab should report data in millequivalents per 100 grams (meq/100g) so that it can be compared to other soil pedon nutrient analysis.

*Wetlands Photo 1. A patch of maidenhair fern along a preferential flow path in a Western Hemlock-Red Cedar-Blueberry-Skunk cabbage plant association 43 meters downslope of the logjam road. This fern is typically not found in this plant association. Field pH is about 7.0 at this spot.*

*Wetlands Photo 2. Maidenhair fern and red cedar growing on the edge of a limestone shot rock road in the Logjam sloping bog.*

In 3 of the 4 wetlands, the elevated pH downslope of the road appeared to be due to the chemical reaction of relatively acidic wetland water in contact with, and flowing past high pH/basic limestone road fill.

In the Turn Creek and Buster Creek wetlands, pH was significantly elevated on both sides of the road when compared to two samples collected 50 meters from the road. In these two wetlands, we believe the elevated pH is due to fugitive dust from traffic during dry periods.

As described in last year's monitoring and evaluation report, the ability of road rock to affect wetland chemistry is dependent on several variables. First, the rock itself has to be soluble and of a chemical composition that can change the chemistry of the soil water. The second variable seems to be the surface area of the rock in contact with acidic water. The surface area of the rock depends, in part, on the traffic levels and road maintenance that breaks down the rock and produces finer aggregate. The third variable appears to be the amount of water flowing through the road subgrade, although flow through the road was not measured as part of this monitoring. Preferential flow paths were identified in the Red Bay wetland and the Logjam wetland. pH measurements along preferential flow paths showed an elevated pH further from the road than samples taken away from preferential flow paths.

### *Vegetation Analysis*

The vegetation data consisted of species composition and percent cover. The analysis was conducted to compare upslope vegetation plots with downslope vegetation plots for all transects, selected transects and selected species. The methods used included data reduction, principal component analysis (PCA), non-metric multidimensional scaling (NMS), multi-response permutation procedures (MRPP), and multivariate analysis of variance (MANOVA). For selected species analysis, Welch's t-test was used to identify significant differences. All analyses were conducted by Greg Brenner of Pacific Analytics.

The comparison of all upslope vegetation plots with downslope vegetation plots did not identify a significant difference in plant community upslope versus downslope of the road. When only the transects with differences in field pH were included in the analysis, the MRPP method showed evidence of a significant difference in vegetation communities, but the more robust MANOVA results did not.

Vegetation species with a PCA score of more than 0.5 were subjected to a Welch's t-test in an attempt to identify indicator species in the vegetation data. The results are in Table 3.

**Wetlands Table 3. Results of Welch's t-tests for species with PCA scores greater than 0.5. The results are discussed in the text.**

| Wetland and Transect | Species | Common Name | Welch's t-test findings | Species Location for significant findings |
|---|---|---|---|---|
| Logjam Transect 3 | *Chamacyparis nootkatensis* | Yellow cedar | No evidence (p-value = 0.8324) | |
| Logjam Transect 3 | *Tsuga heterophylla* | Western hemlock | No evidence (p-value = 0.2381) | |
| Logjam Transect 3 | *Vacinium vitis-videa* | Lingonberry | Evidence (p-value = 0.0033) | Lingonberry is more common upslope of the road at this site. |
| Logjam Transect 3 | *Carex pluriflora* | Several flowered sedge | No evidence (p-value = 0.3105) | |
| Red Bay Transect 3 | *Cornus canadensis* | Bunchberry | Evidence (p-value = 0.0188) | Bunchberry was more common upslope of the road at this site. |
| Red Bay Transect 3 | *Pinus contorta* | Shore pine | Suggestive evidence (p-value = 0.1395) | Shore pine was more common upslope of the road at this site. |
| Red Bay Transect 3 | *Trichophorum cespitosum* | Tufted clubrush | No evidence (p-value = 0.725) | |
| Mike's Road Transect 1 | *Trichophorum cespitosum* | Tufted clubrush | Evidence (p-value = 0.0475) | Tufted clubrush was more common downslope at this site. |
| Mike's Road Transect 1 | *Carex sitchensis* | Sitka sedge | Evidence (p-value = 0.0941) | Sitka sedge was more common downslope at this site. |
| Mike's Road Transect 1 | *Vaccinium uliginosum* | Bog blueberry | Suggestive evidence (p-value = 0.0863) | Bog blueberry was more common upslope at this site. |

For the species where the analysis indicated evidence or suggestive evidence of a difference in abundance between upslope plots and downslope plots, several of those species in Table 3 are known to occur across a broad pH range in southeast Alaska. Those species are bunchberry, shore pine, tufted club rush and Sitka sedge. Two species, lingonberry and bog blueberry, are known to occur on strongly acidic soils and may be good indicators of acidic soil conditions (Mackenzie and Moran 2004).

The species list from our plots was also compared to a list of plants identified by Klinka et al. (1989) as indicators of a calcium-rich or alkali environment. Three species from Klinka's list were found on our plots.

*Dodecatheon pulchellum* (few-flowered shooting star) was found in 7 vegetation plots at the Lava Creek wetland and one plot at Logjam wetland. Interestingly, the plots where the few-flowered shooting star occurred are mix of upslope and downslope plots and the majority of the plots do not have elevated pH based on field measurements. On our plots, the few-flowered shooting star was not a good indicator of calcium-rich or alkali substrates.

*Parnassia fimbriata* (fringed grass-of-parnassus) occurred on 5 plots in the Lava Creek wetland. Of the 5 plots, field pH indicated 3 of the plots with an acidic pH (4.5) and two plots with field pH of 6.6. On our plots, the fringed grass-of-parnassus is not a good indicator of calcium-rich or alkali substrates.

*Adiantum pedatum* (maidenhair fern) was found in 1 downslope plot at Red Bay, 2 downslope plots at Lava Creek and 1 downslope plot in the Logjam wetland. Three of the 4 plots had Truog field pH values

in the 7.0 to 7.8 range and 1 plot had a field pH of 4.2. Maidenhair fern seems to be a good indicator of near-neutral substrates.

Of the plant species identified on our plots and identified by Klinka et al. (1989) in coastal British Columbia as preferring calcium-rich or alkali environments, maidenhair fern appears to be the best indicator of calcium-rich substrates. See Photo 1.

Our concept wetland was one with consistent herbaceous vegetation, soils, soil depth and slope with a limestone road constructed through the middle of it. The concept wetland was difficult to find because roads are typically located to avoid wetlands and almost always the preference is to locate on the edge of the wetland where there is woody debris to help float the road and where the peat depth is thinner. Many of the wetlands had variable amounts of shore pine, with the shore pine typically growing in clumps. Even with our short transects and small plot size, it was difficult to locate a transect where the plots consistently did or did not have shore pine in them.

Another reason we had difficulty finding our concept wetland with a limestone road was the fact that limestone-dominated areas have fewer wetlands, and there are more opportunities for road locators to avoid wetlands in limestone-dominated areas.

### *The Effects of Elevated Soil pH*

In the three wetlands where elevated pH was found, the effects on wetland vegetation appear to be negligible. No changes to wetland vegetation species composition or cover were noted. Measurements of vegetative biomass or growth response were not part of this monitoring. In theory, an increase in soil pH from acid condition to a more neutral condition should make more nutrients available for plant growth, thus an increase in site productivity may result. Measurements of growth rates may show increased growth of plants in these wetland soils with a higher pH. Foliar analysis comparing vegetation upslope versus downslope of the road may show that plants are using additional available calcium.

At this time there are no documented Tongass plants that do not tolerate the elevated soil pH at these sites. Such plants would have to tolerate a very low pH and a narrow range. Our results show that bog blueberry and lingonberry may be two such plants, but more work is needed to better define the pH range tolerance levels for those plants.

## Evaluation of Results

Wetland chemistry has changed and is changing adjacent to some limestone roads through some wetlands. The effect is not consistent across all wetlands sampled nor does it appear to be widespread. Both field pH and soil chemistry lab data show increases in pH and extractable calcium ion concentrations downslope of limestone road segments in 3 of the 7 wetlands monitored. In these 3 wetlands, the extractable calcium ion concentrations increased 2.4 to 3.3 fold and pH increased at least 1.0 pH units (field measurements) in the first 10 meters downslope of the road fill.

The effects of elevated pH on soils or vegetation species composition and structure appear to be negligible in the three wetlands where elevated pH was identified downslope of the limestone road segments we monitored. In theory, an increase in soil pH from strongly acid conditions to near-neutral conditions should result in more available nutrients for plant growth. Plant growth rates were not measured as part of this monitoring. Foliar nutrient analysis would help determine if plants downslope of these roads are using the calcium from the increased concentrations of extractable calcium we identified in the soils downslope of the roads.

Vegetation analysis indicates little or no change to species composition and abundance that can be attributed to the change in soil chemistry even when soil pH increased 0.6 to 1.0 pH units. At our Logjam wetland, an individual maidenhair fern was noted in the non-forested wetland and a patch of maidenhair fern was noted at a discharge point downslope in a red-cedar-western hemlock-blueberry-skunk cabbage

forested wetland. Maidenhair fern does not typically occupy these habitats, and we believe it is there due to the change in soil chemistry.

The vegetation analysis suggests that bog blueberry and lingonberry may be indicators of very acidic soil conditions, but more work is needed to validate that finding.

Maidenhair fern was found on four of our plots in three different wetlands. Soils at three of the four plots had pH values of 7.0 to 7.8 and one plot had pH 4.2 based on Truog tests. Our observations agree with Klinka et al. (1989). On the Tongass National Forest, maidenhair fern appears to be a good indicator of a calcium-rich, near-neutral pH substrate. Maidenhair fern is often found growing on limestone outcrops and on the edge of limestone shot rock roads (Photo 2).

## Action Plan

No future wetland/road monitoring is planned. Through this monitoring and the monitoring completed by Landwehr 2007, 2008 and 2011, we have a better understanding of the impacts of forest roads on wetland chemistry, hydrology, soil and vegetation. Considering the limited miles of limestone roads on acidic wetlands, the negligible effects to vegetation, and the limited extent of effects found, the need for additional wetland/road monitoring is greatly diminished. At this time, we are not recommending any additional forest-level wetland/road monitoring work unless the amount of road construction increases or interest and funding comes from sources other than limited forest plan monitoring dollars.

The data presented in the report (Landwehr and Dillman 2014) does identify several recommendations for future road/wetland monitoring work, if more work is pursued.

To further minimize the impacts of forest roads on acidic wetlands, the forest could avoid using limestone rock to construct roads across wetlands when non-calcareous rock sources are present.

## Citations

Brenner, G. 2014. Statistical analysis of wetland vegetation near roads. Pacific Analytics. Prepared for Karen Dillman, USDA Forest Service. Tongass National Forest. February.

Landwehr, D.J. 2011. Unpublished. The implementation and effectiveness monitoring of wetland best management practices on the Tongass National Forest. October.

Landwehr, D.J. and K. Dillman. 2014. Unpublished. The effects of roads constructed of limestone fill on wetland chemistry. Tongass National Forest Wetland Monitoring Report. May.

Maas, K.M, J.C. Still and P.E Bittenbender. 1991. Mineral investigations in the Ketchikan mining district, Alaska 1991: Prince of Wales Island and Vicinity. USDI, Bureau of Mines. OFR 81-92.

# 23. Karst and Cave Ecosystems

**Goals:** Maintain, to the extent practical, the natural karst processes and the productivity of the karst landscape while providing for other land uses where appropriate.

**Objectives:** Allow for the continuation of natural karst processes. Maintain the productivity of the karst landscape while providing for other land uses where appropriate.

**Background:** Karst is a comprehensive term that applies to the unique topography, surface and subsurface drainage systems, and landforms that develop by the action of water on soluble rock (primarily limestone and marble carbonates) in Southeast Alaska. The dissolution of the rock results in the development of internal drainage, producing sinking streams (streams that sink into the stream bed or karst features), closed depressions, sinkholes, collapsed channels, micro relief karst features (e.g., karren), and caves.

The geology and climate of Southeast Alaska are particularly favorable for karst development. Extensive areas of very pure carbonate (>95 percent $CaCO_3$), approximately 549,522 acres (859 square miles), are found within the boundaries of the Tongass National Forest. This includes carbonate bedrock on private, state, and federal lands. Because of fractures in the carbonates, high annual precipitation, and peatlands adjacent to the carbonate bedrock, karst has developed, to varying extent, within all carbonate blocks. The Tongass National Forest contains the largest known concentration of solution caves in Alaska.

In Southeast Alaska, the karst landscape can be characterized as an ecological unit found atop carbonate bedrock in which karst features and drainage systems have developed as a result of differential solution by surface and groundwaters. These acidic waters are a direct product of abundant precipitation and passage of these waters through the organic-rich forest soil and the adjacent peatlands. Recharge areas may be on carbonate or adjacent non-carbonate substrate. A few characteristics of this ecological unit include: mature, well developed spruce and hemlock forests along valley floors and lower slopes, increased productivity for plant and animal communities, extremely productive aquatic communities, well-developed subsurface drainage, and the underlying unique cave resources (Baichtal and Swanston 1996, Wissmar et al. 1997, Bryant et al. 1998).

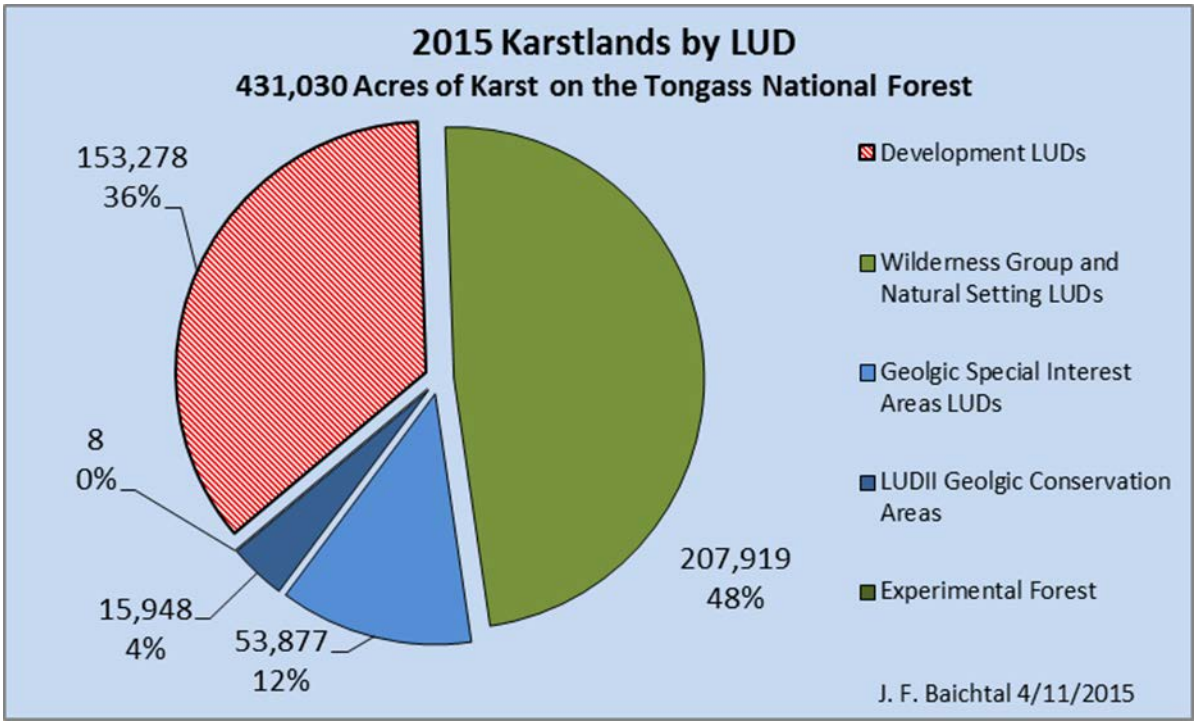
These karst areas are most comparable to those of karst lands found on Vancouver Island and the Queen Charlotte Islands of British Columbia, Canada; portions of Patagonia, Chile; Tasmania; and the west coast of the South Island of New Zealand. All of these areas have very steep surface slopes and subsurface hydraulic gradients, and very high levels of rainfall. These characteristics put them among the most dynamic karst terrains on earth, evolving and changing more rapidly and abruptly than karst in more moderate settings. The Karst Panel Report (Aley et al. 1993) found the karst lands of the Tongass to be of national and international significance for a variety of reasons. The Karst Review Panel in the summer of 2002 reconfirmed these findings (Griffiths et al. 2002). Both of these Panels consisted of world-renowned karst experts with a breadth of karst resource backgrounds and a wide variety of international exposure to karst areas and management considerations. Not only is the level of karst development and the karst hydrology and mineralogy globally significant, the paleontological and archaeological discoveries have, for the first time, written the prehistory of Southeastern Alaska and contributed to and challenged theories of the peopling of North America. This research, in conjunction with associated and ongoing palynology and glacial history research, is defining the paleoecology of the region.

The native and local inhabitants of Southeast Alaska have long known of the presence of caves. The existence of well-developed cave systems was first formally reported in 1975 and mapping of the caves began in 1987. The existence of vast areas in which karst had developed was fully recognized in 1990. Though noted by early foresters and geologists, about this same time the interrelationship between timber production and highly productive forests atop the karst landscape became apparent. With the passing of the Federal Cave Resources Protection Act (FCRPA) in 1988, the Tongass struggled with methods to

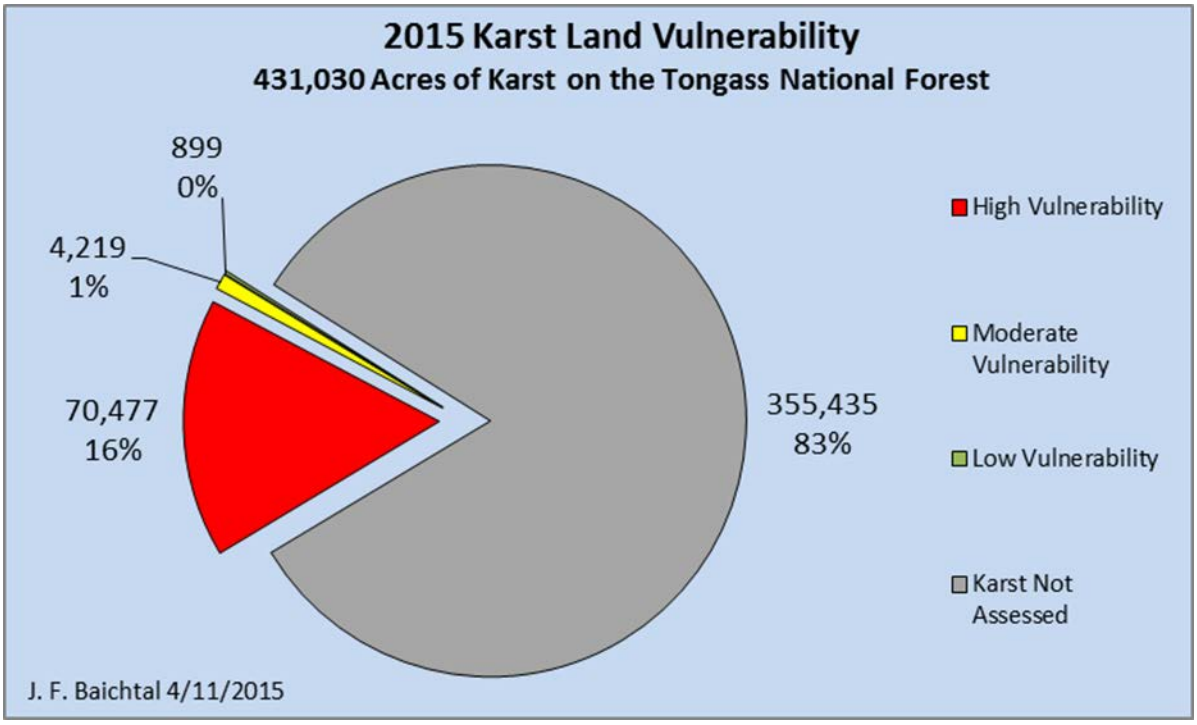
protect the many caves throughout the landscape. At first, protection focused on only the large, significant karst features and cave entrances. Subsequent measures tended to look at entire karst hydrologic systems including contributing non-carbonate catchments.

From 1993 to 1997, the Tongass worked on revising the Tongass Land and Resource Management Plan (Forest Plan). One of the five emphasis areas identified in the Forest Plan revision was karst and cave resource management. Responding to the need for a management strategy, standards and guidelines were developed which provided for other land uses while taking into account the function and biological significance of the karst and cave resources within the landscape. This strategy was developed with the recommendations of a karst and cave resource significance assessment completed by Aley et al. in 1993 and combining the most current thinking on karst management issues. The Tongass began adopting a land management strategy for the karst lands similar to hazard area mapping or risk assessment. Referred to as "vulnerability mapping" or "karst vulnerability", this strategy assesses the susceptibility of the karst resources to any land use. Vulnerability mapping utilizes the fact that some parts of a karst landscape are more sensitive than others to planned land uses. The key elements of the strategy focus on the openness of the karst system and its ability to transport water, nutrients, soil and debris, and pollutants in to the underlying hydrologic systems. The strategy strives to maintain the capability of the karst landscape to regenerate a forest after harvest, to maintain the quality of the waters issuing from the karst hydrologic systems, and protect the many resource values within the underlying cave systems as per the requirements of the FCRPA.

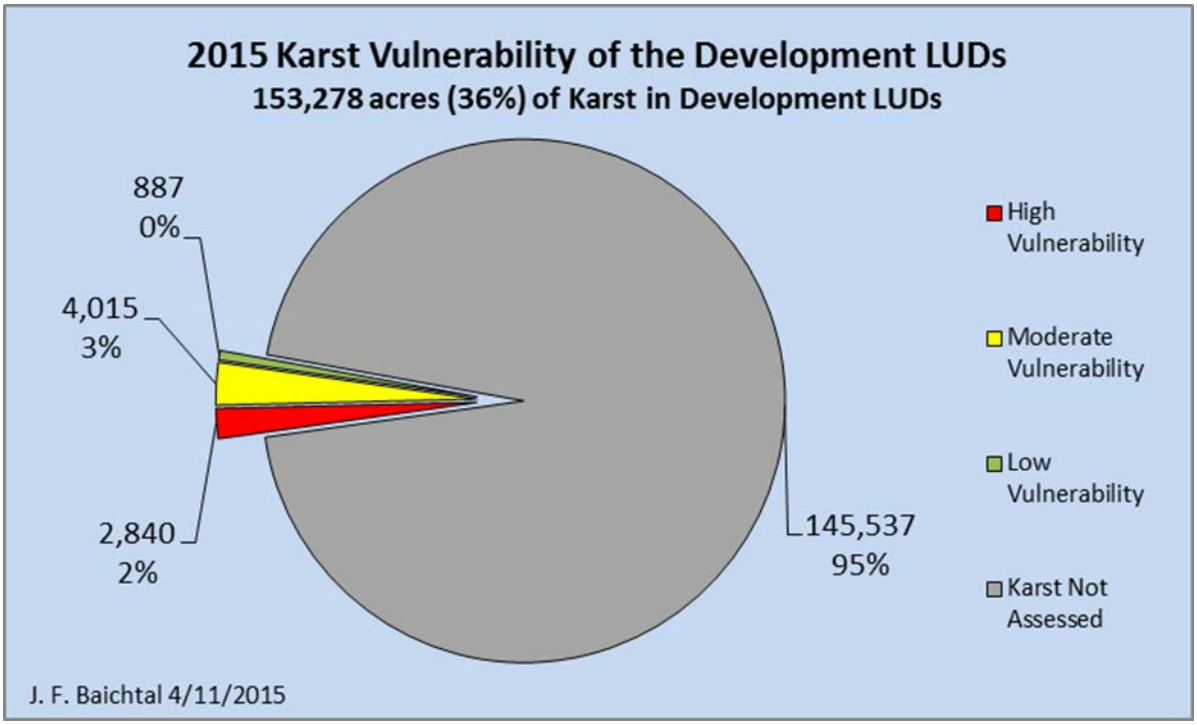
Using the 2008 Forest Plan land use designations (LUDs), changes to those LUDs with provisions in the National Defense Authorization Act for Fiscal Year 2015, and the most current geologic information, some 431,030 acres (674 square miles; 1744 square kilometers) of karst underlie the lands currently administered by the Tongass National Forest. Of those acres, 207,919 acres (48 percent of the Tongass karst lands) are in the Wilderness Group and Natural Setting LUDs and 69,825 acres (16 percent of the Tongass karst lands) are Geologic Special Interest Areas or LUD II Geologic Conservation Areas. The remaining 153,278 acres of karst (36 percent of the Tongass karst lands) are in Development LUDs. Of the karst lands in Development LUDs, 2,840 acres are mapped as high vulnerability. Of the remaining 150,447 acres of karst lands within the Development LUDs, it is estimated that through inventory and karst vulnerability assessments, that a minimum of 30 percent or 45,134 acres of additional high vulnerability karst lands would be characterized from those lands. Considering all these LUDs and projected inventory results, 325,717 acres or 76 percent of the karst lands are protected or are modeled to be protected. Therefore, the remaining 24 percent of the karst lands may be available for some level of management pending the results of a thorough inventory and karst vulnerability assessment. Some of these areas have already been harvested and management would be as pre-commercial and commercial thinning. Current GIS queries show a total of 80,025 acres (19 percent of the Tongass karst lands) of harvest on karst on lands managed by the Tongass National Forest.




**Karst and Cave Figure 1. 2015 karst lands by land use designation (LUD)**




**Karst and Cave Figure 2. 2015 karst land vulnerability**




**Karst and Cave Figure 3. 2015 karst vulnerability of the development LUDs**

The above acres of karst lands and karst lands by LUDs in Figures 1 to 3 were generated in April of 2015 from the geologic mapping completed in cooperation with the US Geological Survey (USGS) in Anchorage and from USFS field inventories. The USGS-USFS geology layer was queried to reflect rock units known to develop karst systems. The USGS-USFS geology layer has been updated to reflect mapping completed in conjunction with the Madan, Iyouktug, Sealevel, Kosciusko, Suemez, Logjam, Slake, Big Thorne and Licking Creek Project Areas and mapping completed by the Forest on northwestern Etolin Island.

The Forest Plan standards and guidelines for Karst Resources (2008 Forest Plan) outline a management strategy and define a process, which requires a karst landscape assessment be conducted. This four-step process first identifies and inventories the karst development and karst hydrologic systems, then evaluates karst resources as to their vulnerability or sensitivity to land uses affecting the karst systems. Consistent implementation of these guidelines across the Tongass has been a challenge. It is believed that this is partially due to unclear direction and limited experience of field personnel with this unseen resource. The flexibility in interpretation has resulted in conflicts between the Forest Service and concerned organizations, particularly the local caving community. Specifically, the definitions of high, moderate, and low vulnerability karst have been interpreted differently in the field. Differences in interpretation are exacerbated by the lack of understanding of the way timber harvest impacts karst and cave resources, most notably, by changes to hydrology and sediment delivery. The discussion in the 1997 Forest Plan does not make clear the difference between riparian management objectives and karst and cave management objectives. This understanding is critical for Forest Service employees tasked with implementing resource protection measures in the field. The 1997 Forest Plan did not discuss young-growth management opportunities on karst lands and did not address the question of salvage of windthrown timber on karst lands.

Multiple reviews of the current and proposed karst management strategies have been conducted by two panels, independent reviewers, and internally. These include: Karst and Cave Resource Significance Assessment, Ketchikan Area, Tongass National Forest, Alaska (Aley et al. 1993); Application of a Karst

Management Strategy: Two Case Studies from the Tongass National Forest, Southeastern Alaska The Challenges of Implementation (Baichtal 1997); Heceta Sawfly Salvage Sale, Soils, Karst, and Cave Resource Evaluation, Heceta Island, Southeastern Alaska (Baichtal and Landwehr 1997); Karst Vulnerability Assessment Review, Heceta Island (Aley 1997); and Karst Management Standards and Implementation Review, Final Report of the Karst Review Panel (Griffiths et al. 2002).

These reviews, combined with implementation and effectiveness monitoring and resource specialist input, form the basis for the proposed changes discussed below. The standards discussed here have been implemented since 1991 in one form or another. Thus, the Tongass has nearly 20 years of implementation experience. The effectiveness and appropriateness of these standards have been discussed and debated internally and externally, both nationally and internationally. The final report from the karst panel in 2002 noted that "implementation of the 1997 Forest Plan karst standards and guidelines has ensured a high level of protection for karst resources overall. The panel noted high standards in both the philosophy of management, and the way that specific management practices were formulated and applied. Implementation of specific policies and procedures was found to be very good and in general compliance with the stated goals and objectives of the karst program."

In 2006, the Tongass National Forest initiated a process to amend the 1997 Tongass Land and Resource Management Plan (Forest Plan). The 2008 Amendment to the Forest Plan includes substantial changes to the karst and cave resources standards and guidelines. These new guidelines will hopefully correct some of the ambiguity of past direction and clarify the karst and cave management strategy and process. The 2008 Forest Plan and the National Defense Authorization Act for FY2015 have placed some 629,825 acres of karst into either geologic special interest areas or LUD II geologic conservation areas to protect karst lands that are most vulnerable to disturbance from development.

## Karst and Caves Ecosystems Question: *Are the biological, mineralogical, cultural, paleontological components, and recreational values of the karst and caves maintained?*

Monitoring was completed on projects implemented under the direction of the standards and guidelines in the Forest Plan. Work completed under the Forest Plan karst and cave standards and guidelines included preliminary inventory, cave inventory and mapping, timber harvest unit and road reconnaissance, timber harvest unit layout, and road layout.

### Monitoring Results

The karst and cave standards and guidelines outlined in Forest Plan were implemented to the fullest extent practicable, and through effectiveness monitoring have shown that they ensure a high level of protection for significant caves and karst resources overall.

Current ongoing projects and those with signed records of decision focus on karst area protection. The karst and cave resources standards and guidelines require that areas of high vulnerability karst within the project area be deleted from land considered for harvest. Karst lands included in project areas are typically low or moderately-low vulnerability karst. The karst and cave resources standards and guidelines were fully implemented in completed projects such as Logjam and Slake Timber sales on central Prince of Wales Island. The karst and cave resources standards and guidelines are fully implemented in proposed and ongoing projects such as the Big Thorne Timber Sale, Kosciusko Island Timber Sale, Dargon Point CE, Saddle Lakes Timber Sale, Twelve Mile Restoration EA, the Wrangell Timber Sale, and Phase 1 and 2 of the Forest Highway 43 construction from the Coffman Cove Junction to the Whale Pass Junction. Karst resource inventory is planned in 2015 for completion of the Kosciusko Timber Sale, Waterfront Timber Sale in Sea Otter Sound and the Kuiu Roaded Project. Karst resource input is being incorporated into the 2016 Tongass Land and Resource Management Plan Amendment focusing on management of young-growth. Karst resource input was provided for a number of sales

associated with the small sales program on Thorne Bay and Craig Ranger districts on Prince of Wales Island. Particular emphasis was placed on the inventory and design of the prescriptions and mitigation proposed for commercial thinning opportunities. Karst resource input was made to the El Capitan/North Prince of Wales Road and the Forest Highway 58 Improvement Project.

Efforts on the above projects included on-the-ground inventories by the Tongass geologist and geology staff, soil scientists, hydrologists, fisheries biologists, and timber specialists. Features were mapped and characterized, and the streams flowing to and from them identified. Resource reports for each area were developed. The findings of these efforts have been mapped and incorporated into the final reports. Also included were survey and inventory of some of the caves found within the project areas. Resource reports were provided to the planning interdisciplinary teams and incorporated into the final design of the projects and the project recommendations. These findings were also incorporated into the chapter 3 discussions in the environmental documents associated with these projects.

Effectiveness monitoring has been historically tied to post-harvest monitoring and preliminary cave resource inventories. In FY2014, a minor amount of logging occurred on karst lands where mitigation had been prescribed. Monitoring of some of the small sales on the Thorne Bay Ranger District was conducted to evaluate the effectiveness of proposed mitigation. Monitoring of these sites found that prescriptions such as partial suspension and buffer windfirmness were achieved. Limited subsurface monitoring was accomplished. These included subsequent trips into known cave systems to document changes and pre-harvest inventory of karst features to establish baseline inventories. No substantial changes as a result of management activities were documented within the known cave systems.

The Edna Bay Municipal Watershed Delineation Project on Kosciusko Island will continue on 2015. In cooperation with the City of Edna Bay and State of Alaska, this project was initiated to define the catchment area of the springs which provide water to the town of Edna Bay, Alaska.

Monitoring of the effectiveness of the implementation of the standards and guidelines over the past few years has shown the need for clarification of the implementation procedures and identified changes to the standards needed. The 2008 Forest Plan Amendment karst and cave resource guidelines reflected these changes. These changes capture the findings of past effectiveness monitoring and hopefully provide clarification of the implementation procedures.

## Evaluation of Results

The value of karst and cave resources across the Tongass in recognized. Resource specialists from various disciplines are bringing observations, concerns and discoveries to the attention of the Tongass geologist and/or geology staff for consideration during the inventory and design phase of projects. Implementation monitoring has shown the need for continued education and training of specialists across the Tongass. Specialists themselves have requested this training. Substantial changes have been implemented in the karst and cave resource guidelines for the 2008 Amendment to the Tongass Land and Resource Management Plan that better define the karst management strategy and vulnerability assessment process.

Programs such as the small sale program on Thorne Bay Ranger District allow the karst management specialist to work closely with the presale forester, purchaser, and sale administrator to ensure consideration of karst resource values. As funding allows, the Tongass needs to continue to strive for pre-harvest, immediately post-harvest, and post-harvest monitoring of areas where mitigation is applied.

The karst and cave resource standards and guidelines in the 2008 Forest Plan have helped with implementation and clarification of standards from past guidelines. The awareness of karst and cave resources and mitigation measures are more easily integrated into project design and implementation. Monitoring has shown that mitigation designed to protect karst resources has been more effective than in the past, especially when considering the effects of windthrow and losing streams. The current standards allow for appropriate protection measures for minor features to be designed on a case-by-case basis as

field assessed by a karst management specialist. This is an important change from past standards that allow flexibility in the implementation of standards. It is believed that the current standards, as written, are effective in protecting the karst and cave resources on the Tongass National Forest.

## Action Plan

Continue implementation of the karst and cave resource standards and guidelines across the Tongass in all projects where resources may occur. Continue to increase awareness of potential karst and cave resources within proposed projects across the Tongass. Continued training and involvement of karst specialists, hydrologists, soil scientists and other resource specialists is essential in implementation of the karst and cave resources standards and guidelines.

As timber harvest occurs in areas where karst is present and mitigation has been prescribed, effectiveness monitoring will follow as funding allows. Tracer dye studies will continue to further characterize karst groundwater systems.

## Citations

Aley, T., C. Aley, W. Elliot, and P. Huntoon. 1993. Karst and cave resource significance assessment, Ketchikan Area, Tongass National Forest, Alaska, Final Report, prepared for the Ketchikan Area of the Tongass National Forest. 76 pp. + appendix.

Aley, T.C. 1997. Karst vulnerability assessment review, Heceta Island. Report prepared for the Thorne Bay District Ranger, Steve Kimball. USDA Forest Service internal document. 7 p.

Baichtal, J.F. and D.N. Swanston. 1996. Karst landscapes and associated resources: A resource assessment. General Technical Report, PNW-GTR-383. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. 13p.

Baichtal, J.F. and D.J. Landwehr. 1997. Unpublished. Heceta Sawfly Salvage Sale: Soils, karst, and cave resource evaluation. Heceta Island, Southeastern Alaska, USDA Forest Service internal document.

Baichtal, J.F. 1997. Application of a karst management strategy: Two case studies from the Tongass National Forest, Southeastern Alaska. The challenges of implementation. *In*: Proceedings of the 1997 Karst and Cave Management Symposium 13th National Cave Management Symposium Bellingham, Washington and Chilliwack and Vancouver Island, BC, Canada, October 7-10, 1997; Stitt, R.R., editor. Bellingham, WA: 4-11.

Bryant, M.D., D.N. Swanston, R.C. Wissmar and B.E. Wright. 1998. Coho salmon populations in the karst landscape of Northern Prince of Wales Island, Southeast Alaska. Transactions of the American Fisheries Society. 127: 425-433.

Griffiths, P., T. Aley, S. Worthington, and W. Jones. 2002. Karst management standards and implementation review. Final report of the karst review panel. Prepared for USDA Forest Service, Tongass National Forest, submitted to MWH (Montgomery Watson Harza) under the terms of USDA Contract 53-0116-2-55901, 27 p. + appendices.

Wissmar, R.C., D.N. Swanston, M.D. Bryant and K. McGee. 1997. Factors influencing stream chemistry in catchments on Prince of Wales Island, Alaska. Freshwater Biology. 38: 301-314.

# 24. Timber Resources: Economics and Volume

**Goals:** Provide for the continuation of timber uses and resources by the timber industry and Alaska residents. Manage the timber resources for timber production of saw timber and wood products for suitable forest lands made available for timber harvest on an even-flow, long-term, sustained-yield basis and in an economically efficient manner.

**Objectives:** Pre-commercially thin previously harvested suitable forestland. Evaluate non-clearcutting silvicultural systems. Seek to provide an economic timber supply sufficient to meet the annual market demand[1] for Tongass National Forest timber and the market demand for the planning cycle, up to a ceiling of the Forest Plan's allowable sale quantity, which is 2.67 billion board feet in the first decade. Maintain young-growth to improve habitat for wildlife and commercial timber products. Review standards and guidelines for applicability to young-growth stands. Provide 2 to 3 years supply of volume under contract to local mills and then establish shelf volume[2] to maintain flexibility and stability in the sale program. Review the timber sale program and work with the state and other partners to implement changes that will keep an "economic timber" perspective throughout the process and monitor the implementation of these reforms to ensure they are consistently employed across the Forest.

## Timber Resources Question: *Is the timber management program meeting the objectives of achieving economic timber sales and rebuilding the volume under contract and shelf volume components of the sale program?*

The evaluation criteria and sampling/reporting period are outlined below. No data relative to this question was reported.

### Evaluation Criteria

Forest Plan Chapter 2 Timber Goals and Objectives states that Congress mandates that all timber sales offered for sale by the Tongass National Forest, using the Residual Value Appraisal System (RVAS) requires that western redcedar be appraised for domestic processing and be above base rates before it can be offered for sale. No timber sale in Region 10 shall be advertised if the indicated rate is deficit when appraised using RVAS that assigns domestic Alaska values for western redcedar. The primary evaluation criteria includes timber volume offered for sale and timber sale volume under contract. Secondary information that may help management determine if the Forest Plan objectives are met includes timber sale bid rate, volume of timber sold, number of no bid timber sales, and volume of no bid timber sales. Tertiary information that may help management determine if the Forest Plan objectives are met includes annual volume harvested and number of timber sale purchasers.

### Sampling/Reporting Period

Timber sale volume offered is reported annually. Timber sale volume under contract is reported monthly. The secondary and tertiary information can be collected from the primary reports or from reports currently available in the Timber Information Management (TIM) system.

[1] The annual market demand forecast is a methodology used to set the short-term goals for the Tongass Timber Program – volume the Forest plans to offer in the current year, pending sufficient funding and sufficient National Environmental Policy Act (NEPA)-cleared volume. NEPA-cleared volume is defined as NEPA documents with a signed decision.

[2] Shelf volume is volume that has been NEPA-cleared and is available for offer.

## Monitoring Results

In FY2014, the Tongass offered 120 MMBF, sold and awarded 100 MMBF and had 449.00 MMBF in no-bid timber sales that remained unsold at the end of the fiscal year. In FY2014, the purchasers harvested 39 MMBF and had an ending inventory of 152.834 MMBF. The average annual harvest for the past 5 years is 34 MMBF. In FY2013, the harvest level was 32 MMBF with timber sales of 15 MMBF and a remaining inventory of 104.9 MMBF and 3.67 years of volume under contract based on a 5-year average annual harvest of 36 MMBF/year. The average bid rate for the timber under contract is $40.51/MBF. At the end of FY2013, the average bid rate was $28.02/MBF.

## Evaluation of Results

The Tongass has not been able to establish sufficient shelf volume to maintain flexibility and stability in the timber sale program.

# 25. Timber Resources: Standards and Guidelines

**Goals:** Provide for the continuation of timber uses and resources by the timber industry and Alaska residents. Manage the timber resources for timber production of saw timber and wood products for suitable forest lands made available for timber harvest on an even-flow, long-term, sustained-yield basis and in an economically efficient manner.

**Objectives:** Pre-commercially thin previously harvested suitable forestland. Evaluate non-clearcutting silvicultural systems. Seek to provide an economic timber supply sufficient to meet the annual market demand[1] for Tongass National Forest timber and the market demand for the planning cycle, up to a ceiling of the Forest Plan's allowable sale quantity, which is 2.67 billion board feet in the first decade. Manage young-growth to improve habitat for wildlife and commercial timber products. Review standards and guidelines for applicability to young-growth stands. Provide 2 to 3 years supply of volume under contract to local mills and then establish shelf volume[2] to maintain flexibility and stability in the sale program. Review the timber sale program and work with the state and other partners to implement changes that will keep an "economic timber" perspective throughout the process and monitor the implementation of these reforms to ensure they are consistently employed across the Forest.

**Background:** The 1997 Tongass Forest Plan implemented standards and guidelines that prohibited or limited commercial timber harvest in areas such as the beach, estuary, and riparian corridors and provided for case-by-case evaluation of harvest on slope gradients greater than 72 percent. The 2008 Tongass Land and Resource Management Plan (Forest Plan) maintains the same standards and guidelines. Factors to consider when allowing harvest on slopes greater than 72 percent are provided in the Forest Plan's forest-wide standards and guidelines for the soil and water resource.

The 1976 National Forest Management Act (NFMA) regulations established 100 acres as the maximum size for created openings using the even-aged system (clearcutting, seed tree and shelterwood) within the western hemlock, Sitka spruce forest type of coastal Alaska. The forest supervisor, under certain conditions, can approve created openings of up to 150 acres. The regional forester can approve openings up to 200 acres. Factors to consider, when approving openings greater than 100 acres, are provided in the Forest Plan's Forest-wide standards and guidelines for the timber resource. There appears to be no need to pursue a change in the maximum opening size or the factors for approving openings greater than 100 acres.

## Timber Resources Question: *Are timber harvest activities adhering to applicable timber management standards and guidelines relative to: created openings exceeding the maximum size limit for unit harvest, harvest on slopes greater than 72 percent slope gradient, or within the 1,000 feet beach and estuary buffer?*

This question addresses the limitation of created openings greater than 100 acres, the 1,000-foot beach and estuary buffer requirement and the limitation of harvest on slopes steeper than 72 percent. All harvest unit locations are entered in the Forest's geographic information system (GIS), specifically the activity polygon and covertype layers and into the Forest Service Activity Tracking System (FACTS) which tracks all activities on managed stands. Units are entered into these layers and into FACTS by district

[1] The annual market demand forecast is a methodology used to set the short-term goals for the Tongass Timber Program – volume the Forest plans to offer in the current year, pending sufficient funding and sufficient National Environmental Policy Act (NEPA)-cleared volume. NEPA-cleared volume is defined as NEPA documents with a signed decision.

[2] Shelf volume is volume that has been NEPA-cleared and is available for offer.

personnel at the completion of yarding of each unit and no later than the end of each calendar year. To answer this question, these harvest units are compared to the 1,000-foot beach and estuary buffers to determine if they infringe on the buffer zones. The harvest units are also compared to the Slope 72 percent cover to determine amount of harvest that occurred on slopes. In addition, unit size is tracked for units that were harvested using even-aged silvicultural systems.

## Monitoring Results

There were 2,722 acres fully or partially harvested during FY2014. Of these acres, 1,324 acres resulted in the creation of an opening through the use of even-aged silvicultural systems. The 100-acre size limitation applies to all harvest units that create an opening using even-aged management. Of the total harvest acres that created openings in the fiscal year 2000-2014 period, seven units exceeded the 100-acre limit, but none went over 148 acres. All seven units were analyzed and approved in project-level records of decision. There were two openings greater than 100 acres created in FY2014.

During FY2014, 97 harvest areas (timber stands) were reported as harvested with corresponding records created in the FACTS database. Accounting for adjacency (harvested stands that touch one another, which create a larger opening when added together), 45 harvest areas were logged in FY2014 that created openings using the even-aged silvicultural system and 49 stands were harvested using two-aged or uneven-aged silvicultural systems. Table 1 displays the number of openings created through even-aged timber harvest during FY2014.

**Timber Resources Table 1. Harvest unit frequency by unit size through even-aged harvest during FY2014**

| Acreage Range | Number of Openings | Total Number of Acres |
|---|---|---|
| 1-10 | 11 | 68 |
| 11-20 | 13 | 189 |
| 21-30 | 9 | 237 |
| 31-40 | 2 | 75 |
| 41-50 | 3 | 142 |
| 51-60 | 3 | 158 |
| 61-70 | 0 | 0 |
| 71-80 | 0 | 0 |
| 81-90 | 0 | 0 |
| 91-100 | 2 | 184 |
| 101 + | 2 | 271 |
| Totals | 45 | 1,324 |

## Evaluation of Results

### *Harvest size openings*

The 45 openings had a weighted average opening size of 29 acres, and ranged in size from 4 to 148 acres. The majority of openings (78 percent) were 40 acres or less in size. Two exceeded 100 acres. Forest Plan standards and guidelines for scenery and sensitive species such as Northern goshawk and American marten, and soil and water BMPs emphasize smaller sizes. Also, emphasis on leaving old-growth (legacy) structure in harvest areas is resulting in smaller harvest openings. Of the 1,324 acres managed via the even-aged system, 29 percent retained a portion of the original stand structure through the retention of leave trees. The remaining 71 percent received a traditional clearcut. The increase over the last couple of years in percent of traditional clearcutting without leaving reserve trees is a result of most harvest in the

past few years occurring in areas that do not require implementation of Legacy standard and guidelines. The marten standard and guidelines were implemented in more VCUs than the current legacy standard and guidelines require, meaning fewer even-aged units are required to have trees retained within the unit.

In addition to the harvests discussed above, 14 stands were harvested using two-aged management totaling 301 acres. Forty-nine stands were harvested using an uneven-aged silvicultural system totaling 1,398 acres. Both group selection (openings 2 acres or less) and single tree selection prescriptions were used to implement uneven-aged silvicultural systems.

The system name is based on the number of age classes present after the initial harvest, such as even-aged, two-aged, and uneven-aged. Even-aged systems produce stands that consist of trees of the same or nearly the same age. Two-aged stands result from treatments which leave behind a substantial portion of the original stand structure in the form of large trees distributed or clumped throughout the stand area. The remnant trees left on the site represent one age class, and the newly established trees represent another age class. Finally, uneven-aged systems create stands that include three or more distinct age classes by using individual or group selection methods.

### *Harvest within the 1,000-foot beach buffer*

Under the 2008 Forest Plan, programmed timber harvest which counts toward the Allowable Sale Quantity (ASQ) is not allowed within the 1,000-foot beach and estuary buffer. However, salvage harvest of dead standing and/or down material is allowed, if it is consistent with the long-term management objectives of both the beach and estuary buffer and the Land Use Designation (LUD) within which the harvest occurs. Of the total 2014 harvest, there were 67 acres of windthrow harvest in six units that were salvage harvested within the 1,000-foot beach and estuary buffer. This harvest was associated with the Zarkof Salvage Sale located on Zarembo Island on the Wrangell Ranger District and was authorized under the Zarkof Salvage Sale CE, signed on June 27, 2012.

### *Harvest on slopes greater than 72 percent*

In 2014, approximately 30 acres of timber harvest occurred on slopes over 72 percent gradient. About 18 acres were in the Tonka Timber Sale project area. About 12 acres were in the Eight Fathom Timber Sale project area.

In the Tonka Timber Sale project area, approximately 3 acres of harvest on slopes over 72 percent occurred in each of the following units: 109, 129, and 199. About 9 acres of timber harvest occurred on slopes over 72 percent in unit 605. The steep slope areas were harvested according to mitigation defined in the Tonka Timber Sale EIS. All steep slope areas were partial harvest with 66 percent retention and log removal was via helicopter.

The Eight Fathom Timber Sale was planned in 1996 before the 1997 Forest Plan standards and guidelines required on-site analysis of timber harvest proposed on steep slopes. Based on the available 20 meter Digital Elevation Model (DEM) about 12 acres of timber harvest on slopes over 72 percent gradient occurred in 2014. The steep slope harvest occurred in two units: 2608 (4 acres) and 2915 (8 acres). The unit card for unit 2915 describes gentle slopes with good deflection. The 20 meter DEM may not be accurate for this unit. The unit card for unit 2608 also describes good deflection.

## Action Plan

No action is currently needed. The timber harvest activities discussed above are adhering to applicable standards and guidelines.

# 26. Timber Resources: Allowable Sale Quantity

**Goals:** Provide for the continuation of timber uses and resources by the timber industry and Alaska residents. Manage the timber resources for timber production of saw timber and wood products from suitable forest lands made available for timber harvest on an even-flow, long-term, sustained-yield basis and in an economically efficient manner.

**Objectives:** Pre-commercially thin previously harvested suitable forestland. Evaluate non-clearcutting silvicultural systems. Seek to provide an economic timber supply sufficient to meet the annual market demand[1] for Tongass National Forest timber and the market demand for the planning cycle, up to a ceiling of the Forest Plan's allowable sale quantity, which is 2.67 billion board feet in the first decade. Manage young-growth to improve habitat for wildlife and commercial timber products. Review standards and guidelines for applicability to young-growth stands. Provide 2 to 3 years supply of volume under contract to local mills and then establish shelf volume[2] to maintain flexibility and stability in the sale program. Review the timber sale program and work with the state and other partners to implement changes that will keep an "economic timber" perspective throughout the process and monitor the implementation of these reforms to ensure they are consistently employed across the Forest.

**Background:** The allowable sale quantity (ASQ) for the Tongass National Forest as specified in the 2008 Forest Plan is 2.67 billion board feet for the first decade following implementation of the plan. The ASQ consists of two separate non-interchangeable components (NIC), also referred to as an operability inventory, and is based on land type and difficulty of harvest. NIC I (set at 2.38 billion board feet of timber per decade) and NIC II (set at 0.29 billion board feet per decade) and a proportional mix set at approximately 89 percent NIC I and 11 percent NIC II (Forest Plan ROD, page 7).

## Timber Resources Question: *Is the ASQ land base consistent with resources information and programmed harvest?*

### Evaluation Criteria

New information leading to changes in timber utilization standards; timber inventory results; timber dispersion requirements; tentatively suitable land base; yield tables; operability inventory projections on area managed for riparian, beach fringe and estuary resources; implementation factors; spatial limitations of analysis; and natural condition.

### Sampling/Reporting Period

Analysis of Forest Plan ASQ compared with the actual sale and harvest can be produced annually.

### Monitoring Results

Table 1 displays the sale volume for FY2004 through FY2014. For FY2004 through FY2014, the average annual volume sold was 53.88 million board feet (MMBF) or 20.05 percent of the annual ASQ. This information is presented to illustrate the trend in recent allotment of timber sale ASQ. The decline in timber sale volume is based on a variety of factors including economic conditions, harvest costs, and litigation.

---

[1] The annual market demand forecast is a methodology used to set the short-term goals for the Tongass Timber Program – volume the Forest plans to offer in the current year, pending sufficient funding and sufficient National Environmental Policy Act (NEPA)-cleared volume. NEPA-cleared volume is defined as NEPA documents with a signed decision.

[2] Shelf volume is volume that has been NEPA-cleared and is available for offer.

**Timber Resources Table 1. Timber volume sold for fiscal years 2004-2014**

| Fiscal Year | Timber Volume Sold (MMBF) | Percent of ASQ Sold | Annual ASQ (MMBF) |
|---|---|---|---|
| 2004 | 87 | 32.5 | 267 |
| 2005 | 65 | 24.3 | 267 |
| 2006 | 85 | 31.8 | 267 |
| 2007 | 30 | 11.2 | 267 |
| 2008 | 5 | 1.8 | 267 |
| 2009 | 10 | 3.7 | 267 |
| 2010 | 49 | 18.3 | 267 |
| 2011 | 37.5 | 14.04 | 267 |
| 2012 | 52.5 | 19.6 | 267 |
| 2013* | 15.79 | 5.9 | 267 |
| 2014 | 100 | 37.45 | 267 |
| Ten Year Average | 53.88 | 20.05 | 267 |

*The Big Thorne Timber Sale (102 MMBF) was offered in FY 2013 and pulled back for further NEPA review. The 2013 offer was 117.8 MMBF or 44 percent of ASQ.

## Action Plan

No action is necessary at this time because the annual volume sold has been, and is expected to continue to remain, well below the ASQ. Recommendations are to continue to monitor the trend of annual ASQ sold.

# 27. Timber Resources: Tongass Timber Reform Act (TTRA)

**Goals:** Provide for the continuation of timber uses and resources by the timber industry and Alaska residents. Manage the timber resources for timber production of saw timber and wood products from suitable forest lands made available for timber harvest on an even-flow, long-term, sustained-yield basis and in an economically efficient manner.

**Objectives:** Pre-commercially thin previously harvested suitable forestland. Evaluate non-clearcutting silvicultural systems. Seek to provide an economic timber supply sufficient to meet the annual market demand[1] for Tongass National Forest timber and the market demand for the planning cycle, up to a ceiling of the Forest Plan's allowable sale quantity, which is 2.67 billion board feet in the first decade. Manage young-growth to improve habitat for wildlife and commercial timber products. Review standards and guidelines for applicability to young-growth stands. Provide 2 to 3 years supply of volume under contract to local mills and then establish shelf volume[2] to maintain flexibility and stability in the sale program. Review the timber sale program and work with the state and other partners to implement changes that will keep an "economic timber" perspective throughout the process and monitor the implementation of these reforms to ensure they are consistently employed across the Forest.

## Timber Resources Question: *Is the timber demand being met within limits of the adaptive management strategy and TTRA?*

The evaluation criteria and sampling/reporting period are outlined below. No data relative to this question was reported.

### Evaluation Criteria

The adaptive management strategy (see Forest Plan ROD, pages 64 through 66) will be implemented in three phases based on the annual timber harvest. Phase 1 restricts the timber program to a portion of the suitable land base that excludes moderate and higher value roadless areas. Should the level of harvest reach 100 MMBF for two consecutive fiscal years, the Tongass could then plan for timber projects in the Phase 2 portion of the approved suitable land base. However, personal use of timber, micro sales, salvage sales, small commercial timber sales generally less than 1 MMBF, young-growth management projects, and the roads associated with these activities, would be allowed in development land use designations outside of the Phase 1 portion of the ASQ land base within Phase 2 lands. Should the harvest reach 150 MMBF for two consecutive fiscal years, the Tongass could then plan for timber projects in Phase 3 areas, which includes the entire suitable land base.

In addition, the Tongass National Forest, specifically, is directed under the Tongass Timber Reform Act (TTRA) to seek to provide a supply of timber that meets market demand annually and for the planning cycle. The annual demand calculation is an analysis of the timber industry in Southeast Alaska, where some of the variables include installed mill capacity and utilization, projected harvest level, and timber volume under contract. The demand calculation is not based on actual timber harvest. The demand analysis is done for four different scenarios – limited lumber, expanded lumber, medium integrated and high Integrated – as explained in the 2008 Forest Plan Amendment FEIS, Appendix G.

### Sampling/Reporting Period

[1] The annual market demand forecast is a methodology used to set the short-term goals for the Tongass Timber Program – volume the Forest plans to offer in the current year, pending sufficient funding and sufficient National Environmental Policy Act (NEPA)-cleared volume. NEPA-cleared volume is defined as NEPA documents with a signed decision.

[2] Shelf volume is volume that has been NEPA-cleared and is available for offer.

The amount of timber harvested is calculated monthly and annually, and shows in the "Volume Under Contract" reports. The demand calculation is done annually. These reports are posted on the Alaska Regional Office
website: http://www.fs.usda.gov/detail/r10/landmanagement/resourcemanagement/?cid=fsbdev2_038785.

## Monitoring Results

In FY2014, all timber harvest offered and harvested was from Phase 1 lands. In FY2014, the annual demand calculation was 127 MMBF using the expanded lumber scenario. In FY2014, the Tongass offered 120 MMBF, sold 100 MMBF and had 449 MMBF in no-bid timber sales. Timber harvest for FY2014 was 39 MMBF.

## Evaluation of Results

Since the amount of harvest is less than 100 MMBF, it indicates that the Tongass timber harvest planning efforts should continue in Phase 1 areas on the Forest with the exception of small sale opportunities. At the end of FY2014, there was 152.8 MMBF under contract. Approximately 3.8 MMBF under contract in the Juneau Access Road volume and Upper Carroll II timber sale is technically not available for harvest due to litigation on the Access Road and timber sale contract termination negotiations on Upper Carroll II. The corrected volume under contract for the end of FY2014 was approximately 119 MMBF. Since the demand calculation estimates that there should be an estimated 127 MMBF under contract, the objectives of TTRA are not being met and efforts to establish shelf volume should continue.

*Timber Resources Photo 1. Front loader working at a log transfer facility, Tuxekan Island, Alaska*

# 28. Timber Resources: Adaptive Management Strategy

**Goals:** Provide for the continuation of timber uses and resources by the timber industry and Alaska residents. Manage the timber resources for timber production of saw timber and wood products from suitable forest lands made available for timber harvest on an even-flow, long-term, sustained-yield basis and in an economically efficient manner.

**Objectives:** Pre-commercially thin previously harvested suitable forestland. Evaluate non-clearcutting silvicultural systems. Seek to provide an economic timber supply sufficient to meet the annual market demand[1] for Tongass National Forest timber and the market demand for the planning cycle, up to a ceiling of the Forest Plan's allowable sale quantity, which is 2.67 billion board feet in the first decade. Manage young-growth to improve habitat for wildlife and commercial timber products. Review standards and guidelines for applicability to young-growth stands. Provide 2 to 3 years supply of volume under contract to local mills and then establish shelf volume[2] to maintain flexibility and stability in the sale program. Review the timber sale program and work with the state and other partners to implement changes that will keep an "economic timber" perspective throughout the process and monitor the implementation of these reforms to ensure they are consistently employed across the Forest.

## Timber Resources Question: *Has a Timber Sale Adaptive Management Strategy threshold been reached, so that it is appropriate to move to the next phase?*

The evaluation criteria and sampling/reporting period are outlined below. No data relative to this question was reported.

### Evaluation Criteria

The evaluation criterion is volume harvested by fiscal year, which runs from October 1 to September 30. The timber program will be restricted to Phase 1 areas until harvest levels reach 100 million board feet (MMBF) for 2 consecutive fiscal years. After reaching the 100 MMBF harvest level for 2 consecutive fiscal years, timber management activities can be planned on Phase 2 areas, which includes all Phase 1 areas. After reaching 150 MMBF harvest levels for 2 consecutive fiscal years, timber management activities can be planned on Phase 3 areas, which include all Phase 1 and Phase 2 areas.

### Sampling/Reporting Period

The timber sale accounting system is updated each month and reports are available monthly and summarized annually.

### Monitoring Results

In FY2014, the Tongass offered 120 MMBF, sold 100 MMBF and had 449 MMBF in no-bid timber sales. Timber harvest for FY2014 was 39 MMBF and annual harvest has not exceeded 100 MMBF in the previous decade.

[1] The annual market demand forecast is a methodology used to set the short-term goals for the Tongass Timber Program – volume the Forest plans to offer in the current year, pending sufficient funding and sufficient National Environmental Policy Act (NEPA)-cleared volume. NEPA-cleared volume is defined as NEPA documents with a signed decision.

[2] Shelf volume is that volume that has been NEPA-cleared and is available for offer.

## Evaluation of Results

The total volume harvested has not exceeded 100 MMBF in the last decade. Harvest less than 100 MMBF indicates that the Tongass timber sale planning efforts will continue in Phase 1 areas on the Forest.

*Timber Resources Photo 1. Active logging operation, Tongass National Forest*

# 29. Timber Resources: Non-Interchangeable Components

**Goals:** Provide for the continuation of timber uses and resources by the timber industry and Alaska residents. Manage the timber resources for timber production of saw timber and wood products from suitable forest lands made available for timber harvest on an even-flow, long-term, sustained-yield basis and in an economically efficient manner.

**Objectives:** Pre-commercially thin previously harvested suitable forestland. Evaluate non-clearcutting silvicultural systems. Seek to provide an economic timber supply sufficient to meet the annual market demand[1] for Tongass National Forest timber and the market demand for the planning cycle, up to a ceiling of the Forest Plan's allowable sale quantity, which is 2.67 billion board feet in the first decade. Manage young-growth to improve habitat for wildlife and commercial timber products. Review standards and guidelines for applicability to young-growth stands. Provide 2 to 3 years supply of volume under contract to local mills and then establish shelf volume[2] to maintain flexibility and stability in the sale program. Review the timber sale program and work with the state and other partners to implement changes that will keep an "economic timber" perspective throughout the process and monitor the implementation of these reforms to ensure they are consistently employed across the Forest.

**Background:** Non-interchangeable components (NICs) are defined as increments of the suitable land base and their contribution to the allowable sale quantity (ASQ) established to meet Forest Plan objectives. NICs are identified as parcels of land and the type of timber thereon, which are differentiated for the purpose of Forest Plan implementation. The total ASQ is derived from the sum of the timber volumes from all NICs. NICs cannot be substituted for each other in the timber sale program.

**NIC I - Normal Operability:** This is volume scheduled from suitable lands using existing logging systems. Most of these lands are expected to be economic under projected market conditions. On average, sales from these lands have the highest probability for a purchaser to gain a profit from their investment and labor. This is the best operable ground. Normal operability includes those systems most frequently used on the Tongass. These systems are tractor, shovel, standard cable, and some helicopter.

**NIC II - Difficult and Isolated Operability:** This is volume scheduled from suitable lands that are available for harvest using logging systems not in common use in Southeast Alaska. Most of these lands are presently considered economically and technologically marginal.

## Timber Management Question: *Are the non-interchangeable components (NICs) of the allowable sale quantity (ASQ) consistent with actual harvest?*

### Evaluation Criteria

The evaluation criteria include:

- Volume harvested by logging system from suitable lands from healthy commercial forest timber stands.
- Volume harvested by logging system from suitable lands from commercial forest timber stands that are unhealthy and currently in a non-productive status; for example, yellow-cedar decline and blowdown with heavy sap rot or breakage.

[1] The annual market demand forecast is a methodology used to set the short-term goals for the Tongass Timber Program – volume the Forest plans to offer in the current year, pending sufficient funding and sufficient National Environmental Policy Act (NEPA)-cleared volume. NEPA-cleared volume is defined as NEPA documents with a signed decision.

[2] Shelf volume is that volume that has been NEPA-cleared and is available for offer.

- Distance from the setting to landing. For helicopter settings, settings over 0.75-mile flight distance from landings, either on the land or in the water, is considered NIC II.

## Sampling/Reporting Period

Geographical information systems (GIS) analysis of Forest Plan Logging System Transportation Analysis (LSTA) of the harvest setting compared with the actual timber harvest settings. The analysis can be produced annually.

## Monitoring Results

In FY2014, there were approximately 39 MMBF harvested from the Tongass. All of the harvest was in NIC I areas. In 2012, timber harvest consisted of 82 percent conventional logging systems and 18 percent helicopter logging systems. Completed harvest was estimated based on normal operability to obtain the Forest Plan NIC data. The units harvested using normal operability within the Forest Plan were estimated by timber sale harvest unit and operability factors. The NIC Forest Plan calls were then compared to actual timber sale harvest unit maps to determine yarding methods.

**Timber Management Table 1. Comparison of NIC I and NIC II harvest by fiscal year and percent of total harvest**

| Fiscal Year | NIC I percent of harvest | NIC II percent of harvest |
|---|---|---|
| 1999 | 88 | 12 |
| 2000 | 77 | 23 |
| 2001 | 46 | 54 |
| 2002 | 90 | 10 |
| 2003 | 91 | 9 |
| 2004 | 84 | 16 |
| 2005 | 91 | 9 |
| 2006 | 78 | 22 |
| 2007 | 45 | 55 |
| 2008 | 95 | 5 |
| 2009 | 93 | 7 |
| 2010 | 100 | 0 |
| 2011 | 99 | 1 |
| 2012 | 99 | <1 |
| 2013 | 100 | 0 |
| 2014 | 100 | 0 |

The 1997 Forest Plan Monitoring and Evaluation Report did not analyze the NIC I and NIC II timber harvest categories.

## Evaluation of Results

NIC data has been reviewed for the past 16 years. An apparent upward trend was occurring in the proportion of the NIC II harvest component from 1999 through 2001. Fiscal years 2002, 2003, and 2005 show a reverse swing in the NIC trend; however, 2006 and 2007 showed a dramatic increase in the NIC II component. The increase in NIC I for 2002, 2003, and 2005 may be due to the poor timber market and higher fuel costs influencing purchasers to focus on more conventional harvests. The increase of NIC I component in 2008 and 2009 is likely due to changes in the appropriations law that requires the Tongass timber sale program to only conduct timber sales that appraised positively using the residual value appraisal approach. This trend continued in 2010. In 2009, the USDA established a process that required the Secretary to approve road building and timber harvest in inventoried roadless areas. Therefore, the Tongass began to focus on areas already roaded for timber harvest projects. Roaded areas are usually classified as NIC 1 components. These circumstances explain the shift away from harvest in the NIC II component. If the moratorium and approval process remain in effect, the offering a planned mix of NIC I and NIC II components of the ASQ is unlikely.

# 30. Timber Management: Non-Interchangeable Components Proportional Mix

**Goals:** Provide for the continuation of timber uses and resources by the timber industry and Alaska residents. Manage the timber resources for timber production of saw timber and wood products from suitable forest lands made available for timber harvest on an even-flow, long-term, sustained-yield basis and in an economically efficient manner.

**Objectives:** Pre-commercially thin previously harvested suitable forestland. Evaluate non-clearcutting silvicultural systems. Seek to provide an economic timber supply sufficient to meet the annual market demand[1] for Tongass National Forest timber and the market demand for the planning cycle, up to a ceiling of the Forest Plan's allowable sale quantity, which is 2.67 billion board feet in the first decade. Manage young-growth to improve habitat for wildlife and commercial timber products. Review standards and guidelines for applicability to young-growth stands. Provide 2 to 3 years supply of volume under contract to local mills and then establish shelf volume[2] to maintain flexibility and stability in the sale program. Review the timber sale program and work with the state and other partners to implement changes that will keep an "economic timber" perspective throughout the process and monitor the implementation of these reforms to ensure they are consistently employed across the Forest.

**Background:** The allowable sale quantity (ASQ) consists of two separate non-interchangeable components (NICs), also referred to as an "operability inventory". Under the 2008 Forest Plan Amendment, the ASQ is divided into NIC I (set at 2.38 billion board feet of timber per decade) and NIC II (set at 0.29 billion board feet per decade). The Forest Plan sets the proportional mix of timber harvest volume for the NIC I and NIC II categories. The proportional mix in the Forest Plan is set at approximately 89 percent NIC I and 11 percent NIC II (Forest Plan ROD, page 7).

NIC components are estimates designed to prevent the disproportionate harvest of the most economical portions of the Forest over the long-term. Thus, the separate limits on each component are binding on a decadal basis. The components are non-interchangeable because lower sale level in one component may not be compensated by higher sale levels in the other. The NIC I component includes land that can be harvested using "normal operability" logging systems (normal operability being defined as standard logging systems such as shovel and short span cable). The NIC II component includes difficult and isolated operable timber stands requiring special logging equipment requirements due to yarding distances or topography (such as the use of long-span cable, helicopter or multi-span cable).

Theoretically, the NIC II portion of the ASQ would only be offered for sale after the NIC I component had been satisfied. The sale of timber from NIC II lands would most likely be offered when the commodity market for timber is relatively high and the higher operational costs could be covered by the wood fiber value. However, the Forest Service consistently offers some portion of NIC II with the total timber sale package. Reasons for the inclusion of NIC II lands in timber sales include silvicultural treatments, economics of mobilization and the development of alternatives in environmental assessments that address public concern. Unless the offer volume is at or near the full NIC I allowable volume of 238 MMBF, the NIC II over-harvest is not likely to occur.

## Timber Management Question: *Is the proportional mix of volume in NIC I and NIC II as estimated in the Forest Plan accurate?*

[1] The annual market demand forecast is a methodology used to set the short-term goals for the Tongass Timber Program – volume the Forest plans to offer in the current year, pending sufficient funding and sufficient National Environmental Policy Act (NEPA)-cleared volume. NEPA-cleared volume is defined as NEPA documents with a signed decision.

[2] Shelf volume is that volume that has been NEPA-cleared and is available for offer.

## Evaluation Criteria

The evaluation criteria include:

- Volume harvested by logging system from suitable lands from healthy commercial forest timber stands.
- Volume harvested by logging system from suitable lands from commercial forest timber stands that are unhealthy and currently in a non-productive status; for example, yellow-cedar decline and blowdown with heavy sap rot or breakage.
- Distance from the setting to landing. For helicopter settings, settings over 0.75-mile flight distance from landings, either on the land or in the water, is considered NIC II.

## Sampling/Reporting Period

Geographical information systems (GIS) analysis of Forest Plan Logging System Transportation Analysis (LSTA) of the harvest setting compared with the actual timber harvest settings. The analysis can be produced annually.

## Monitoring Results

In FY2014, there were approximately 39 MMBF harvested from the Tongass. All of the harvest was in NIC I areas. Completed harvest was estimated based on normal operability to obtain the Forest Plan NIC data. The units harvested using normal operability within the Forest Plan were estimated by timber sale harvest unit and operability factors. The NIC Forest Plan calls were then compared to actual timber sale harvest unit map to determine yarding methods. In 2014, timber harvest consisted of 70 percent conventional logging systems and 30 percent helicopter logging systems.

**Timber Management Table 1. Comparison of NIC I and NIC II harvest by fiscal year and percent of total harvest**

| Fiscal Year | NIC I percent of harvest | NIC II percent of harvest |
|---|---|---|
| 1999 | 88 | 12 |
| 2000 | 77 | 23 |
| 2001 | 46 | 54 |
| 2002 | 90 | 10 |
| 2003 | 91 | 9 |
| 2004 | 84 | 16 |
| 2005 | 91 | 9 |
| 2006 | 78 | 22 |
| 2007 | 45 | 55 |
| 2008 | 95 | 5 |
| 2009 | 93 | 7 |
| 2010 | 100 | 0 |
| 2011 | 99 | 1 |
| 2012 | 99 | <1 |
| 2013 | 100 | 0 |
| 2014 | 100 | 0 |

The 1997 Forest Plan Monitoring and Evaluation Report did not analyze the NIC I and NIC II timber harvest categories.

## Evaluation of Results

NIC data has been reviewed for the past 16 years. An apparent upward trend was occurring in the proportion of the NIC II harvest component from 1999 through 2001. Fiscal years 2002, 2003, and 2005 show a reverse swing in the NIC trend; however, 2006 and 2007 showed a dramatic increase in the NIC II component. The increase in NIC I for 2002, 2003, and 2005 may be due to the poor timber market and higher fuel costs influencing purchasers to focus on more conventional harvests. The increase of NIC I component in 2008 and 2009 is likely due to changes in the appropriations law that requires the Tongass timber sale program to only conduct timber sales that appraised positively using the residual value appraisal approach. This trend continued in 2010. In 2009, the USDA established a process that required the Secretary to approve road building and timber harvest in inventoried roadless areas. Therefore, the Tongass began to focus on areas already roaded for timber harvest projects. Roaded areas are usually classified as NIC 1 components. These circumstances explain the shift away from harvest in the NIC II component. If the moratorium and approval process remain in effect, the offering a planned mix of NIC I and NIC II components of the ASQ is unlikely.

*Timber Management Photo 1. NIC II timber harvest operation, Thorne Bay Ranger District*

# 31. Transportation System: Standards and Guidelines

**Goals:** Develop and manage roads and utility systems to support resource management activities. Recognize the potential for future development of major transportation and utility systems.

**Objectives:** Provide access for Forest users. Design and construct roads in support of forest resource management activities. Decommission roads that are no longer needed or are not affordable. Manage and maintain roads to protect water, soil, fish and wildlife resources.

## Transportation Question: *Are the standards and guidelines used for Forest development roads effective in limiting the environmental effects to anticipated levels?*

### Evaluation Criteria

Evaluation criteria are the environmental effects of forest development roads and log transfer facilities (LTFs). Focal areas include drainage of rock pits (TRAN4 IV., BMP 14.9, TRAN4 II.A.6, BMP 14.18) and effectiveness of access management prescriptions in restricting access and preventing sediment transport (TRAN6-1.A, BMP 14.22). Monitoring observations will focus on roads closed in high use areas. At least 10 percent of recently closed national forest system roads on a selected road system will be evaluated annually.

The roads selected for monitoring in 2014 included road 6351 on the Tonka road system (Kupreanof Island), road 3015 on the North Thorne road system (Prince of Wales Island), road 7576 Harbor Mountain, road 7513 Starrigavan campground and Frenchy road 6208 on the Mitkof road system. The INFRA[1] database was utilized to determine which roads were in the selection pool that were recently closed or maintained. These road systems were selected due to recreational use and a random selection of open maintained roads.

### Sampling/Reporting Period

There is an annual sampling period, and the reporting period is every 5 years.

### Monitoring Results

#### *Roads*

**Effectiveness of drivable water dips for erosion control.** A drivable water dip was constructed on road 6351 when the road was reconstructed for recreational use. This road is 0.532 mile long and ends in a parking area at the Mitchell Creek fishpass. The road had been constructed to access timber units as a specified road and left open to provide public access and administrative access to the fishpass.

*Transportation Photo 1. Drivable dip on Tonka road 6351*

Road 6351 was designed and constructed with culverts at all live stream crossings; however, as part of the stewardship contract, the road was reconstructed with a drivable dip to minimize road surface erosion

[1] INFRA is a Forest Service database used to manage information on national resources, such as buildings, trails, roads, wilderness areas and water systems.

associated with a blocked culvert. The culvert was removed from the live stream and a drivable water bar was installed. This stream is a class IV stream that flows to Mitchell Creek and transports water from a beaver pond across the road. The road was constructed roughly 200 feet upslope of Mitchell Creek.

Roadway reconditioning included installation of a one foot deep lift of shot rock aggregate. The reconstruction included surfacing a 30 x 45 feet parking lot at the end of road 6351 for the Mitchell Creek fishpass. The construction specified the aggregate be placed on the slopes of the drivable ford in a compacted layer. This maintenance was covered in the categorical exclusion for road maintenance that does not require a decision memo as defined in 36 CFR 220.6(d).

The drivable dip was functioning to transport water across the road with minimum sediment transport. A minor amount of fines were noted at the crossing in the water adjacent to the road. The fines noted in the crossing amounted to less than 0.1 cubic yard of sand and silt. Drivable dips are effective at transporting water across the road where there is minimal flow and traffic. The drivable dip provided an effective solution to an area where beavers had plugged a culvert and water was blocked from crossing the road prior to the road maintenance.

**Effectiveness of road grading and culvert installation for erosion control.** Road 7513 accesses Starrigavan Recreation Area, a popular recreation area, and is located near the community of Sitka. It includes an estuary, recreation facilities including camping, picnic sites, an artesian well and several different recreation trails. It is regularly graded for road maintenance and no ruts or potholes were noted in the running surface. The work included blading the road with a compaction B. The roads within in the campground were graded and rolled twice. The first grading occurred in July and the second in September. The road grading was effective at limiting erosion potential (Photo 2).

*Transportation Photo 2. Looking east on Starrigavan road 7513. Road is graded with no ruts.*

The Harbor Mountain road 7576 was reviewed as a recreational use ML2 road. This road traverses along the sideslope with switchbacks from the base starting at sea level. This road is graded and has a lift of crushed aggregrate on the surface (Photo 3). The road showed no erosion potential and the culverts were functional. The culverts were installed at angles to transport water effectively across the road from the intermittent channels and seeps (Photo 4).

Frenchy Road 6208 showed effective road maintenance where road brushing had been completed on a regular basis to maintain an open roadway. This road can be accessed off the Petersburg road system and is used by local hunters. The road surface is good with no evidence of erosion and sediment transport (Photo 5). Water is transported across the road by a large culvert. No evidence of erosion or undercutting was noted at the crossing (Photo 6).

North Thorne Road 3015 was monitored as a ML2 maintained road (Photo 7). This road had been recently reconstructed with a lift of crushed aggregate and replaced culverts. The streams that traverse down the sideslopes adjacent to this road are flashy streams that respond rapidly to precipitation. The angular cobbles and boulders are transported down the sideslopes from avalanche and slide areas in the uplands. The culverts were oversized to accommodate the storm water flows (Photos 8, 9 and 10). The streams frequently do not show significant flow during dry periods and occasionally show no flow. The road showed no evidence of erosion.

*Transportation Photos 3 and 4. Left: Harbor Mountain road 7576 looking downslope. Right: Culvert outlet on Harbor Mountain road effectively transporting water*

*Transportation Photos 5 and 6. Left: Frenchy road 6208; no erosion noted on road surface. Right: Stream crossing French road 6208; not cutting noted in the channel; banks well-armored with rock.*

*Transportation Photos 7 and 8. Left: Road 3015 at milepost 8.743. Road is graded with no erosion or diversion potential. Right: Road 3015 milepost 8.743. Culvert inlet showing a poorly-sorted alluvium bedload of gravels, and angular cobbles and boulders.*

*Transportation Photos 9 and 10. Left: Road 3015 at milepost 1.773. Culvert outlet is transporting water through the culvert at relatively low flow. Right: Road 3015 milepost 1.773. Culvert inlet bedload is poorly-sorted gravels and alluvium.*

### *Log Transfer Facilities*

Each log transfer facility (LTF) is operated under terms of the LTF permits, and in accordance with Alaska Water Quality Standards and requirements from the Environmental Protection Agency (EPA) for storm water discharge (National Pollutant Discharge Elimination System [NPDES] permits). LTF monitoring for this report was accomplished through field inspection, and was documented through completion of an LTF monitoring table. The table is designed to tabulate assessments of the success of the best management practices (BMPs) stipulated as terms of the LTF permits. The assessment elements of the LTF monitoring table include the following:

- Site identification
  - common name
  - Corps of Engineers permit name
  - NPDES general permit
- Transfer activity
  - facility transfer type
  - activity status
  - current year volume
- Fuel control
  - visible oil sheen per LTF guidelines M5 of the Forest Plan (Alaska Timber Taskforce Guidelines)
  - discharge reported to Alaska Department of Environmental Conservation (ADEC) under requirements of Alaska Administrative Code (18 AAC 75.300-307)
  - discharge reported to National Response Center (NRC) under requirements of the Clean Water Act (40 Code of Federal Regulations [CFR] 110, 117, and 302)
- Runoff control, reference BMP 14.27
  - drain to sediment trap
  - vegetated filter strip

- Bark and debris, reference BMP 14.27
    - excessive churning prevented
    - remove debris and bark from LTF or yard
    - bark and debris properly disposed
    - marine bark zone of deposit
    - date of last dive

Two general types of monitoring occur, upland and marine. The upland monitoring is summarized into assessments developed by Forest Service timber sale administrators, and is recorded under the general categories of fuel control, runoff control, and bark and debris. These assessments were made for all the active sites. Divers perform underwater bark debris surveys to accomplish marine monitoring.

**Bark Monitoring and Reporting.** Bark monitoring is required annually for each LTF under the EPA general NPDES permit no. AK-G670-1000 and EPA general NPDES permit no. AK-G70-0000. This monitoring is required at sites that are planned to transfer a total volume of 15 million board feet (MMBF) or more during the next 5 years and are located in less than 60 feet mean lower low water (MLLW). Monitoring for bark accumulations is not required on LTFs classified as type V or type VI under part I.B. If the annual bark monitoring survey conducted at the beginning of the season indicates continuous coverage by bark and wood debris of 0.9 acre or greater, the next annual bark monitoring survey is conducted after cessation of log transfer, or in the following year prior to any additional log transfer. Otherwise, the annual bark monitoring survey is not required during years when the LTF is not operating.

The purpose of the bark monitoring program is to determine compliance with the Alaska water quality standards for settable-residues in marine waters. In accordance with 18 AAC section 70.210, ADEC has authorized a zone of deposit for facilities authorized to discharge under the general NPDES permit. The zone of deposit may include continuous coverage, discontinuous coverage, and trace coverage by bark and wood debris. No wood was put into marine waters in 2012, although logging operations did put wood into marine waters in FY2014. Logging operations were ongoing in the fall, and bark monitoring dives had not yet been completed.

**Oil Sheen Monitoring and Reporting.** During periods of log transfer operation, receiving waters at the LTF shall be visually monitored daily for the presence of oil sheen. The presence of oil sheen shall be recorded, with the date, name of observer, cause or source of oil sheen and corrective measures taken, and shall be reported to EPA within 24 hours in accordance with part IX.B.

In FY2014, all active LTFs were operated in accordance with their permits. No fuel or hydraulic fluid spills occurred. If spills occur, the oil, fuel or contaminated soils are handled as specified in the spill prevention control and counter measure plan section of their operating plans. The actions of the sale administrators, which are prescribed in the standards and guidelines for LTFs, have served to limit the environmental effects of LTF operation to anticipated levels. The guideline for locating LTFs along straits and channels proved to be effective in reducing underwater bark accumulations.

*Transportation Photos 11 and 12. Left: Accessing the Tonka LTF from the sort yard. Right: Tonka sort yard surface clean of bark material.*

*Transportation Photos 13 and 14. Left: Settling pond at the Tonka sort yard. Right: Secondary settling area after the settling pond at the Tonka LFT.*

## Evaluation of Results

The FY2014 monitoring showed that we were effective in limiting environmental effects as a result of an effective maintenance program on the road system. Sediment transport of eroded materials from the road surfaces was minimal. The road surfaces were in excellent condition and showed no ruts or water diversion. The culverts monitored were effectively transporting water across the road and no maintenance issues were noted on the culverts; no head cutting or bank erosion was noted. The running surface of the Tonka LTF was in good condition; the surface is graded weekly as needed (Photo 11). The surface is cleared of loose soil and bark debris. The sort yard running surface was well-graded and clean of bark (Photo 12). The Tonka sort yard settling pond showed some need for clean-out (Photo 13). The system of settling ponds is functioning well to filter out the fine sediment. No sediment was noted in the ditch downslope of the settling pond and no sediment was noted in transport to the ocean (Photo 14). The settlement pond at the LTF was functioning well, filtering out sediment in the primary and secondary settling areas.

## Action Plan

Maintenance is needed to correct deficiencies on maintenance of the sort yard settling pond at Tonka on Kupreanof Island. The settling pond was cleaned out before the end of the 2014 operating season. The back wall of the sort yard is raveling. An action plan for slope stabilization was developed and documented in the Storm Water Pollution Prevention Plan.

# 32. Transportation System: Maintenance

**Goals:** Develop and manage roads and utility systems to support resource management activities. Recognize the potential for future development of major transportation and utility systems.

**Objectives:** Provide access for Forest users. Design and construct roads in support of forest resource management activities. Decommission roads that are no longer needed or are not affordable. Manage and maintain roads to protect water, soil, fish and wildlife resources.

**Background:** In 2005, the USDA revised regulations regarding travel management on national forest system lands to clarify policy related to motor vehicle use, including the use of off-highway vehicles (OHVs). The 2005 travel management rules require the designation of those roads, trails and areas open to public use. It prohibits the use of motorized vehicles off the designated system, as well as use of motor vehicles in areas not consistent with the designations. The 2005 travel management rule also required the development and implementation of access and travel management plans for each district by the end of 2009. These plans were developed, but were not fully implemented forest-wide until the end of 2009. Part of these plans included developing motor vehicle use maps (MVUMs) for each district. In essence, the 2005 rule changed the management strategy from a presumption that all roads are open unless blocked or designated closed, to a presumption that all roads are closed unless designated open on the MVUM or by permit. The MVUMs are updated annually to reflect the current management status of the roads.

## Transportation Question: *Are roads and trails maintained in accordance with management objectives?*

### Evaluation Criteria

Evaluation criteria are the environmental effects of forest development roads and log transfer facilities. Focal areas include drainage of rock pits (TRAN4 IV., BMP 14.9, TRAN4 II.A.6, BMP 14.18) and effectiveness of access management prescriptions in restricting access and preventing sediment transport (TRAN6-1.A, BMP 14.22). Monitoring observations will focus on roads closed in high use areas. At least 10 percent of recently closed national forest system roads on a selected road system will be evaluated annually.

The roads selected for monitoring in FY2014 included road 6351 on the Tonka road system (Kupreanof Island), road 3015 on the North Thorne road system (Prince of Wales Island), road 7576 Harbor Mountain (Sitka), road 7513 Starrigavan campground (Sitka) and Frenchy road 6208 on the Mitkof road system. The Kruzof North Beach ATV use area at the end of trail 317591 (closed road 7591) was also monitored. The INFRA[1] database was utilized to determine which roads were in the selection pool that were recently closed or maintained. These road systems were selected due to recreational use and a random selection of open maintained roads.

*Transportation Photo 1. North Thorne road 3015*

[1] INFRA is a Forest Service database used to manage information on national resources, such as buildings, trails, roads, wilderness areas and water systems.

*Transportation Photo 2. Frenchy road 6208 on Mitkof Island, Petersburg Ranger District*

## Sampling/Reporting Period

There is an annual sampling period, and the reporting period is every 5 years.

## Monitoring Results

### *Are roads displayed correctly on the motor vehicle use map?*

All roads monitored in FY2014 were shown accurately on the MVUM. Roads with maintenance level (ML) 1 designation (closed roads) do not appear on the MVUM unless they are dually designated as a motorized trail. This was the case with road 7591. The road itself did not appear on the MVUM map, but the corresponding motorized trail, named trail 317591 appeared in its place. Roads with ML 2 through 5 designations (open roads) appear on the MVUM as roads. The MVUM is updated annually to the extent necessary to reflect revisions to travel management decisions (36 Code of Federal Regulations [CFR] 212.54 and 212.56). The MVUM for each district can be accessed at: http://www.fs.usda.gov/detail/tongass/maps-pubs/?cid=stelprdb5430063.

### *Has public motorized use been eliminated on closed roads (maintenance level 1 roads)?*

Road 7591 has received a dual designation as motorized trail 317591 and is being used by off-road vehicles. The MVUM states the maximum width of a vehicle on this route is 60 inches.

*Transportation Photo 3. Tonka road 6351 on Kupreanof Island, Petersburg Ranger District*

### *Have the roads been maintained in accordance with maintenance level designations?*

The roads monitored showed they have been maintained in accordance with maintenance level designations. Tonka road 6351, Frenchy road 6208, Harbor Mountain road 7576, Starrigavan road 7513, and North Thorne road 3015 were maintained to ML 2 standards with crushed rock surfacing, and clean and functioning culverts. Kruzof trail 317519 was maintained to standard and passable by ATVs and OHVs.

### *Evaluation of open roads (maintenance level 2 through 5)*

Through road maintenance, surface reconditioning and grading, the road surface and road site erosion has been minimized. The roads are maintained to meet BMPs, regardless of the methods used to obtain the maintenance work. Roads were managed to provide cost-effective support to land use designation objectives and safe travel to users of the system, while protecting the environment, adjacent resources and the public investment. Consistent with road management objectives, design features were incorporated to protect water quality by minimizing long-term maintenance needs (e.g., drivable dips adjacent to culverts, oversized culverts). Road running surfaces, bridge decks, ditches and culverts were maintained to keep water flowing effectively, and to provide for the disposal of materials collected during road maintenance (soil, rock, debris) in a manner that minimizes sediment entering into streams and lakes. During monitoring, reviewers noted that road surface maintenance to limit surface runoff, such as catch basin

cleaning and ditch maintenance, was completed.

Road maintenance plans are developed and approved on the Tongass districts for all national forest system roads based on access and travel management plans and road management objectives. The road maintenance plans encompass both short-term and long-term needs. The road maintenance plans are revised as necessary to respond to emergencies and meet changing resource and traffic needs. Condition surveys have been performed in accordance with national guidelines. Bridges were inspected at the frequency and by the standards specified in Forest Service Manual (FSM) 7730.

*Transportation Photo 4. Starrigavan road 7513, Sitka Ranger District*

## Evaluation of Results

The 2014 monitoring effort has shown that MVUMs have consistently made motor vehicle access prohibitions known. However, the map by itself has not been completely effective in eliminating access. This was underscored in the review of motorized trails where users labored to modify structures to continue accessing a road that had recently been changed to maintenance level 1 and dual designated as a motorized trail. Roads where culverts and bridges were removed were effective in eliminating unauthorized motorized use. Unauthorized use by OHVs did not cause any environmental damage or concerns on the routes evaluated. Monitoring of maintenance level 2 through 5 roads showed that roads are being maintained according to the road maintenance objectives.

## Action Plan

Access and travel management plans must continue to adapt to the Forest's needs and goals. Additionally, subsistence and recreation needs are important considerations in the management of the transportation system. Periodic public meetings are recommended, either as part of larger projects or simply as outreaches, to generate input from the public regarding their needs and desires. The unauthorized use of motorized trails (maintenance level 1 roads) could be eliminated by adding vehicle width restrictions at the beginning of a trail or road. One way this can be done is by installing riprap at the entrance of the trail. Motorized trails have maintenance needs that should be addressed. Off-highway vehicle use did not generate any noteworthy damage on the shot-rock roads monitored, and OHV use seems to disappear as vegetation establishes itself on the road surface. This recommendation does not apply to all roads, however. Prior monitoring reviews have shown that rock can weather quickly, and gravel soils can be sensitive to significant OHV traffic and may erode.

*Transportation Photo 5. Harbor Mountain road 7576, Sitka Ranger District*

# 33. Mining and Minerals Exploration

**Goals:** Provide for environmentally sound mineral exploration, development, and reclamation in areas open to mineral entry and in areas with valid existing rights that are otherwise closed to mineral entry. Seek withdrawal from mineral entry of specific locations where mineral development may not meet land use designation objectives. Maintain inventory of surficial geology, geomorphic features, geologic hazards and paleontological resources.

**Objective:** Implement the Minerals and Geology Standards and Guidelines.

**Background:** A wide range of mineral resources and deposit types occur within the boundaries of the Tongass National Forest. Examples include, but are not limited to, gold, silver, molybdenum, and uranium, as well as nationally designated "strategic" and "critical" minerals such as lead, zinc, copper, tungsten, and rare earth elements. The Forest Service recognizes that minerals are fundamental to the nation's wellbeing and, as policy, encourages the orderly exploration and development of the mineral resources on National Forest System lands. The Secretary of Agriculture has provided regulations (36 CFR 228) to ensure surface resource protection during the exploration and development of the mineral resources.

## Mining and Minerals Exploration Question: *Are federal regulations (36 CFR 228) to ensure surface resource protection implemented and is the administration of this regulation through the Forest Plan effective in limiting soil and water resource impacts?*

### Evaluation Criteria

The Forest Service is engaged in an on-going effort to mitigate the dangers posed by abandoned mine land (AML) features on the National Forests. These features include tunnels, adits, shafts, tailings ponds, rock dumps, mill sites and other associated mining features. FY2014 inspections of mineral sites indicate that the effects of mining activities on surface resources are consistent with Forest Plan expectations.

### Monitoring Results

The Forest Service administered two large locatable mine plans (Greens Creek and Kensington Gold Mine) in FY2014 and processed several dozen exploration-drilling programs and mineral material operations (Herbert Glacier Project, Bokan Project, Woewoedski Island Project, Zarembo Island Project, among others).

### Evaluation of Results

Inspections of mineral sites indicate that the effects of mining activities on surface resources are consistent with Forest Plan expectations. The necessity of the operator to obtain approval for their Plan of Operations provides the Forest Service the opportunity and authority to control the effects of the development on the Forest surface resources.

# 34. Subsistence

**Goal:** Protect the non-wasteful subsistence uses of fish and wildlife resources by rural Alaska residents.

**Objective:** Evaluate the effect of the Forest Plan on subsistence uses.

**Background:** Title VIII of the Alaska National Interest Lands Conservation Act (ANILCA) provides for the customary and traditional uses by rural Alaska residents of wild renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation. Non-wasteful subsistence uses of fish and wildlife and other renewable resources shall be the priority consumptive uses of all such resources on the public lands of Alaska when it is necessary to restrict taking in order to assure the continued viability of a fish or wildlife population or the continuation of subsistence uses of such population. Within the Forest Service, this program is unique to Alaska. The Forest Service has responsibility for fish and wildlife population management on National Forest System lands in Alaska, with close coordination with the Office of Subsistence Management and the Alaska Department of Fish and Game (ADF&G). The Forest Service coordinates and receives recommendations from the Southeast Alaska Subsistence Regional Advisory Council (Council) to assist in management of subsistence uses (https://www.doi.gov/subsistence). Our mandate is to provide a meaningful subsistence priority while managing for healthy stocks of fish and wildlife and minimizing restrictions on other users.

Several pieces of legislation and regulations provide the framework for our legal responsibilities. These are:

- Title VIII of ANILCA,
- Federal subsistence regulations (36 CFR 242 and 50 CFR 100),
- Federal Advisory Committee Act (FACA), and
- Federal Advisory Committee management regulations (41 CFR 101-6).

All land management projects that require a National Environmental Policy Act (NEPA) analysis are required to conduct an ANILCA 810 analysis to evaluate the effect of the project on subsistence uses. All federal subsistence regulations regarding the take of fish and wildlife contain a clear subsistence priority over other uses as required under ANILCA Title VIII.

Under Sec. 805(a)(D), the Council is required to prepare an annual report to the Secretary which shall contain “(i) an identification of current and anticipated subsistence uses of fish and wildlife populations within the region; (ii) an evaluation of current and anticipated subsistence needs for fish and wildlife populations within the region; (iii) a recommended strategy for the management of fish and wildlife populations within the region to accommodate such subsistence uses and needs; and (iv) recommendations concerning policies, Standards and Guidelines, and regulations to implement the strategy."

All subsistence uses are important; however, the Council has identified the use of sockeye salmon and Sitka black-tail deer as the mainstay subsistence resources that occur on federal public lands on the Tongass. The Council has rated these resources as the highest priority for monitoring under the Federal Fisheries Resource Monitoring Program (FRMP) and the Wildlife Information System (WIS). To address the following question, the protocols will focus on the subsistence use of those species.

The focus of the subsistence question is uses of subsistence resources not the conservation of the species. The conservation of the species is the top priority and is addressed through federal regulation, management and harvest reporting. Questions regarding the conservation of species are addressed in biodiversity, biodiversity ecosystem, stream-fish habitat and wildlife terrestrial sections of the Tongass Monitoring and Evaluation Plan.

# Subsistence Question: *Are the effects of management activities on subsistence uses in rural Southeast Alaska communities consistent with those estimated in the Forest Plan?*

## Evaluation Criteria

Changes in traditional resource use patterns, traditional environmental knowledge, and subsistence needs and uses.

### *Subsistence Fisheries Monitoring in 2014*

Section 812 of ANILCA directs the secretaries of the departments of Interior and Agriculture, cooperating with the State of Alaska and other federal agencies, to research fish and wildlife subsistence uses on federal public lands. To increase the quantity and quality of information available for management of subsistence fisheries, the FRMP was created within the Office of Subsistence Management. The FRMP was envisioned as a collaborative inter-agency, interdisciplinary approach to enhance existing fisheries research, and effectively communicate information needed for subsistence fisheries management on federal public lands.

Eleven fisheries assessment projects were conducted in Southeast Alaska in 2014 (Table 1). Ten projects assessed sockeye salmon harvests and escapements for stocks that sustain subsistence fisheries. One project surveyed Unuk River eulachon.

**Subsistence Table 1. 2014 subsistence monitoring projects**

| Project # | Project Title |
|---|---|
| 14-601 | Redoubt Lake Sockeye Stock Assessment |
| 14-602 | Falls Lake Sockeye Stock Assessment |
| 14-603 | Hetta Lake Sockeye Stock Assessment |
| 14-605 | Hatchery Creek Sockeye Stock Assessment |
| 14-606 | Klawock Lake Sockeye Stock Assessment |
| 14-607 | Unuk River Eulachon Monitoring |
| 14-608 | Kanalku Lake Sockeye Stock Assessment |
| 14-609 | Klag Lake Sockeye Stock Assessment |
| 14-610 | Kook Lake Sockeye Stock Assessment |
| 14-611 | Sitkoh Lake Sockeye Stock Assessment |
| 14-612 | Neva Lake Sockeye Stock Assessment |

### *Subsistence Wildlife Monitoring*

Aerial moose surveys were conducted near Yakutat in 2014.

## Monitoring Results

A review of project-level 810 analyses will occur in 2017 to determine the effects of the Forest Plan on subsistence uses.

Monitoring trends in fish and wildlife populations and subsistence uses generally requires long-term data sets and will be analyzed in 2017.

Issues identified in the data set analysis will be reviewed in 2017 to identify long-term unresolved issues and determine the effect of the Forest Plan on those issues.

## Action Plans

1. Continue to conduct ANILCA 810 analysis at the project level. Every five years a survey of project level 810 analyses will be conducted to determine what projects had a significant effect on subsistence resources and if the project was consistent with the Forest Plan, and what effects it had on subsistence uses.
2. Continue to collect data on fish and wildlife populations that are important for subsistence uses. Every five years the subsistence fish and wildlife data collected through the monitoring program and other sources such as the ADF&G will be analyzed for trends and evaluated to determine whether the Forest Plan had any effect on those trends.
3. Continue to work with the Council and review the annual reports. Every five years, Annual Reports from the Council will be reviewed for unresolved issues and whether the Forest Plan was responsible for those unresolved issues.

### *Feedback Mechanism*

Evaluate management practices and change, if needed.

# 35. Wilderness

**Goal:** Manage all designated wilderness to maintain the enduring resource of wilderness as directed by the Wilderness Act of 1964, subject to the special provisions and exceptions in the Alaska National Interest Lands Conservation Act of 1980 (ANILCA) and the Tongass Timber Reform Act of 1990 (TTRA).

**Objectives:** Apply a multi-disciplinary focus to wilderness management; consider stewardship of wilderness in the annual program of work by all resources.

**Background:** The Tongass National Forest contains almost 5.8 million acres within 19 congressionally designated wilderness areas. Each wilderness area is managed as a separate system as the character and resources for each wilderness are unique.

The Wilderness Act of 1964 specifies that the Agency has a responsibility to protect the wilderness resources and wilderness character. Efforts have been made over the last several years by the district rangers, who are responsible for the management of these resources, to identify the character for each wilderness and how to protect these components. Much of this effort was facilitated through Washington Office direction, called the Wilderness Stewardship Challenge, which was intended to have a wilderness identified as being maintained to a minimum stewardship level by the 50$^{th}$ anniversary of the Wilderness Act in 2014. At the end of 2014, the Tongass reported all 19 wilderness areas meeting a minimum stewardship level. The long-term maintenance of the wilderness character is one of the ten elements measured for wilderness stewardship.

Tongass National Forest wilderness is managed under both the Wilderness Act of 1964 and the Alaska National Interest Lands Conservation Act of 1980 (ANILCA). The Wilderness Act mandates that each agency administering designated wilderness shall be responsible for preserving the wilderness character of the area[1]. Wilderness management policy identifies the baseline time frame for preserving wilderness character at the time of wilderness designation.

ANILCA Section 707 states, “except as otherwise expressly provided for in ANILCA, wilderness shall be administered in accordance with applicable provisions of the Wilderness Act….” ANILCA provides specific exceptions to some of the prohibitions of the Wilderness Act to accommodate subsistence lifestyles and unique situations in Alaska. The challenge for managers of ANILCA wilderness is to preserve wilderness character, as it was at time of designation, while also managing for uses allowed under ANILCA. Monitoring for changes in wilderness character is critical to determine if wilderness character is being preserved with this complex management situation.

## Wilderness Question: *Is the wilderness character being maintained?*

In September 2012, the Tongass Forest Supervisor signed the Wilderness Character Monitoring Plan for the Tongass National Forest. This plan provides direction for monitoring and evaluating changes in wilderness character for the 19 wilderness areas on the Tongass. The plan also identifies a pathway for action to prevent or halt degradation of wilderness resources and qualities. To monitor wilderness character, managers will identify trends in the four qualities of wilderness character: untrammeled, natural, undeveloped, and solitude or primitive/unconfined recreation.

Understanding the maintenance of the wilderness character requires measurements, both annually and

[1] The Wilderness Act, Statement of Policy, section 2(a), states that wilderness areas “shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment of wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character.” Section 4 (b) of the Act, Use of Wilderness Areas, states that “…each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area….”

every five years, to identify changes or trends. This work also requires interdisciplinary participation for the inventory and monitoring of the specific components that collectively make up the wilderness character for the separate wildernesses. Since the standards were established in 2012, the answer as to whether or not the wilderness character is being maintained for each of the 19 wilderness areas may not be known until after 2017.

## Evaluation Criteria

The four qualities of wilderness character are: untrammeled, undeveloped, natural, and outstanding opportunities for solitude or a primitive and unconfined type of recreation. These are derived from the definition of Wilderness in the Wilderness Act, Section 2(c). Keeping it Wild (Landres et al. 2008) describes in detail the use of these four qualities in wilderness character monitoring. A fifth quality is being considered as a potential addition to these qualities. This fifth quality would focus on unique/other features - such as cultural, ecological, geological, or other features of scientific, educational, scenic, or historical value.

Following is a description of the qualities of the wilderness character and indicators that will be measured over the next 5 years (from the Tongass Wilderness Character Monitoring Plan). The “objective” and “question” for each quality provide focus on the desired state of the wilderness and the purpose of the monitoring. The “indicators” are from the national framework. They were selected for their relevance, reliability, and cost-effectiveness.

The monitoring measures identified in this plan are “core measures” applicable to all wilderness areas on the Tongass National Forest. District rangers have discretion to add other measures important for tracking changes in individual Wilderness areas.

For each of the four qualities of wilderness character, there are indicators, measures, monitoring frequency, data source, responsibility and protocol. (Appendix A-G of the Tongass Wilderness Character Monitoring Plan) Some of the measures have “monitoring flags” that serve as a potential indicator of degrading trends. Additional monitoring flags may be developed as experience is gained with the monitoring. Monitoring flags may be replaced by “standards” – established levels of acceptable change – as these are developed with the Forest Plan or other planning decisions.

## Sampling/Reporting Period

The sampling period is annually, and the reporting and evaluation period every 5 years. Much of the sampling is done annually as required by the Washington Office to report whether or not a wilderness is being maintained at a minimum stewardship level. Some sampling will be captured to reflect trends over a 5-year period.

## Monitoring Results

The Tongass Wilderness Character Monitoring Plan was signed by the Forest Supervisor in September 2012. While components of the monitoring have been identified, the sampling methods will be refined and tested. Until trends are identified through additional monitoring, there can be no conclusions regarding the success or the maintenance of the wilderness character on the Tongass.

**Wilderness Table 1. Qualities of wilderness character**

| | |
|---|---|
| NATURAL<br>Wilderness "...is protected and managed so as to preserve its natural conditions."<br>***Wilderness ecological systems are substantially free from the effects of modern civilization.***<br>Indicators are:<br>Plant and animal species and communities<br>Physical resources<br>Biophysical processes<br>Measures could include:<br>Abundance/distribution for species of concern<br>Non-native species<br>Grazing allotments<br>Visibility, ozone, chemical deposition<br>Departure from natural fire regimes<br>Loss of connectivity<br>Measures related to climate change | UNTRAMMELED<br>Wilderness is "...an area where the earth and its community of life are untrammeled by man..." and "...generally appears to have been affected primarily by the forces of nature."<br>***Wilderness is essentially unhindered and free from the actions of modern human control or manipulation.***<br>Indicators are:<br>Actions authorized by the federal land manager that manipulate the biophysical environment<br>Actions not authorized by the federal manager that manipulate the biophysical environment<br>Measures could include:<br>Spraying weeds<br>Suppressing or lighting fire<br>Introducing non-native species<br>Unauthorized actions such as predator control |
| UNDEVELOPED<br>Wilderness is "...an area of undeveloped Federal land...without permanent improvement or human habitation" and "...where man himself is a visitor who does not remain."<br>***Wilderness retains its primeval character and influence, and is essentially without permanent improvement or modern human occupation.***<br>Indicators are:<br>Non-recreational structures, installations, developments<br>Inholdings<br>Use of motor vehicles, motorized equipment, or mechanical transport<br>Measures could include:<br>Authorized installations and developments such as scientific equipment, radio repeaters, fish barriers<br>Unauthorized installations and developments<br>Inholdings<br>Administrative and emergency uses of motor vehicles, motorized equipment or mechanical transport<br>Unauthorized uses of motor vehicles, motorized equipment or mechanical transport | SOLITUDE OR PRIMITIVE AND UNCONFINED RECREATION<br>Wilderness "…has outstanding opportunities for solitude or a primitive and unconfined type of recreation."<br>***Wilderness provides outstanding opportunities for solitude or primitive and unconfined recreation.***<br>Indicators are:<br>Remoteness from sights and sounds of people inside the wilderness<br>Remoteness from occupied and modified areas outside the wilderness<br>Facilities that decrease self-reliant recreation<br>Management restrictions on visitor behavior<br>Measures could include:<br>Visitor use<br>Area affected by travel routes<br>Night sky visibility<br>Impacts to soundscape<br>Authorized recreation facilities such as trails, toilets, bridges, shelters<br>Unauthorized recreation facilities such as user-created campsites, illegal motorcycle/ATV trails<br>Visitor management restrictions |

Progress in 2014 in establishing the baseline needed to respond to the ongoing wilderness character monitoring question was facilitated by grant funds totalling $95,100 provided by the Washington Office and through integrated projects and the increased participation of regional non-profit organizations interested in wilderness stewardship. These grants and integrated projects improved the work in wilderness stewardship across the Tongass and specifically funded:

- Wilderness Character Monitoring
- Tongass Wilderness Education Program
- Inventory and monitoring of solitude, campsites, invasive plants, air quality and climate change in the South Prince of Wales, Coronation and Karta River Wilderness Areas
- Inventory and monitoring of solitude, campsites, cultural resources and outfitter/guide permits; and removal of invasive plants at several sites in the Kuiu, Tebenkof Bay and Petersburg Creek-Duncan Salt Chuck Wilderness Areas. The south end of Kuiu Island, Kuiu Wilderness, is a remote portion of the Petersburg Ranger District that is difficult to reach. A multi-disciplinary team traveled to the area and completed work including monitoring of multiple outfitter/guide permit sites, monitoring and inventory of heritage resource sites, monitoring of dispersed recreation sites, wilderness solitude monitoring, campsite monitoring, and inventorying bird species (including an unusually high numbers of 14 and 32 Black Oystercatchers in Port Beauclerc and Totem Bay, respectively)
- Improved Wilderness Character Monitoring reporting format for all districts
- Updated campsite inventory forms and campsite information, expanded solitude monitoring protocol to west shore, treated high priority invasive weeds in Gambier Bay and Seymour Canal within the Kootznoowoo Wilderness
- Updated Endicott River Wilderness campsite inventory, monitored solitude for over 300 hours and outfitter/guide group areas in the Chuck River, Endicott and Tracy Arm-Fords Terror Wilderness Areas, treated invasive weeds in the Chuck River Wilderness
- Funded a Sitka Conservation Society (SCS) intern to conduct monitoring trips for invasive plants, encounters, campsites, and outfitter-guide contacts in the South Baranof and West Chichagof-Yakobi Wilderness Areas
- Monitored campsites, amphibians and glacial retreat in the Stikine-LeConte and South Etolin Wilderness Areas
- Monitored six lichen air bio-monitoring plots within the Coronation Island, South Etolin and Kootznowoo Wilderness Areas
- Wilderness Monitoring of Outfitter and Guide Camps in the Stikine and South Etolin Wilderness Areas were accomplished by Petersburg zone archaeologists. They made two monitoring trips, a day trip to the Stikine Wilderness and a three day trip to the South Etolin Wilderness. They monitored 14 use sites and 10 Alaska Heritage Resource Survey sites.

Specific improvements in wilderness stewardship elements included work in elements 5, 7, 8 and 9.

**Element 5 - Solitude and Primitive Recreation Monitoring:** The Tongass completed a forest-wide protocol for monitoring areas of outstanding opportunities for solitude. The plan outlines a strategy to identify and preserve areas in Tongass wilderness that provide the most outstanding opportunities for solitude and are considered at risk of losing those opportunities. A goal is to focus the limited resources available to monitoring to observe trends for these outstanding opportunity areas at risk. Another goal is to set up a pathway for action when it is needed to preserve these outstanding areas. Through these efforts, 11 of 19 wilderness areas improved their management goals in 2014.

**Element 7 – Outfitter and Guide Operations:** A Washington Office grant in 2013 provided extra funds to improve the management and oversight of outfitter and guide operations in 6 wilderness areas. At this time, all nineteen wilderness areas are reporting that outfitter and guide operations have language in their annual operating plans that identify their responsibility to preserve and protect the wilderness resource.

**Element 8 – Adequate Standards to Prevent Degradation**: As mentioned, the Tongass completed a monitoring plan for maintaining wilderness character. Elements of this plan will continue to be refined as the aspects of the plan are tested for their effectiveness. Work on this plan allowed 10 of 19 wilderness areas improve their management scores.

**Element 9 – Wilderness Information Needs**: To evaluate changes to resources over time requires a baseline inventory for each wilderness, 18 of 19 wilderness areas now have an information needs assessment in place. Work in 2014 on completing information needs plans and basic inventories improved our understanding of the wilderness resources in several wilderness areas.

In addition, many specific accomplishments resulted from partnerships between the Tongass National Forest and the Sitka Conservation Society (SCS), Southeast Alaska Conservation Society (SEACC), and Student Conservation Association (SCA) allowing for cooperation on stewardship projects:

- SCS partnered with the Ketchikan Misty Fiords Ranger District for an 18-day invasive species inventory and social encounter monitoring trip up the Portland Canal. They produced a report with locations, size, and identification of invasives found in the Portland Canal along with recommendations for treatment.
- Two SCA interns assisted the Ketchikan Misty Fiords Ranger District with wilderness lake monitoring trips where they recorded social encounters and float plane landings for permit compliance.
- Building upon a 2013 partnership with the SEACC, SEACC employed two stewardship interns to work with the Admiralty National Monument/Juneau Ranger District wilderness crew. These interns assisted with monitoring outfitter/guide small group and large group use areas; removal of noxious weeds in areas enjoyed by guided and non-guided recreationists in Tracy Arm-Fords Terror, Kootznoowoo and Endicott River wilderness areas.

## Evaluation of Results

Some results for components of the wilderness character are being reported separately by resource (for example, air quality and invasive plants). There has not been enough information collected to determine whether or not the wilderness character of each wilderness is being maintained.

## Action Plan

The action plan for maintaining the wilderness character is highlighted in specific resource monitoring strategies attached to the Tongass Wilderness Character Monitoring Plan, attachments A-G. Protocols have been developed, or are being formulated, to address invasive plants, lichen biomonitoring, wilderness development indexing, preserving outstanding opportunities for solitude, measuring encounters, and campsite inventories.

Resource inventories may establish other monitoring components over time. These may include protection needs for historic properties and additional protections for sensitive plants. Future accomplishments will depend on the available funding and participation by stewardship partners willing to assist in the collection of the required information.

# 36. Heritage Resources

**Goals:** Identify, evaluate, preserve, protect and enhance heritage resources.

**Objectives:** Protect heritage resources (as described in the Forest Plan's Heritage Resources Standards and Guidelines).

**Background:** The 1997 Tongass Land and Resource Management Plan (Forest Plan) provides guidance on maintenance of a heritage program that identifies, evaluates, protects and enhances significant cultural resources. This guidance applies across the Tongass National Forest and on a project-specific basis pursuant to the National Historic Preservation Act (NHPA), as amended, as well as other relevant acts and implementing regulations, including the Archaeological Resources Protection Act (ARPA), the Native American Graves Protection and Repatriation Act (NAGPRA) and the American Indian Religious Freedom Act (AIRFA). The Forest Plan heritage resources standards and guidelines address:

- Project clearance/inventory
- Project implementation
- Mitigation
- Enhancement

The NHPA establishes a general framework for how federal agencies manage heritage resources. Each federal agency must establish a preservation program, in consultation with the Secretary, for the identification, evaluation, protection and nomination to the National Register of significant heritage resources.

Section 110 describes the broad general requirements historic properties under the control of federal agencies are managed in a way that considers preservation of their heritage values, how historic properties are considered fully in the agency planning process, and how preservation related activities are carried out in consultation with appropriate stakeholders, including Indian tribes. Under Section 110 the Forest Service carries out inventory and monitoring activities to identify historic properties and to understand their condition through time.

Section 106 requires agency procedures for compliance to be consistent with regulations issued by the Advisory Council on Historic Preservation and requires federal agencies to consider the effects of undertakings (activities permitted, funded or undertaken on federally owned or administered lands) on heritage resources eligible for, or listed on, the National Register of Historic Places (National Register).

36CFR800 implements Section 106 of the NHPA. Since July 1995, the Tongass has operated under the terms of a programmatic agreement with the Alaska State Historic Preservation Officer (AKSHPO) and the Advisory Council on Historic Preservation (ACHP). The programmatic agreement allows the agency to streamline compliance with Section 106 by standardized procedures for evaluating effects of routine management actions on historic properties. The third amended programmatic agreement became effective in December 2010.

Under current procedures, project areas are inventoried prior to implementation in order to identify National Register eligible properties in the project area, and to determine potential effects to those properties. Areas are monitored, as time and funding allows, under the terms of Section 110 to ensure that historic properties are protected and remain eligible to the National Register. Additionally, areas are monitored to continually evaluate the effectiveness of the predictive models for site locations currently in use. Well-vetted predictive models provide management with high-quality information about potential historic site locations in proposed project areas.

# Heritage Resources Question: *Are (1) project clearance/ inventory, (2) project implementation, (3) mitigation, and (4) enhancement completed in accordance with the requirements and regulations for heritage resources?*

## Sampling/Reporting Period

Sampling and reporting occurs annually and every 5 years.

## Monitoring Results

Heritage specialists recorded 105 undertakings on the Tongass National Forest in 2014. Of those, 27 were reviewed under the standard 4-part process under Section 106 of the NHPA and involved evaluating sites for National Register eligibility in addition to evaluating potential impacts from agency undertakings. This represents a slight decrease compared to the number of reviewed projects completed in Fiscal Year (FY) 2013 (n = 110). Four of the FY2014 projects were determined to have an Adverse Effect to sites eligible to or listed in the National Register and required mitigation through an MOA with the SHPO. This represents an increase from zero (0) in FY2013. The activities within the remaining 78 agency undertakings met the criteria for evaluation under the programmatic agreement with the SHPO. Section 110 activities include direct monitoring and condition of sites, as well as partnerships and educational activities that enhance understanding and protection of cultural resources. Sixty-five activities, 19 of which include direct monitoring, were carried out in FY2014.

Qualified heritage resource professionals using accepted professional standards administer the heritage program. The Tongass heritage program is administratively divided into five zones:

- Ketchikan Zone – Ketchikan/Misty Fiords Ranger District
- Prince of Wales Zone – Craig and Thorne Bay Ranger Districts
- Petersburg Zone – Petersburg and Wrangell Ranger Districts
- Sitka Zone – Hoonah and Sitka Ranger Districts
- Juneau Zone – Admiralty National Monument, Juneau and Yakutat Ranger Districts

### *FY2014 Monitoring Projects Summary*

Despite declining budgets for activities related to the management of cultural resources, Tongass archeologists continued a fairly active program to ensure the protection of the Forest's cultural resources. Opportunistic surveys and condition assessments are carried out when heritage staff are working in adjacent areas and have the time and funding. Tongass archeologists monitored the condition of 119 sites in FY2014, which represents a decrease from the preceding year (n =141). There were 18 new discoveries during FY2014, none of which were inadvertent discoveries of archeological materials during project implementation or otherwise. In general, condition assessments completed as part of monitoring activities have revealed relatively stable sites (good condition). Some, however, were noted to be eroding due to environmental factors such as slope instability. In spite of this, there were no recommendations made for site stabilization or other overt activity to protect these sites.

### *Monitoring Projects - Petersburg/Wrangell Ranger Districts*

#### Keku and Kuiu Islands Project

Petersburg zone archaeologists and other Forest Service staff conducted monitoring activities during a weeklong remote tour. Participants stayed at the Forest Service bunkhouse in Kake and used a twin engine 24-foot Almar for transportation. Staff went ashore 11 times, monitored nine special use permit sites and 31 acres of land was surveyed for cultural resources. No uses occurring at the permit sites are

affecting cultural resources.

While carrying out investigations for special use permits, four Alaska Heritage Resource Survey (AHRS) sites were monitored and five previously unknown cultural sites were discovered (PET-749, PET-750, XPA-367, XPA-368, and XPA-369) and recorded. At the previously identified sites, new site components were identified and recorded.

Reports of inland shell deposits were investigated in the Kuiu Islands, and a sample of shell located at the outlet of a small low-elevation lake was collected. Also discovered was a raised marine shell deposit up a creek in Saginaw Bay. The shell yielded a conventional radiocarbon age of 9650 +/- 30 BP (Beta - 395235). The information provides data for a Paleoshoreline Predictive Model for Southeast Alaska.

**East Kuiu Project**

Petersburg zone archaeologists and Forest Service recreation specialists inventoried campsites and surveyed for cultural resources on East Kuiu and Kupreanof islands. Working off of the M/V Chugach, 19 individual stops were made and about 65 acres of land was surveyed. Ten outfitter/guide and seven AHRS-listed sites were monitored and two previously unknown sites were discovered.

A paleo-geologic survey was also completed at selected areas. While searching for reported lithic resources on Conclusion Island veins of red and yellow jasper, chalcedony and blue agate were discovered. This is important because this kind of material is common in stone tools. Shell samples were collected from a paleobeach in Port Beauclerc. The marine shell yielded a conventional radiocarbon age of 10000 +/-30 BP (Beta-395234).

Inclement weather forced the conclusion of project travels and ended with training exercises for cultural resource assistant, Tory DeAngelis, at known prehistoric village, camp and fort sites. Tory practiced finding buried shell midden deposits using a split spoon soil auger, and we discussed site terrain, elevation, deposit depth and thickness, site size and function. During this exercise, we also discovered a new site component at PET-378.

*Heritage Resources Photo 1. Jane Smith collecting a sample of a paleomarine shell deposit for radiocarbon dating analysis in the Port Beaclerc area.*

**South Etolin Project**

Petersburg zone archaeologists and Forest Service recreation and wilderness specialists visited campsites and surveyed for cultural resources in the South Etolin Wilderness Area. Based out of the Frosty Bay Forest Service recreation cabin, stops were made at Fisherman Chuck, Canoe Pass, Brownson Island, Kundays Cove, McHenry Inlet, Dewey Anchorage, Krough Creek, Stone Harbor and Onslow Island.

Over the course of four days, 28 stops were made and 42 acres were surveyed for cultural resources. A total of 25 use-sites were monitored and 6 AHRS-listed sites. New site components were mapped and recorded at one known site, and four new sites were discovered. Detailed site information and completed site maps were prepared for future eligibility recommendations.

### *Monitoring Projects - Sitka/Hoonah Ranger Districts*

Sitka Ranger District continued to work with principal investigator (PI) McMahan, the National Science Foundation, and the Sitka Historical Society on the NEVA project. In this fiscal year, we did a site visit with the PI to monitor the condition of the site and determine suitable locations for establishment of a field camp.

Three new sites were recorded, two that are WWII sites in the Sitka Sound area (SIT 1011) and (XPA-366). Survey for these two areas comprised 9 acres of Section 110 survey. Both sites were evaluated and recommended as eligible to the National Register. The other new site (SIT-964) was recorded with Madonna Moss and Anne Pollnow and is comprised of eight weir stakes along Starrigavan Creek. Ten sites were visited during three separate trips with other resource personnel from the district. Sites were monitored for effects from Forest Service actions and disturbances by non-Forest Service activities.

### *Monitoring Projects – Ketchikan-Misty Fiords Ranger District*

**Cultural Resource Monitoring and Survey at Tongass Island, Kirk Point, George Inlet, & Thorne Arm**

The Ketchikan-Misty Fiords Ranger District hosted an archaeological inventory and monitoring expedition called "Cultural Resource Monitoring and Survey at Tongass Island, Kirk Point, George Inlet, & Thorne Arm; A Windows on the Past Joint Project between the USDA Forest Service and the University of Alaska Southeast-Ketchikan May 5-9, 2014." The expedition was an annual cooperative effort between the USDA Forest Service and the University of Alaska Southeast-Ketchikan.

*Heritage Resources Photo 2. Student Volunteer Sara Gross excavates a test pit at the Tongass Island Midden (XPR-104)*

The expedition leaders were: Ketchikan-Misty Fiords Ranger District archaeologist Martin Stanford, Forest Tribal Relations Specialist John Autrey and professor of anthropology Dr. Priscilla Schulte from the University of Alaska Southeast Ketchikan Campus. The 2014 group of four student volunteers consisted of Forest Haven, Heather Evoy, Sara Gross and Victoria Daniels. The Ketchikan-Misty Fiords District Ranger Jeff DeFreest and another student, Noah Lloyd, were able to participate in the activities for one day (May 5, 2014) on Tongass Island.

This year's expedition took place at several locations including Tongass Island, Kirk Point, George Inlet, and Thorne Arm. This was limited to day trips where site survey and monitoring was completed with transportation by aircraft to Tongass Island and then utilizing skiffs from Ketchikan to travel to Kirk Point, George Inlet and Thorne Arm. The Forest Service boat operators were Clark Simpson, Jon Regetz and Art Williams.

This program provided opportunities for five students, under the joint leadership of the University of Alaska Southeast and the Forest Service, to participate in heritage resources management and site stewardship. Students experienced how archaeological and historic sites are located, documented and monitored. In addition, the students experienced traditional Native subsistence activities. These activities included beach food harvesting, tool making and carving. The volunteers contributed 288 hours to complete new archaeological surveys of approximately 10.2 acres.

The expedition discovered four new Alaska Heritage Resource Survey (AHRS) sites including a shell midden (XPR-104, see Photo 2) near the center of Tongass Island (Calibrated C14 date of: BC 940-825. Beta-386326.), a new boat run (KET-1355), a new fish trap (KET-1356), and a new petroglyph (KET-1357). Finally, the expedition monitored the condition of 18 known sites including old village sites, fish traps, pictographs, petroglyphs, middens, seasonal camps, a fur farm and several old mines. None of the monitored sites appeared to have been damaged by recent vandalism or artifact collecting but natural erosion was occurring at some of the sites.

**A Windows on the Past Search of the Duke Island Area Traditional Cultural Property (TCP) by Sea Kayak**

The Ketchikan-Misty Fiords Ranger District hosted an archaeological survey and monitoring expedition called the "A Windows on the Past Search for Kegan; The "Lost" Village of the Tantakwan and Other Archaeological Surveys and Monitoring in the Duke Island Area Traditional Cultural Property (TCP) by Sea Kayak, June 16-27, 2014." This excursion provided opportunities for six volunteers, using sea kayaks, to locate, document and monitor prehistoric and historic sites. The expedition leaders were Ketchikan-Misty Fiords Ranger District archaeologist Martin Stanford and Forest Tribal Relations Specialist John Autrey. The six volunteers were Karen Denman, Bill Hucks, Tom Metke, Jan Nevler, Lynn Paquette and David Richards.

The sea kayaking expedition completed new surveys of Judd Harbor and Cape Northumberland within the Duke Island Area Traditional Cultural Property (TCP). During the course of the expedition, the six volunteers contributed approximately 780 hours to help inventory about 33 acres while paddling sea kayaks along approximately 43 miles of coastline. While it was disappointing to not locate the Tongass Village called Kegan, pre-field research did establish the first European contact of the Tongass people. Tongass oral history suggested the first European contact was with Captain James Cook in 1778; however, Captain Cook did not set foot in Southeast Alaska. Some historians have suggested it was Captain George Vancouver who made the first contact with the Tongass people in 1793. However, from the literature, it seems clear that it was Scottish Captain William Douglas in the Iphigenia Nubiana who first met Tongass Chief Tlexi'h near Cape Northumberland on June 7, 1789.

*Heritage Resources Photo 3. Volunteer Tom Metke Excavates a Stake at the Wolf Creek Stake Trap (XPR-105)*

One of the highlights of the expedition was the discovery of a new wooden stake weir (XPR-105, see Photo 3). One of the stakes returned a Calibrated C14 date of: BC 975 – 830 (Beta – 386317). Twenty known AHRS sites were monitored for evidence of erosion, vandalism or artifact collecting. Fortunately, only natural erosion was occurring at some of the sites. A site map and new documentation was completed for XPR-015 and XPR-077. The new fish trap site discovered has added significantly to our understanding of prehistoric resource utilization in the Duke Island area. In addition, the volunteers learned something about Native culture, traditional subsistence lifestyles, site stewardship, site documentation and management of historical and archaeological resources.

### *Monitoring Projects - Prince of Wales*

Prince of Wales Zone archaeologists monitored the condition of 19 archaeological sites in 2014 in various

locations throughout the island. The results of this monitoring will be factored into the management of those resources.

## Evaluation of Results

Tongass archeologists have recorded and evaluated thousands of sites and monitored their condition, either through planned revisits or opportunistically, in the last decade. Requirements of Sections 110 and 106 of the NHPA are being met. A review of Tongass compliance records indicates that the intent of the provisions of Section 106 that require federal agencies to consider the effects of undertakings on cultural resources that meet eligibility requirements for the National Register of Historic Places are being complied with. Field inventory procedures and site assessments are stringent enough to identify cultural resources within project Areas of Potential Effects for the purposes of Section 106. This claim is supported by the fact that no inadvertent discoveries have occurred once a project site has been evaluated. Present results suggest forest plan's heritage resource standards and guidelines are adequate to protect the forest's cultural resources in the event of an undertaking.

Monitored sites are chosen based on several factors, including their resource values and their susceptibility to disturbance from natural forces, vandalism or management activity. In the last five years an added factor is ease of accessibility, i.e., sites close to communities or near roads or other transportation networks. Declining heritage budgets coupled with the increased costs of transportation to remote sites leaves more remote sites without monitoring. Whether this is a concern is a question. Remote sites suffering natural degradation likely would not generate a management action, whereas a readily accessible site experiencing the ill effects of too much public attention would. At present, most monitored sites appear to be weathering naturally, and only a few sites have yielded evidence of human damage, either inadvertent or intentional.

Efforts to make the Tongass more relevant to the general public may result in increased recreation in more remote locations, which potentially could adversely impact sites that are rarely monitored. In areas that are frequented by the public, archeologists have noted trampling, minor erosion and other types of surface disturbance that could lead to adverse effects to buried sites. They have also noted items being left or moved at sites considered the most vulnerable, such as human burials and other sacred places.

Isostatic rebound throughout Southeast Alaska is of concern for sites that lie within the beach fringe and on low lying terraces. Some shorelines are subsiding, while others are rising. Changes in sea level, as well as increases in storm events and magnitudes attributed to changes in the climate are cause for concern for these low lying sites. In the Tongass larger, prehistoric/protohistoric village sites are generally located along the shoreline. Recent modeling and investigations of paleo-shorelines have revealed, however, an upper terrace where prehistoric sites, with no historic components, are located. This information is not well-incorporated into the current predictive model for site locations. Investigations have already revealed some of the earliest known sites in Southeast Alaska, and may lead to the discovery of significant cultural resources in places that, until recently, were considered low probability areas. Incorporating these new areas into a monitoring plan will stretch an already limited budget even further.

In summary, the forest plan's standards and guidelines appear to be complying with the requirements to identify and protect the forest's significant cultural resources. Most of the monitored sites are stable and in good condition, with only a few being actively eroded through natural means, or experiencing adverse effects from visitors. Decreasing funding challenges the monitoring program to look for alternative methods to carry out the work. In this case, the staffs introduce efficiencies by working cooperatively with other program areas to visit sites.

FY2014 monitoring was conducted at the sites displayed in the table below.

**Heritage Resource Table 1. Heritage resources monitored on the Tongass National Forest in FY2014**

| AHRS Number | Site Name |
|---|---|
| CRG-00066 | Brownson Saltery |
| CRG-00627 | Canoe Pass Pictograph |
| CRG-00628 | Canoe Pass Hole-In-The-Wall |
| CRG-00629 | Kundays Creek Stone Arc Traps |
| CRG-00630 | Kundays Cove Midden |
| CRG-177 | Thorne Bay Site |
| CRG-578 | Logjam Creek Terrace Site |
| CRG-580 | Edna Bay Midden |
| CRG-600 | Staney Creek |
| CRG-603 | Falls Creek Site |
| CRG-606 | Cape Pole 18 Meter Terrace |
| CRG-607 | Finish Line Site |
| CRG-608 | Cape Pole 25 Meter Terrace |
| CRG-609 | Cape Pole Easy 12 Meter Site |
| CRG-610 | Cape Pole 30 Meter Terrace Site |
| CRG-612 | Cape Pole 12 Meter Terrace Site |
| CRG-670 | Black Beauty Site |
| CRG-680 | Survey Cove High Terrace |
| CRG-681 | Cape Pole Easy Raised Marine Beach |
| CRG-713 | Tolstoy Bay Midden |
| CRG-714 | Extended Roots Site |
| CRG-715 | Beautiful Creek Site |
| DIX-069 | Ross Adams Mine/Bokan Mountain |
| JUN- 1018 | Spaulding Trail |
| JUN-025 | Auk Village |
| JUN-1010 | Montana Creek Trail |
| JUN-1020 | Peterson Tram |
| JUN-1073 | Dull And Stephens Mine |
| JUN-1115 | Trail Of Time |
| JUN-1183 | Mendenhall Lake Trail |
| JUN-241 | Nugget Power Complex |
| JUN-242 | Skaters Cabin |
| JUN-598 | Cobble Shelter |
| JUN-617 | East Glacier Trail |
| JUN-689 | Ak Empire Mine |
| KET-00003 | Cape Fox Village (Gaq, Gash, Qaas, Kah Shakes' Village, Kirk Point) |
| KET-00005 | Kah Shakes Cove Village (Eskutua'N) |
| KET-00006 | Mary Island Settlement |
| KET-00010 | Cat Island Village And Burial & Midden (Old Tongass, Tongass, Tangak) |
| KET-00013 | Village Island Village (Daasax'Akn) & Midden |
| KET-00018 | Leask Cove (Petroglyph, Cabins And Fish Traps) |
| KET-00024 | Mary Island Light Station |

| AHRS Number | Site Name |
|---|---|
| KET-00028 | Sealevel Mine |
| KET-00051 | Grave Point Burial |
| KET-00072 | Ore Cars (Ccc Camp Yard Ward Lake) |
| KET-00074 | Fish Creek Trap #2 |
| KET-00075 | Fish Creek Petroglyphs |
| KET-00087 | Ward Lake Community Shelters And Recreational Area |
| KET-00091 | Fish Creek Trap #1 |
| KET-00349 | Gockachin Creek Fishtraps And Midden |
| KET-00351 | Settlers Cove Fish Weir |
| KET-00362 | Devil Cliff Pictograph |
| KET-00363 | Winstanley Pictograph |
| KET-00430 | Bakewell Lake Trail |
| KET-00433 | Ward Lake Outlet Foot Bridge (Nrj 05/11/93) |
| KET-00437 | Snipe Island Fox Farm |
| KET-00445 | Fish Creek Cabin And Gardens |
| KET-00665 | Gold Banner Mine |
| KET-00722 | Kah Shakes Village Petroglyphs |
| KET-00729 | Sealevel, Goo-Goo Mine, Gold Banner Mines Historic District |
| KET-00746 | Carroll Point Pictographs |
| KET-00750 | Thorne Arm Pictographs |
| KET-00780 | South Double Island Midden |
| KET-00792 | Cat Island Log Crib Burials |
| KET-00805 | Connel Lake Dam & Pipeline |
| KET-00999 | Cone Point Pictograph |
| KET-01094 | Settlers Cove Petroglyph |
| KET-01118 | Perseverance Lake Trail |
| KET-01194 | Signal Creek Pump Station |
| KET-01195 | Ward Lake Nature Trail |
| KET-01197 | Ward Cove Abandoned Trail |
| KET-01202 | Bakewell Arm Pictograph And Burial |
| KET-01257 | Carl Manzoni'S Twice Crashed Cessna 185 |
| PET-00027 | Sandy Beach Fish Traps And Petroglyphs |
| PET-00041 | Kuiu Cabin |
| PET-00085 | Conclusion Island Cabins |
| PET-00371 | West Shore Midden |
| PET-00372 | Little Totem Village |
| PET-00377 | Totem Lookout Midden |
| PET-00378 | Another Midden |
| PET-00382 | Barred Hawk Midden (Fort) |
| PET-00401 | Gumboot Midden (Fort) |
| PET-00409 | Sal'S Site |
| PET-00494 | Totem Bay Pit |
| PET-00576 | Crossings Midden |
| PET-00582 | South Big Creek Petroglyphs |
| PET-029 | Shipley Bay Site |

| AHRS Number | Site Name |
|---|---|
| SIT- 681 | No Site Name |
| SIT-229 | Starrigavan Midden And Garden |
| SIT-231 | Russian Charcoal Pits |
| SIT-351 | False Island Midden |
| SIT-371 | Windfall Harbor Shelter |
| SIT-371 | Windfall Harbor Shelter |
| SIT-457 | Fort Babcock |
| SIT-539 | Moser Island Midden |
| SIT-542 | Windy Day Village |
| SIT-642 | Patterson Bay Camp |
| SIT-960 | Angoon Administrative Site |
| SIT-960 | Angoon Administrative Site |
| SUM-00008 | Turnabout Island Village |
| SUM-098 | Pleasant Bay Maul Site |
| XPA-00073 | Kell Bay Cannery Site |
| XPA-00286 | Saginaw Bay Rock Shelter And Petroglyphs |
| XPA-00287 | Xpa-00287, Midden |
| XPA-305 | Maid Island Fur Farm |
| XPA-306 | Tava Island Fur Farm |
| XPR-00001 | Fort Tongass (Tlehonsiti) |
| XPR-00002 | Tongass Island Village & Midden (Tangak, New Tongass, Ka Duch Hoo Ka) |
| XPR-00010 | Xpr-00010 (Ship Wreck) |
| XPR-00014 | Duke Island Midden |
| XPR-00015 | Dog Island Midden (& Burial) |
| XPR-00028 | Ryus Homestead |
| XPR-00041 | Duke Island Cabin |
| XPR-00063 | Judd Harbor Boat Run And Cabin Ruins |
| XPR-00067 | Goose Lake Stake Weir |
| XPR-00068 | Goose Lake Rock Weirs |
| XPR-00069 | Goose Lake Rock Alignments |
| XPR-00070 | Wolf Creek Traps |
| XPR-00071 | Wolf Creek Weirs |
| XPR-00075 | Wolf Creek Midden |
| XPR-00077 | Dog Island Midden # 2 |
| XPR-00078 | Dog Island Stone Weir |
| XPR-00092 | Inside Of Worm Rock Fish Traps |
| XPR-00095 | Harold F. Gilmore Cenotaph |
| XPR-00096 | Outside Fort Fish Trap/Weir Complex |
| XPR-00098 | Pond Bay Rock Alignments |

# 37. Recreation

**Goal:** Provide a range of recreation opportunities consistent with public demand, emphasizing locally popular recreation places and those important to the tourism industry.

**Objectives:** Manage recreation settings in accordance with recreation opportunity spectrum (ROS) standards and guidelines for each land use designation (LUD), maintain existing trails and recreation sites to standard, and remove facilities that are no longer needed or are not affordable.

**Background:** The Tongass National Forest maintains 2 large visitor centers, about 200 cabins and shelters, and over 400 miles of trails for use by local residents and visitors. Along with the infrastructure, recreation use of the Tongass is facilitated through outfitters and guides. These services range from accommodation of transport to cabins and shelters, to multi-day big game hunting experiences in the most remote locations of the Tongass.

## Recreation Question: *Are areas of the Forest being managed in accordance to the prescribed recreation opportunity spectrum (ROS) class in Forest-wide standards and guidelines? Is the classification consistent with public demand?*

### Evaluation Criteria

Standards and guidelines for the management of visitor use are maintained according to the ROS class which is appropriate for the land use designation.

### Sampling/Reporting Period

There is an annual sampling period and a 5-year reporting period.

### Monitoring Results

#### *Outfitters and Guides*

More than 600,000 recreation visitor days of guide services were provided on the Tongass National Forest in FY2014. Guides provided nature touring, hiking, flightseeing, rafting, dog-sledding, wilderness adventures and big game guiding. Currently, this use is authorized through existing environmental analysis consistent with the Forest Plan direction to provide a level of commercial uses appropriate to the capacity.

The capacity for outfitters and guides may change on several districts in the future as the Hoonah, Juneau, Sitka, Wrangell and Yakutat ranger districts, and the Admiralty National Monument are updating environmental documents related to the recreation capacity for all or portions of their districts. Documents are also being prepared for the Anan Wildlife Observation Site on the Wrangell Ranger District and for Outfitter and Guide operations on the Yakutat Ranger District. These analyses may result in changes to the capacity for guided use in 2016.

#### *Developed Recreation Facilities and Trails*

The Tongass maintains more than 350 developed recreation sites across the Forest. These include 2 major visitor centers, 4 major wildlife and fish viewing sites, almost 200 shelters and cabins, 12 campgrounds, and more than 40 day use or interpretive sites. The Tongass also manages more than 400 miles of hiking trails, of which almost 92 miles are within congressionally designated wilderness. Another 400 miles of motorized trails are identified on district motor vehicle use maps that are updated annually and available at the local district offices. Funding for the operations and maintenance of these facilities and trails is accomplished through congressional appropriations from fees collected at recreation fee sites (major

visitor centers, campgrounds, cabins, special recreation areas), and fees collected from outfitters and guides who use the trail systems.

In 2013, the Tongass completed an environmental assessment to determine whether or not to remove 12 cabins. Most of the cabins were available for public use through the National Recreation Reservation System, but have seen little to no use for several years. Some of the cabins are in disrepair and are not safe for occupation. As the manual requires the Forest Service to maintain facilities to a safe standard for the public, removing these facilities will allow funding for the operation and maintenance of these sites to be used in other locations where public demand is higher. In 2014, 3 cabins were decommissioned on the Ketchikan-Misty Fiords Ranger District. One cabin on the Yakutat Ranger District will be decommissioned and 1 cabin on the Admiralty National Monument will be converted to a shelter in 2015. The remaining cabins identified for decommissioning will be removed as funding allows.

### *Wilderness Monitoring at Ketchikan-Misty Fiords Ranger District*

All locations monitored in the Misty Fiords Wilderness were below the established standards. ROS classifications may not be consistent with public demand for landings on remote lakes in the most popular portions of Misty Fiords National Monument. A change in the ROS classification, however, would result in additional difficulty maintaining wilderness character in the core area of Misty Fiords, and would contradict the new encounter standards identified in the Ketchikan-Misty Fiords Outfitter and Guide Management Plan FEIS.

# 38. Wild, Scenic and Recreational Rivers

**Goals:** To maintain, enhance and protect the free-flowing character and outstandingly remarkable values of rivers and river segments recommended for inclusion into the National Wild, Scenic and Recreational Rivers System.

**Objectives:** Manage the 31 rivers (or segments) recommended for designation as Wild, Scenic or Recreation Rivers, pending designation by Congress, to maintain the eligibility of the total miles of river for the Wild, Scenic or Recreational classification. Approximately 536 miles of rivers on the Tongass are included in this recommendation:

- Wild 359.5 miles
- Scenic 87.5 miles
- Recreational 89.0 miles

## Wild, Scenic and Recreational Rivers Question: *Are Wild, Scenic and Recreational River standards effective in maintaining or enhancing the free-flowing conditions and outstandingly remarkable values at the classification level for which the river was found suitable for designation as part of the National Wild and Scenic River System?*

### Evaluation Criteria

The evaluation must be completed on a river-by-river basis as the outstandingly remarkable values vary for each river. Depending on the activity, different resource specialists will provide information as to whether or not the values for which the rivers have been recommended have been enhanced or impacted.

### Sampling/Reporting Period

There is an annual sampling period and a five-year reporting period.

### Monitoring Results

No site-specific monitoring was completed in 2014. There were no projects proposed that included effects to proposed Wild, Scenic or Recreational River characteristics and no NEPA documents completed that evaluated impacts to Wild, Scenic or Recreational River characteristics.

# 39. Scenery

**Goals:** Provide Tongass National Forest visitors with visually appealing scenery, with emphasis on areas seen along the Alaska Marine Highway, tour ship and small boat routes, state highways, major forest roads, and from popular recreation places; recognize that in other areas where landscapes are altered by management activities, the activity may visually dominate the characteristic landscape.

**Objective:** Manage the scenery of the Tongass National Forest in order to achieve the adopted scenic integrity objectives (SIO).

**Background:** Each land use designation (LUD) in the Forest Plan has a corresponding scenic integrity objective that defines maximum levels of visual impact desirable from human-induced alterations to the natural landscape character. Associated with each objective is a set of recommended guidelines that includes unit size ranges and type of harvest treatment for different visual absorption capability settings. Additionally, part of the FORPLAN[1] modeling process includes a set of guidelines that define roughly how much of a viewshed (or logical part of a viewshed segment) can be in a "disturbed" condition and still meet the visual quality objective. The 5-year monitoring effort is intended to assess whether these guidelines, as applied, actually result in meeting established visual objectives.

Annually, landscape architects on the Tongass evaluate many sites for a wide range of projects, including timber harvest projects. Special use project requests, ranging from recreation cabins to transmission lines, have the potential to visually impact the scenery. Evaluation of these projects and sites utilize the Forest visual priority travel routes and use areas reference list (Forest Plan, Appendix F). Assessment and monitoring of these projects and requests will help to meet our overall scenery goal and objectives by comprehensively evaluating the entire spectrum of potential impacts.

## Scenery Question: *Are the adopted scenic integrity objectives established in the Forest Plan being met?*

### Evaluation Criteria

Tongass National Forest landscape architects completed 14 analyses (Table 1) for compliance with scenery standards and guidelines as part of implementing the Forest Plan in FY2014. There were also numerous minor scenery resource support efforts provided to several ranger districts for special use permits and small district projects (modifications to cabins, communication sites, a fish pass, and small-scale tree thinning projects). Some of these projects will be monitored in the coming years as they are implemented.

**Scenery Table 1. Projects completed by landscape architects in FY2014**

| Ranger District | Project |
|---|---|
| Craig | Sunnahae Trail construction |
| Hoonah | Eight Fathom Rock Pit EA |
| Juneau | Lena Beach Recreation Area Reconstruction EA and design support |
| | Sweetheart Lake Hydroelectric Project PDEA review |
| | West Glacier Recreation Area EA and design support |
| | Kensington Mine Fuel Storage Depot EA |
| Ketchikan-Misty Fiords | Saddle Lakes Timber Sale resource report (DEIS published in 2014) |
| | Margaret Creek Wildlife Observatory Enhancement EA and design support |
| Petersburg | Mitkof Island Timber Sale EA resource report |
| | Kake-Petersburg Powerline Intertie scenery resource review |
| | Thomas Bay Timber Sale Gate 1 analysis |
| | Raven's Trail construction (Phase 1) |

[1] FORPLAN is a timber modeling computer program

| Ranger District | Project |
|---|---|
| | Seal Point Recreation Area construction administration support |
| | Cascade Trail Reconstruction contract package development |
| | Blind River Rapids Picnic Shelter contract administration |
| Sitka | Takatz hydroelectric |
| | Sawmill Creek Campground design |
| | Sitka office |
| Thorne Bay | Interpretive Kiosks design and contract package preparation |
| | Luck Lake construction contract administration support |
| | Sarkar Lake construction contract administration support |
| | Salt Chuck Mine Interpretation Project site design |
| | Kosciusko Vegetation Management and Watershed Improvement Project scenery resource input |
| Wrangell | Wrangell Island Timber Sale EIS scenery analysis |
| | Anan Wildlife Observatory survey/design for safety improvements |

Many of the projects that were implemented during 2014 (other than timber sales) were evaluated using the "exception for small areas of non-conforming developments, such as recreation sites, transportation developments, log transfer facilities and mining development... on a case-by-case basis" as allowed by the LUD.

In these situations, the SIO allowed under the exception often differs from the SIO established by the LUD's standards and guidelines because the benefit to the public of the development or management activity has been judged to outweigh the need to strictly conform to the original SIO. Considerations that may lead to allowing an exception include user safety, a known socio-economic need, or resource protection. Most often, the impact affects the foreground viewing distance. For example, when a new recreation development is desired for reasons of improved user safety and erosion control, but it could not meet a high SIO for foreground conditions because it would be visually evident to the casual observer, the decision would allow compliance with an SIO compatible with the development while still maintaining the intent of the LUD.

In these cases, project design considers various elements such as size, shape, orientation to viewer, color, texture, etc. in determining whether or not individual structures and the development as a whole can meet the new adopted SIO.

The following are projects that underwent construction in 2014 and fall into the "exceptions" clause category:

- Sunnahae Trail reconstruction (active project)
- Raven's Roost Trail new construction Phase 1a (completed June 2014)
- Seal Point Recreation Area new construction (completed May 2014)
- Luck Lake Recreation Area new construction (completed in 2015)

This monitoring report will discuss the outcome of Seal Point Recreation Area and Raven's Roost Trail Phase 1a.

Active timber sales in 2014 included:

- Lindenberg Timber Sale (Lindenberg Peninsula, Kupreanof Island)
- Tonka Timber Sale (Kupreanof Island) – sort yard expansion
- Miscellaneous small and salvage sales

This monitoring report will discuss the outcome of two elements of the Tonka Timber Sale: sort yard expansion and harvest of Unit 207.

*Scenery Photo 1. Day use site 1 before the development of the Seal Point Recreation Area*

## Monitoring Results

### *Seal Point Recreation Area*

Seal Point Recreation Area is approximately 8.5 miles south of Kake, Alaska. Recreation area facilities consist of two day use sites, a boat ramp, two vault toilets, and parking. The larger day use site (Site 1) is located on Seal Point, and offers two picnic shelters, a vault toilet, beach access, and parking. The smaller day use site (Site 2) offers one picnic shelter, a vault toilet, and parking (see Photo 1). The boat launch and its parking area are located between sites 1 and 2. Day use site 2 falls within a timber production LUD with a low SIO adopted for foreground situations; the boat launch and day use site 1 are within a semi-remote recreation LUD, with an SIO of moderate in the foreground. It is rare that one recreation area would cross LUD boundaries, but this was a previously undeveloped site, offering little more than a patch of ground cleared by repeated use and overgrown parking spurs that were mainly a by-product of timber harvest activities. The existing boat launch was built with so little slope that it was only useable at a 16-foot tide or better. The NEPA decision permitted a small area of non-conforming development, with the goal being to meet an SIO of moderate.

*Scenery Photo 2. Day use site 1 after completion of the Seal Point Recreation Area*

One concession made to keep project costs down and allow for all site elements was to use the nearest rock source for aggregate material, a white limestone. This resulted in a greater impact to scenery but the primary users, residents of Kake, are accustomed to the rock and have expressed no complaints. The rock will darken over time. The picnic shelter materials, colors, and style of construction were chosen to blend with the site while affording a more vandal-proof structure (wood-wrapped steel). The shelters were also designed to accommodate future addition of carved panels in the gable ends through funding from another source. Log wraps on the posts compliment the natural surroundings, help ground the structures in this outdoor setting, and will be compatible with the carved panels.

Construction was completed in May of 2014. Overall, it is felt that the development meets a moderate SIO under the “exceptions for recreation developments” clause.

Future monitoring should watch for issues with drainage, revegetation, and the erosive action of tides and weather in an intertidal area.

*Scenery Photo 3. Vegetative plugs near the rest area along the Raven's Roost Trail, Phase 1a*

### *Raven's Roost Trail, Phase 1a*

Raven's Roost Trail, Phase 1a shares trailhead parking with Sandy Beach Park, near the town of Petersburg, Alaska. The purpose of this trail is to provide an easy hiking experience near town. The trail is wide enough for hikers to pass each other easily. The trail tread is packed three-quarter-inch–minus gravel, and there are no steps. There is one rest area midway through this trail segment (Photo 3), and ample space for hikers to gather and wait at the trailhead.

Much of the trail was constructed over muskeg by laying down a geotextile fabric over ground that had been cleared of trees, stobs, and large shrubs. Low-growing vegetation remained in place, and oftentimes the cleared trees and shrubs were placed under the geotextile to reduce waste and help "float" the trail. The result is a solid trail surface which lays nicely over the muskeg with very little apparent disturbance to adjacent ground.

During construction, a short section of trail was laid in an undesirable location relative to the rest area. With this type of trail construction, the contractor was able to remove the gravel down to the geotextile, move the geotextile to the desired location, and rebuild the gravel surface with very little impact to the muskeg. The location has recovered well; an uninformed hiker would not know where this occurred.

One area near the trailhead which had a drainage issue during construction was reconfigured with a shallow drain dip and sloped outward; this site is draining well. The entire length of this newly constructed trail section is in excellent condition; draining and wearing well under regular use. All culverts appear to be well-located and moving water.

One issue to monitor on future visits will be the revegetation of the trail's shoulders. These were revegetated with plugs of muskeg plants taken from the trail footprint during construction (Photo 3). To help the plugs become established, the gravel shoulders were first dressed with a layer of topsoil from an offsite source.

### *Tonka Sort Yard Expansion*

Sort yard expansion at the Tonka log transfer facility (LTF) was completed in 2012 but has never been monitored for its effects to scenery. The site is located along the Wrangell Narrows, on the east side of Kupreanof Island south of Mountain Point. It is viewed in the foreground distance zone from state ferry and other boat traffic traveling the Wrangell Narrows, and in the middleground from several private homes on Mitkof Island. The LUD is scenic viewshed; SIOs are high for the foreground situation and moderate for the middleground.

*Scenery Photo 4. Sort yard above Tonka Mountain LTF as viewed from Mitkof Island*

The original scenery resource report for the Tonka Timber Sale Project states, "The sort yard has been designed to be mostly screened from view of the Wrangell Narrows by foreground vegetation and topography." However, in July 2012, an industry-

driven design change added 3 acres to the facility's footprint, moving the upper sort yard bay back into the hillside farther than planned. A change analysis was done prior to construction to analyze whether the new design can still meet the SIO.

The change analysis concluded, "Provided windthrow does not become an issue and clearing limits are strictly adhered to, it is expected that the visual impacts of development…will be limited to brief views of some portions of the road system, along with the shadowy effect created by a gap in the tree canopy and brief views of exposed tree boles at the northern end of the upper bay. Homeowners across the Narrows will see the shadowy effect created by a gap in the tree canopy and the top portions of tree boles along a 200' or more length of the northern backline. The canopy gap will exist for the life of the site; tree boles will be covered eventually by new vegetation but not for 30 years or more. These effects fall within acceptable limits for meeting the SIO of High in this Scenic Viewshed LUD."

In Photo 4, the opening created by sort yard clearing is seen as a horizontal, light-colored patch uphill from the LTF. The sort yard was not built to the expected size due to unforeseen bedrock issues. In the two years since completion, blowdown has not increased the opening in the vegetation. The result is similar to what was expected, and conforms to a moderate SIO; the appearance will improve over time as new vegetation grows in.

### *Tonka Harvest Unit 207*

Unit 207 of the Tonka Timber Sale is located on Kupreanof Island across the Wrangell Narrows from the popular Papke's Landing boat launch on Mitkof Island south of Petersburg. The harvest prescription was clearcut with 15 percent retained as reserves; the unit falls within a scenic viewshed LUD and is seen from the Wrangell Narrows in the middleground viewing distance. The unit card states, "Consult landscape architect at implementation to ensure retention and unit size meet a Moderate SIO."

*Scenery Photo 5. Unit 207 from the Tonka Timber Sale is visible just above the tree line as seen from Papke's Landing on Mitkof Island*

In May of 2012, the layout forester contacted the landscape architect regarding unit boundary changes that were recommended based on field conditions. The reviewing landscape architect judged the result would be an improvement over the planned unit shape and size; the backline was brought downslope and the new shape eliminated the appearance of a straight line cutting across the slope. In addition, the landscape architect recommended dropping a triangular patch of ground in the northwest corner of Unit 207 and adding it to the helicopter harvest unit above (Unit 205); with this done, there would be no need for additional retention within Unit 207 to meet the SIO. This was done and the change analysis was approved in July of 2012. In 2013 the unit was harvested.

Forest Plan standards and guidelines state that the harvest activity should meet the SIO within one year of project completion. Assessing the unit's appearance from Papke's Landing boat launch one year post-harvest, the unit shape does appear subordinate to the natural landscape character, and by that standard meets the SIO. There is an unavoidable color contrast which will eventually moderate as it greens up.

## Evaluation Results

Projects monitored met designer expectations regarding effects to scenery at the time of this report.

## Action Plan

Monitor the Raven's Roost Trail and Seal Point Recreation Area in the next one to three years for effectiveness of revegetation efforts, erosion control, and the impacts of intertidal wave action.

# 40. Economics

**Goal:** Provide a diversity of opportunities that contribute to the local and regional economies of Southeast Alaska (2008 Tongass Land and Resource Management Plan, [USDA Forest Service 2008b], p. 2-5).

**Objectives:** Work with local communities to identify rural community assistance opportunities and provide technical assistance in their implementation. Support a wide range of natural resource employment opportunities within Southeast Alaska's communities (USDA Forest Service 2008b, p. 2-5).

**Background:** The Tongass National Forest comprises approximately 90 percent of Southeast Alaska's total land base. Over 74,000 people live in 32 communities within Southeast Alaska. These communities use and depend on Tongass resources for economic opportunities (such as commercial fishing and processing, recreation, tourism, wood products, and mining), quality of life (having a sense of place), traditional and cultural uses (subsistence activities), and recreation activities. Forest management decisions can have significant impacts, positive and negative, on these communities.

## Economics Question: *Are the effects on employment and income similar to those estimated in the Forest Plan?*

### Evaluation Criteria

The following employment sectors are used to respond to the economics monitoring question evaluation criteria, to best represent the Tongass National Forest's contribution to the resource-dependant industries of Southeast Alaska's formal economy.

Note, while the monitoring question addresses employment and income, the Economic Impact Analysis group summary in the 2008 Tongass Land and Resource Management Plan Final Environmental Impact Statement (2008 FEIS) Summary of Effects matrix (USDA Forest Service 2008a, p. 2-61) provides only projections of employment for Alternative 6 (the proposed action, and selected alternative), not for associated income. These sector employment estimates are analyzed and presented in detail in the 2008 FEIS beginning on page 3-490, the economic and social assessment. The employment data considered and analyzed within the 2008 FEIS were derived from credible secondary sources who publish data by sector annually (e.g., U.S. Census Bureau, U.S. Department of Labor and Alaska Department of Labor and Workforce Development [Alaska DOL]). Therefore, this monitoring report will only examine employment figures, and will not address income.

- **Lumber and Wood Products –** Actual annual employment estimates for the lumber and wood products industry are compared to the 2008 FEIS projected average annual equivalent direct employment in logging (801 jobs) and sawmills (542 jobs) (USDA Forest Service 2008a, p. 2-61). Note that employment figures are for maximum harvest levels listed in the 2008 FEIS; currently harvest levels are much lower than the maximum allowable. If employment estimates for this sector are similar to the projections in the 2008 FEIS, then effects on employment for this sector are consistent to those estimated.
- **Recreation and Tourism –** Estimated direct employment based on the non-resident share of recreation and tourism are compared with the 2008 FEIS projected direct employment jobs based on the non-resident share of the recreation and tourism (4,319 jobs), (USDA Forest Service 2008a, pp. 2-61; 3-517). Note: The distinction of the non-resident share of recreation is intended to reflect jobs generated by non-resident expenditures on goods and services as comparable to an export industry which functions to bring new jobs into the region (USDA Forest Service 2008a, p. 3-541). The FEIS analysis and Alaska DOL reported data are calculated to an annual average, as seasonal variation in Southeast Alaska tourism-related industry sectors can be extreme from one month to the next, and Alaska DOL does not publish employment data by sector on a

monthly basis.

If employment estimates for this sector are similar to the projections in the 2008 FEIS then effects on employment for this sector are consistent to those estimated.

- **Mining –** Economic effects of the 2008 FEIS, the plan states that Alternative 6 (the selected alternative) represents "little or no change from the allocations [of non-development Land Use Designations] under the 1997 Forest Plan. The effects on future mining employment and income would depend on whether the potentially effected locatable deposits are economically viable in the future." (USDA Forest Service 2008a, p. 3-542). Annual employment estimates in Southeast Alaska for the mining sector will be examined to determine employment trends. If employment trends are stable or improving, the effects on employment for this sector are consistent to those estimated.
- **Salmon Harvesting and Processing –** The 2008 FEIS states, "There is not expected to be any significant change to the commercial fishing or fish processing industries over the next decade [2008-2018] as a result of the National Forest activities" (USDA Forest Service 2008a, p. 3-542). Annual employment estimates for the fishing industry will be reviewed to determine the overall trend in employment. If no significant change exists, then the effects on employment for this sector are consistent to those estimated.
- **Federal Government –** Employment statistics of the federal government across Southeast Alaska is provided for reference purposes. The government sector is the main source of year round employment in all Southeast Alaska communities. In addition annual government employment can serve as an indication of regional economic health, as local government and private sector activities in Southeast Alaska are dependent on government funding to support community industries and the services they provide.

The precision and reliability of employment data is limited by the type and accuracy of data collected by the Alaska DOL. For example, regional industry sector employment statistics exclude self-employed workers, fishers, domestics, and unpaid family workers (State of Alaska 2013). This will affect some employment sector data used in this report, notably, the salmon harvesting and processing, where available employment information is limited to the seafood processing sector and excludes fishers. Additional industry sector employment information is gathered from the 2011 Alaska National Interest Lands Conservation Act (ANILCA) 706(a) Timber Supply and Demand Report to Congress, Statistical Appendix. Some of the ANILCA report data is sourced from Alaska DOL labor statistics. The report mentions that sawmill employment figures are adjusted based on regional mill studies, which take into account self-employed mill owners, starting in 2001 (USDA Forest Service 2011).

## Sampling/Reporting Period

Annual sampling and five year evaluation as described in the 2008 Forest Plan (USDA Forest Service 2008b, p. 6-20).

## Monitoring Results

Economics Table 1 shows the employment figures for the four industry sectors examined in this report from 2008 through 2014. Data sources and additional information are listed in the table footnotes.

**Economics Table 1. Southeast Alaska Region reported annual average employment statistics**

| Industry Sector | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | Average * |
|---|---|---|---|---|---|---|---|---|
| Logging and sawmills[1] | 265 | 216 | 247 | 262 | ------ | ------ | ------ | 248 |

| Industry Sector | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | Average * |
|---|---|---|---|---|---|---|---|---|
| Recreation and tourism[2] | 14,550 | 13,800 | 13,600 | 13,700 | 13,900 | 12,280 | ------ | 13,910 |
| Salmon harvesting and processing[3] | 1350 | 1400 | 1450 | 1600 | 1,600 | 1,274 | 1,276 | 1,480 |
| Mining[4] | 433 | 415 | 536 | 647 | ------ | ------ | ------ | 508 |
| Federal government[5] | 1,800 | 1,750 | 1,750 | 1,700 | 1,650 | 1,500 | 1,500 | 1,730 |

[1] Logging and Sawmills: Data source - Statistical Appendix 2011 ANILCA 706(a) Timber Supply and Demand Report to Congress, Tongass National Forest. Includes only direct employment with the logging and sawmill industries. Note sawmill employment figures are adjusted based on regional mill studies, which take into account self-employed mill owners (USDA Forest Service 2011) and (State of Alaska 2012b).
[2a] Recreation and Tourism: Data source - Alaska DOL Current Employee Statistics (State of Alaska 2014b).
[2b] Recreation and Tourism: Data source - Alaska DOL Current Employee Statistics, Southeast Economic Region: 2013 Workers by Industry (State of Alaska 2014b). Note these data entries include all employment from recreation and tourism related industry sectors see Evaluation of Results for Recreation and Tourism (p. 6) of this report for a full explanation. Data includes the following industry sectors: trade/transportation/utilities, information services, professional and business services, leisure and hospitality, and other services.
[3] Salmon Harvesting and Processing: Data source – Alaska DOL, Fishery Employee Statistics (State of Alaska 2014b). Note most commercial fishers are self- employed so their earnings are not counted by the Alaska DOL. The figures in Table 1 represent employment in the salmon processing only.
[4] Mining: Data source – Alaska DOL, Current Employee Statistics (State of Alaska 2014b). This data is presented to highlight general trends of employment in the mining industry.
[5] Federal government: Data Source – Alaska Department of Labor and Workforce Development, Current Employee Statistics (State of Alaska 2012b; State of Alaska 2015a).
*Since not all data is available for 2012, the average is based on the number of years of available data. For example, logging and sawmills data is not available for 2012 so the average is based on 4 years. Recreation and tourism data is available for 2012 so the average is based on 5 years.

## Evaluation of Results

The evaluation of monitoring results is listed by employment sector. Reported annual average employment data is compared to projected employment figures (if applicable) in the 2008 FEIS.

### *Logging and Sawmills*

As mentioned previously, actual annual employment estimates for the lumber and wood products industry are compared to the 2008 FEIS projected average annual direct employment in the industry. It should be noted the Timber Sale Program Adaptive Management Strategy was employed basing available supply on volume harvested (USDA Forest Service 2008c, p. 64). The Tongass timber sale program is currently at the Phase 1 performance level. Harvest (and employment) is expected to be far below the allowable sale quantity (ASQ) volume and estimated employment in the 2008 FEIS.

*Economics Photo 1. Tonka sort yard*

Economics Table 2 shows the 2008 FEIS maximum allowable sale quantity (ASQ), estimated non-Forest Service System (non-NFS) land harvest, estimated maximum total harvest and projected (first decade) average annual average employment in the logging and sawmill industry sector.

Note that the ASQ and employment figures represent the maximum non-interchangeable component (NIC) I volume that could be harvested under the selected alternative (Alternative 6); figures are not intended to serve as projected harvest levels.

**Economics Table 2. Maximum annual harvest and projected logging sawmill employment[1]**

| | |
|---|---|
| Tongass allowable sale quantity (ASQ) | 236 MMBF[2] |
| Estimated non-NFS harvest (state, private, etc.) | 109 MMBF |
| Estimated total Southeast Alaska timber harvest (NFS ASQ + estimated non-NFS) | 345 MMBF |
| Projected average annual equivalent direct employment at 376 MMBF harvest levels – logging and sawmills | 1,343 employees |

[1] Data source: USDA Forest Service 2008a, pp. 3-527, 3-537
[2] MMBF = million board feet

Economics Table 3 compares estimated industry employment with actual employment. The 2008 FEIS employment projections were based on historic harvest quantities and logging/sawmill sector employment from 2000-2005.

**Economics Table 3. Logging and sawmill annual average employment – actual and projected**

| | |
|---|---|
| Projected annual average 2008 FEIS employment | 1,343 employees[1] |
| 2008-2011 annual average employment | 248 employees[2] |

[1] Data source: USDA Forest Service 2013b
[2] Data source: State of Alaska 2012b

Table 4 shows annual harvest levels for National Forest System (NFS) and non-NFS lands from 2008 through 2014. Non-NFS lands may include harvest on state or private lands. Figure 1 shows both annual harvest levels and 2008 FEIS ASQ and estimated total harvest.

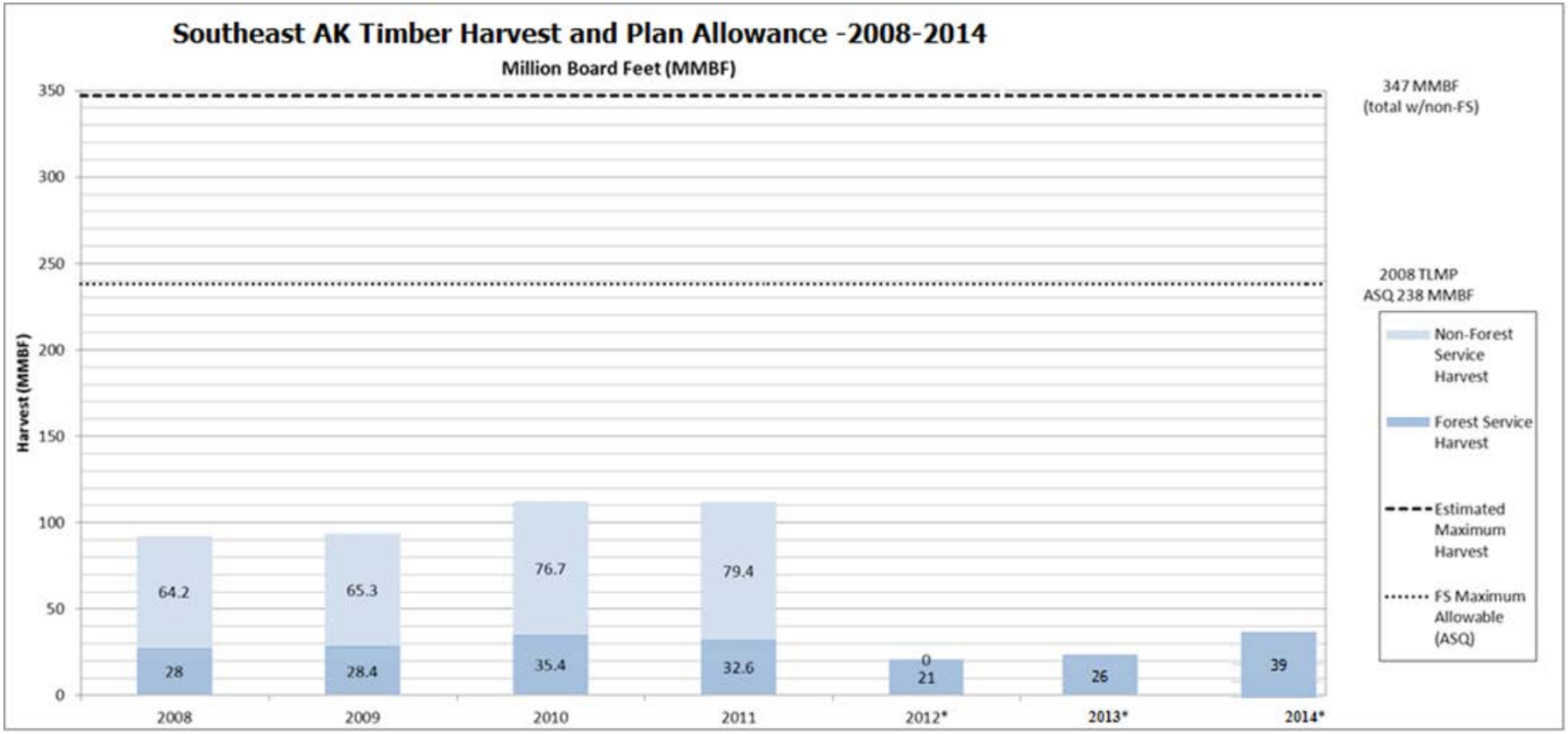
**Economics Table 4. NFS and non-NFS annual harvest for 2008-2012 (in MMBF)[1]**

| Quantities in MMBF | 2008 | 2009 | 2010 | 2011 | 2012* | 2013 | 2014 | Annual average harvest |
|---|---|---|---|---|---|---|---|---|
| NFS only | 28 | 28.4 | 35.4 | 32.6 | 22 | 26 | 39 | 30.2 |
| State and private lands (non-NFS) | 64.2 | 65.3 | 76.7 | 79.4 | ----- | ----- | ----- | 71.4 |
| Total Southeast harvest | 92.2 | 93.7 | 112.3 | 112 | ----- | ----- | ----- | 102.6 |

[1] Data sources: USDA Forest Service 2011 and USDA Forest Service 2014
* Since not all data is available for each year, the average is based on the number of years of available data. For example, Non-NFS land data is not available for 2012 so the average is based on 4 years. NFS land data is available for 2012 so the average is based on 5 years.

*Economics Photo 2. Middle Ridge cabin is constructed from young-growth logs, Wrangell Ranger District*

Current Forest Service harvest levels are within Phase 1 volumes outlined in the 2008 ROD adaptive management strategy. As shown in Figure 1, harvest levels have increased slightly since 2008. Logging and sawmill employment levels have remained fairly stable with minor variations during the same time period. The current level of harvest and industry employment is due to a complex array of factors.




**Economics Figure 1. NFS and non-NFS annual harvest levels (in MMBF) (USDA Forest Service 2011 and USDA). Note: Data does not include Non-NFS because it was not available at time of printing**

In 2010, the Forest Service enlisted the Juneau Economic Development Council to create a cluster-based economic plan for promoting regional growth in certain key industries, including logging and sawmills. The cluster working group approach was used because it is effective in bringing together private sector industry with federal, state and local agencies, as well as other stakeholders. The process resulted in a set of industry-specific action initiatives based on shared economic vision (JEDC 2011). Some of the action initiatives have begun to be implemented including young-growth recreation cabins and biomass heating systems utilizing local wood product waste.

*Economics Photo 3. Naha Trail*

### *Recreation and Tourism*

The projected number of recreation and tourism jobs related to the non-resident share of recreation is indicated in the 2008 FEIS, page 2-61, Table 2-20, Alternative 6. It estimates 4,319 recreation and tourism direct employment jobs. This employment projection was calculated using historical recreation visitor day data and a regional economic model used in the 1997 Tongass Land and Resource Management Plan Final Environmental Impact Statement (USDA Forest Service 1997, p. 3-439). The following language was included in the 1997 FEIS regarding the linear projection approach used to calculate recreation and tourism employment, “Although these assumptions may not accurately reflect underlying economic realities, they were necessary to produce a quantified estimate of the relation between recreation activity and employment” (USDA Forest Service 1997, p. 3-460).

In short, the assumptions and methods used in the 2008 FEIS (based on the assumptions and methods used in the 1997 FEIS) to calculate recreation and tourism employment figures may not accurately represent recreation and tourism employment related to the Tongass National Forest. Rather, the employment projections are intended to provide a quantified estimate between recreation activity and employment for use in comparing FEIS alternatives.

Additionally, Alaska DOL employment statistics are compiled by industry sector and there is no single recreation and tourism industry sector. Employment within this sector is distributed across various related industries such as leisure and hospitality, trade/transportation/utilities and other. No Alaska DOL labor statistic exists to accurately evaluate the identical criteria of employment presented in the 2008 Forest Plan related to recreation and tourism.

With these limitations in mind, the total employment for related industry sectors, which may include recreation and tourism jobs, can be examined for trends in overall employment. This may serve as a general indicator of employment trends in recreation and tourism; the specific reasons for growth or decline are complex and are dependent on many factors outside the effects of the 2008 Forest Plan.

Table 5 shows the Alaska DOL reported annual average employment for industry sectors which may include recreation and tourism employment. These include trade/transportation/utilities, information services, professional and business services, leisure and hospitality, and other services. The data indicates that employment in these sectors has declined slightly but has remained relatively stable over the past five years.

**Economics Table 5. Industry sector employment related to recreation and tourism**

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013[2] | 2014 |
|---|---|---|---|---|---|---|---|
| Total employment | 14,550 | 13,800 | 13,600 | 13,700 | 13,900 | 12,280 | Not available |

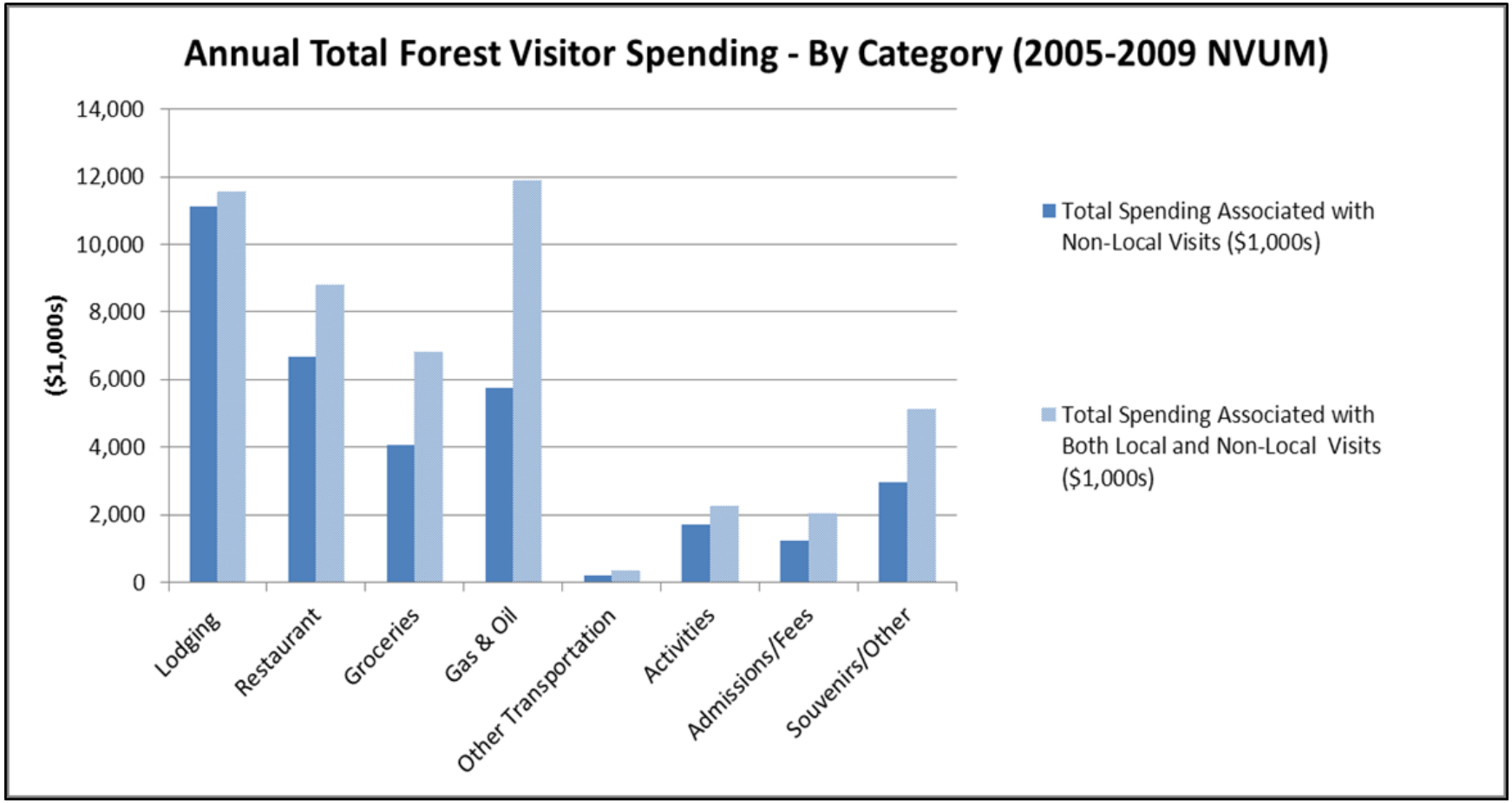
[1] Data source: Alaska DOL Current Employee Statistics (State of Alaska 2010b)
[2] Data source: Alaska DOL Current Employee Statistics, Southeast Economic Region: 2013 Workers by Industry (State of Alaska 2014b).
Note: this data includes all employment from recreation and tourism related industry sectors. Data includes the following industry sectors: trade/transportation/utilities, information services, professional and business services, leisure and hospitality, and other services.

Forest Service National Visitor Use Monitoring (NVUM) is a national monitoring program with a goal of assessing levels of Forest recreation use, demographics of users and economic contributions of Forest visitors. NVUM data was not used in the 2008 FEIS recreation and tourism economic analysis because, at that point, the available data was limited to one year (USDA Forest Service 2008a, p. 3-541). Since then, a second and third round of NVUM monitoring was completed (2005-2009; and 2010-2014) and the data is available for analysis.

NVUM survey data reveals that every 10,000 visitors to the Tongass support 13.7 direct jobs and 17.6 total jobs in Southeast Alaska. By these calculations, recreation visitation estimates on the Tongass (2005-2009) numbering 1,628,294 visits annually supports 2,230 direct jobs and 2,865 total jobs in Southeast Alaska; and (2010-2014) numbering 1,038,000 visits annually, supports 1,422 direct jobs and 1,827 total jobs in Southeast Alaska. The NVUM direct employment figure estimates for both reporting periods, covering annual estimates from 2008-2014, are less than that estimated in the 2008 FEIS (4,319 jobs); however, it should be noted that the methods used to derive these figures are significantly different than those from the 2008 FEIS and the data should not be compared (Alexander 2012).

Additionally, Forest-related economic contributions reported by NVUM include the amount of money spent during visits. Figure 2 shows a summary of 2005-2009 annual visitor spending data from the round 2 NVUM monitoring, as round 3 does not provide data for estimated economic contributions by forest visitor.

The reported annual average employment for industry sectors, which may include recreation and tourism employment, show a slight decline over the past eight years (2008-2014). How this relates to 2008 Forest Plan implementation cannot be ascertained by the type of data reported. Examined employment sectors are complex and depend on many factors including local, state and national economies. The NVUM data provides estimates for economic contributions of the Tongass on the recreation and tourism industry, though employment estimates should not be compared with employment projections provided in the 2008 FEIS.




**Economics Figure 2. Summary of 2005-2009 annual visitor spending data (USDA Forest Service 2009)**

### *Mining*

In reference to possible economic effects of the 2008 FEIS, the plan states that Alternative 6 (the selected alternative) represents "little or no change from the allocations [of non-development Land Use Designations] under the 1997 Forest Plan. The effects on future mining employment and income would depend on whether the potentially effected locatable deposits are economically viable in the future" (USDA Forest Service 2008a, p. 3-542).

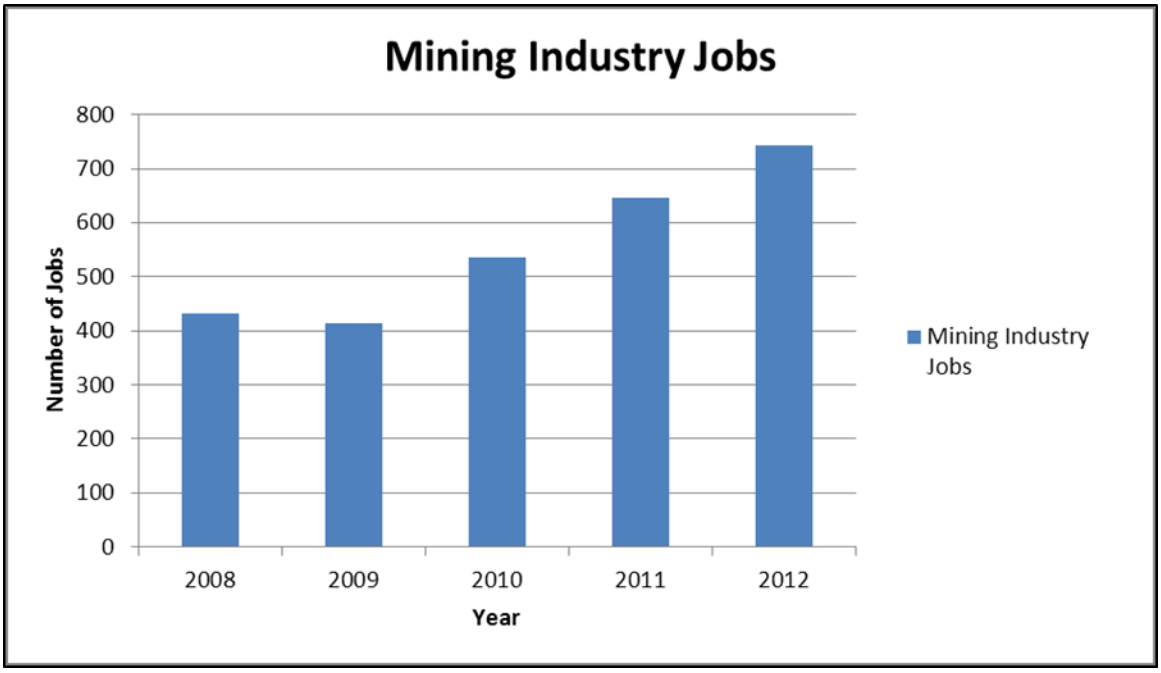
*Economics Photo 4. Greens Creek mine entrance*

Annual Southeast Alaska employment statistics in for the mining sector are available from the Alaska DOL. The possible effects of Forest Service policy on mining employment cannot be easily ascertained. Stability or growth in mining industry employment may indicate that the 2008 Forest Plan is not having a negative effect on the mining industry. Southeast Alaska growth in mining in recent years was mostly from the Kensington mine near Juneau, where employment has leveled off yet exploration continues. Table 6 shows annual average mining employment in Southeast Alaska.

**Economics Table 6. Annual average mining employment[1]**

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013[2] | 2014 |
|---|---|---|---|---|---|---|---|
| Mining industry jobs | 433 | 415 | 536 | 647 | ------ | ------ | ------ |

[1] Data source: State of Alaska 2010b
[2] Data source: State of Alaska 2013b
Note: Alaska DOL reported 2013 mining employment totaled 4,049 jobs statewide (no breakdown of specific Southeast Alaska jobs available)




**Economics Figure 3. Annual average mining employment (State of Alaska 2010b) Note: 2012 data is estimated based on State of Alaska monthly employment numbers and no specific mining employment data available for 2012-2014.**

As the mining table and chart indicate the mining industry has experienced steady growth in the past five years. It is unlikely that this growth is related to 2008 Forest Plan direction but is likely tied to global market demand and prices. The 2008 FEIS indicated that it would have little effect on future mining income and employment and this appears to be the case.

### *Salmon Harvesting and Processing*

The 2008 FEIS states, "there is not expected to be any significant change to the commercial fishing or fish processing industries over the next decade [2008-2018] as a result of the National Forest activities" (USDA Forest Service 2008a, p. 3-542). A review of labor statistics related to salmon harvesting and processing will reveal economic trends; however, current trends in the salmon harvesting and processing employment are more likely a reflection of global market conditions and the related price per pound of fish, rather than a reflection of Tongass management activities. Table 7 shows average annual employment in fish processing related to the salmon harvest. As noted earlier, labor statistics for fishers is unavailable.

**Economics Table 7. Southeast annual average, Alaska salmon processing employment**

| | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|
| Salmon Processing Jobs | 1,022 | 1,086 | 1,218 | 1,293 | 1,274 | 1,726 [2] | ------ |

[1] Data source: State of Alaska 2013
[2] Data source: State of Alaska 2014a

Table 7 shows slight growth in the salmon processing industry over the past five years. While it may be difficult to draw a direct correlation between processing employment and Forest management activities, the 1997 FEIS lists a series of assumption about this relationship that indicates that they may be closely related. The 1997 FEIS states, "it is assumed that 80 percent of Southeast Alaska salmon originate on the Tongass, and thus, 80 percent of the salmon fishing industry is dependent upon the National Forest. The dependence of fish processing employment on the Tongass was derived similarly with the added assumption that salmon represented 60 percent (on volume basis) of the total processed catch. About 48 percent of seafood processing employment is assumed to be dependent upon the Forest" (USDA Forest Service 1997, p. 455). If these assumptions are true, then in regards to salmon seafood processing, National Forest activities may have had a positive effect on the industry. Though, as stated earlier, trends in salmon harvesting and processing are dependent on many factors, only one of which is National Forest activities.

*Economics Photo 5. Salmon*

### *Federal Government*

The government sector is the main source of year round employment in all Southeast Alaska communities. In addition, annual government employment can serve as an indication of regional economic health, as local government and private sector activities in Southeast Alaska are dependent on government funding to support community industries and the services they provide.

**Economics Table 8. Number of federal government employees in Southeast Alaska**

| Industry sector | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | Average * |
|---|---|---|---|---|---|---|---|---|
| Federal government[1] | 1,800 | 1,750 | 1,750 | 1,700 | 1,650 | 1,500 | 1,500 | 1,730 |

[1] Data Source - Alaska Department of Labor and Workforce Development, Current Employee Statistics (State of Alaska 2012b; State of Alaska 2015a)

Although holding steady for the past two years, overall federal government employment has declined since 2008 (Table 8). This may be due to a number of factors including consolidation of positions, lower budgets from Congress, and a decreased number of projects (timber, recreation and road building). Due to the lower federal government employment, some smaller communities may experience difficulty attracting other services and industries (USDA Forest Service 2008a, p. 3-498).

## Action Plan

In the 2008 Forest Plan monitoring plan for economics (p. 6-20), the feedback mechanism is stated as "Evaluate management practices and change, if needed; Rural Community Assistance Standards and Guidelines."

According to the Forest Plan, page 4-55, in "Resource Management Decisions Affecting Communities" the Forest Service should "emphasize, where appropriate, local needs and opportunities for rural community assistance in Forest programs and budgets." Prior to 2011, the Tongass utilized national opportunities made available from the Secure Rural Schools Act and American Recovery and Reinvestment Act to emphasize funding projects for Southeast Alaska needs, with a commitment to include cabins, trails, habitat restoration and local employment.

Beginning in 2009, the Forest Service and other USDA agencies and the U.S. Department of Commerce's Economic Development Administration formalized the USDA Investment Strategy working with Southeast Alaska business industry leaders, tribal government, and non-governmental organizations, and local government agencies, contracted through the Juneau Economic Development Council (JEDC). The partnership analyzed economic opportunities and identified initiatives to improve economic opportunities in Southeast Alaska. This integrated plan is integral to the Tongass' programs, which include multi-year collaborative stewardship, ecological restoration and enhancement, and the updated forest management strategy emphasizing old- and young-growth timber sales (a key component to a transition framework to transition toward young-growth timber sales in the future). To date, these initiatives have included increased watershed restoration for increasing wild salmon production, collaborative emphasis supporting renewable energy development projects and conversion of government agency administrative facilities in Southeast Alaska from oil to renewable energy sources.

In 2013, an additional focus group was created for localizing mining services and supply for Southeast Alaska's Kensington and Greens Creek mines (USDA Forest Service 2013). In 2014, the JEDC was contracted to host the third annual economic innovation summit, where presenters and workshop participants highlighted the continued cooperative resource management and economic development work among community partner organizations, businesses, and USDA multi-agency and Forest Service staff of the Alaska Regional Office and Tongass National Forest.

Based on the monitoring report five-year review (USDA Forest Service 2013), it is recommended that the Tongass continue to monitor economics of the 2008 Forest Plan. Additionally, better ways to monitor the economics should be explored, including using NVUM monitoring. While the Tongass is transitioning from predominately old-growth harvest to young-growth harvest, it is important to monitor the timber industry to determine changes.

## Citations

Alexander, S.J. 2010. Sourdough Notes: How do we love the Forests? Let us count the ways. USDA Forest Service, Alaska Regional Public Affairs. Volume 6, Issue 4, Fall. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5247564.pdf [Accessed September 9, 2015]

Juneau Economic Development Council (JEDC). 2011. Southeast Alaska action initiatives for key economic clusters: Phase 2 of the Southeast Alaska cluster initiative. Prepared for USDA Forest Service by Juneau Economic Development Council. Retrieved: August 10, 2015. http://www.jedc.org/southeast-alaska-action-initiatives-key-economic-clusters-phase-2-southeast-alaska-cluster-initiativ [Accessed September 9, 2015]

Juneau Empire. 2014. Furthering entrepreneurial spirit, innovation. January 24; Opinion: B. Pendleton and J. Nordlundd. Retrieved: June 11, 2015. http://juneauempire.com/opinion/2014-01-24/furthering-entrepreneurial-spirit-innovation [Accessed September 9, 2015]

State of Alaska. 2015a. Monthly employment statistics: Southeast economic region (2014 annual statistics, by industry). AK, Juneau: Alaska Department of Labor and Workforce Development, Research and Analysis Section. Retrieved: June 11, 2015. http://live.laborstats.alaska.gov/ces/ces.cfm?at=60&a=000001&adj=0#y2014 [Accessed September 9, 2015]

State of Alaska. 2015b. Alaska economic trends, Vol. 35(8): Tourism in Southeast (August: ISSN 0160-3345). Alaska Department of Labor and Workforce Development, Employment Security Division website. Retrieved: August 10, 2015. http://labor.alaska.gov/trends/aug15.pdf [Accessed September 9, 2015]

State of Alaska. 2015c. Fishery statistics – participation & earnings: Quartile tables 2014 (salmon: S01A; S03A). Alaska Commercial Fisheries Entry Commission website. February 3, 2015. Retrieved: August 10, 2015. http://www.cfec.state.ak.us/fishery_statistics/earnings.htm [Accessed September 9, 2015]

State of Alaska. 2015d. Information by fishery, commercial salmon catch, effort & value. Harvest information: Alaska commercial salmon harvest & exvessel values, 1994-2013. Alaska Department of Fish and Game website. Retrieved: August 10, 2015. http://www.adfg.alaska.gov/index.cfm?adfg=commercialbyfisherysalmon.salmoncatch [Accessed September 9, 2015]

State of Alaska. 2014a. Alaska economic trends, Vol. 34(1): Employment forecast for 2014 (January: ISSN 0160-3345). Juneau, Alaska: Alaska Department of Labor and Workforce Development, Employment Security Division. Retrieved: June 11, 2015. http://www.labor.state.ak.us/trends/jan14.pdf [Accessed September 9, 2015]

State of Alaska. 2014b. Alaska local and regional information Southeast economic region: 2013 workers by industry. Alaska Department of Labor and Workforce Development website, Research and Analysis Section. August 26, 2014. Retrieved August 21, 2015. http://live.laborstats.alaska.gov/alari/details.cfm?yr=2013&dst=01&dst=03&dst=04&dst=02&dst=06&dst=09&dst=07&r=0&b=0&p=0 [Accessed September 9, 2015]

State of Alaska. 2014b. Alaska economic trends, Vol. 34(11): Seafood harvesting jobs (November: ISSN 0160-3345). Juneau, Alaska: Alaska Department of Labor and Workforce Development,

Employment Security Division. Retrieved: June 11, 2015. http://www.labor.state.ak.us/trends/nov14.pdf [Accessed September 9, 2015]

State of Alaska. 2013a. Chinook salmon stock assessment and research plan, 2013. Alaska Department of Fish & Game Divisions of Sport Fish and Commercial Fisheries, Anchorage, Alaska: ADF&G Chinook Salmon Research Team. Retrieved: August 10, 2015. http://www.adfg.alaska.gov/FedAidPDFs/SP13-01.pdf [Accessed September 9, 2015]

State of Alaska. 2010. Alaska economic trends, Vol. 30(10): Alaska's timber industry: Fallen on hard times (October: ISSN 0160-3345). Juneau, Alaska: Alaska Department of Labor and Workforce Development, Employment Security Division. Retrieved: June 11, 2015. http://labor.state.ak.us/trends/oct10.pdf [Accessed September 9, 2015]

U.S. Bureau of Labor Statistics (BLS). 2015. Quarterly census of employment and wages, frequently asked questions (FAQ) website (Bureau of Labor Statistics of the U.S. Department of Labor). "12. Why are some data unavailable, or marked as ND, NA, or with a dash (-)?" Retrieved: June 11, 2015. http://www.bls.gov/cew/cewfaq.htm#Q12 [Accessed September 9, 2015]

USDA Forest Service. 2015. Natural Resource Manager, National Visitor Use Monitoring (NVUM) website. Tongass National Forest NVUM economics reports (2005-2009 and 2010-2014).

USDA Forest Service. 2014. Region 10 Forest management reports and accomplishments. Retrieved: August 10, 2015. http://www.fs.usda.gov/detail/r10/landmanagement/resourcemanagement/?cid=fsbdev2_038785 [Accessed September 9, 2015]

USDA Forest Service. 2013a. Leader's intent: Forest stewardship and young growth management on the Tongass National Forest. Management bulletin. R10-MB-777. Juneau, AK: USDA Forest Service, Alaska Region. January 2013. Retrieved June 10, 2015. https://fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5408229.pdf [Accessed September 9, 2015]

USDA Forest Service. 2013b. USDA economic diversification in Southeast Alaska (briefing paper). Juneau, AK: USDA Forest Service, Alaska Region. December. Retrieved June 11, 2015. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5366034.docx [Accessed September 9, 2015]

USDA Forest Service. 2012. Collaborative stewardship: Stories from the Tongass National Forest. Progress report. R10-PR-28. Juneau, AK: USDA Forest Service, Alaska Region. April. Retrieved June 10, 2015. https://fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5372414.pdf [Accessed September 9, 2015]

USDA Forest Service. 2011. Statistical appendix 2011 ANILCA 706(a) Timber supply and demand report. Table A-2. USDA Forest Service, Alaska Region. https://fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5349371.pdf

USDA Forest Service. 2010. Natural resource manager, national visitor use monitoring results: Cover pages for user-created reports. November 12. Retrieved June 10, 2015. http://www.fs.fed.us/emc/nris [Accessed September 9, 2015]

USDA Forest Service. 2009. Natural resource manager, national visitor use monitoring (NVUM) website. Tongass National Forest NVUM economics report.

USDA Forest Service. 2008a. Tongass Land and Resource Management Plan. Final Environmental Impact Statement, Plan Amendment, Volume I. Management Bulletin. R10-MB-603c. Juneau, AK: USDA Forest Service.

USDA Forest Service. 2008b. Tongass Land and Resource Management Plan. Management Bulletin. R10-MB-603b. USDA Forest Service, Tongass National Forest.

USDA Forest Service. 2008c. Tongass Land and Resource Management Plan. Record of Decision, Plan Amendment. Management Bulletin. R10-MB-603a. USDA Forest Service, Tongass National Forest.

USDA Forest Service. 1997. Tongass Land Management Plan Revision. Final Environmental Impact Statement. Management Bulletin. R10-MB-338-CD. USDA Forest Service, Tongass National Forest. http://www.fs.usda.gov/detail/tongass/landmanagement/planning/?cid=stelprdb5445359 [ Accessed September 9, 2015]

# 41. Costs and Outputs

The Tongass Land and Resource Management Plan (Forest Plan) includes monitoring requirements to track costs and outputs associated with the allocation used to accomplish Forest Plan objectives.

## Costs and Outputs Question: *What is the trend in outputs and costs associated with those outputs?*

### Outputs

This output information was obtained from the national Performance Accountability System (PAS) Regional Accomplishment by Forest Report for Fiscal Year (FY) 2014. The output tables in some of the previous years followed a different order.

**Cost Table 1. Outputs for FY2014 by resource**

| Resource | FY2014 |
|---|---|
| **Road Maintenance or Construction** | |
| Miles of road decommissioned | 16.2 |
| Miles of high clearance system roads improved | 19.6 |
| Miles of high clearance system roads receiving maintenance | 189.3 |
| Miles of passenger car system roads improved | 22.6 |
| Miles of passenger car system roads receiving maintenance | 375.3 |
| **Planning, Inventory and Monitoring** | |
| Annual monitoring requirements completed | 31 |
| Acres of inventoried data collected and acquired | 4,389,240 |
| Land Management Plan (LMP) amendments underway | 0 |
| Land Management Plan (LMP) assessments completed | 0 |
| **Recreation Management** | |
| Number of heritage programs managed to standard | 1 |
| Acres of National Forest System lands covered by travel management implementation plans | 16,787,000 |
| Recreation site capacity operated to standard (PAOT days) | 63,555 |
| Recreation sites maintained to standard | 288 |
| Recreation special use authorizations administered to standard | 237 |
| Miles of system trail improved | 5.4 |
| Miles of system trail maintained | 203.7 |
| Visitor use monitoring survey days completed | 40 |
| Wilderness areas managed to minimum stewardship level | 19 |
| **Wildlife Habitat Management** | |
| Acres of terrestrial habitat restored or enhanced | 24,319.7 |
| Acres of lake habitat restored or enhanced | 3,236.6 |
| Miles of streams habitat restored or enhanced | 41.8 |
| **Forest Management** | |
| Acres of forest vegetation established | 1,100 |
| Acres of forest vegetation improved | 9,194 |

| Resource | FY2014 |
|---|---|
| Volume of timber sold (CCF [hundreds of cubic feet]) | 219,905.8 |
| **Vegetation and Watershed Management** | |
| Highest priority acres treated annually for noxious weeds and invasive plants on NFS Lands | 57.7 |
| Acres of water or soil resources protected, maintained, or improved to achieve desired watershed conditions | 3,527 |
| **Land Ownership Management** | |
| Acres of land adjustments to conserve the integrity of undeveloped lands and habitat quality | 1.6 |
| Miles of property lines marked/maintained to standard | 12.2 |
| Land use authorizations administered to standard | 319 |
| Number of title management cases administratively completed to standard | 0 |
| Number of land use proposals and applications processed | 121 |
| **Minerals and Geology** | |
| Number of abandoned mine lands (AML) safety risks features mitigated to no further action (sites) | 0 |
| Number of contaminated sites mitigated | 0 |
| Number of geologic hazard sites or areas managed | 2 |
| Number of geologic resource sites or areas managed | 42 |
| Number of mineral operations administered to standard | 34 |
| Number of mineral proposals processed | 5 |
| **Facilities Management** | |
| Number of administrative facilities maintained to standard | 71 |
| Major project list facilities accomplished on time and within budget | 1 |

## Costs

Allocations and expenditures by budget line item are provided for the given fiscal year. Costs associated with outputs will be monitored for a 5-year period and then analyzed to identify trends. This information will show the cost of doing business on the Tongass National Forest.

The following table shows the FY2014 allocations and expenditures.

**Cost Table 2. Allocations and expenditures for FY2014**

| Budget Line Item | Description | Allocated FY2014 Budget | Expended in FY2014 |
|---|---|---|---|
| NFIM | Inventory and monitoring | $2,611,325 | $2,580,589 |
| NFPN | Land management planning | $1,238,140 | $1,232,999 |
| NFMG | Minerals and geology management | $1,104,753 | $1,097,403 |
| NFLM | Land ownership management | $1,398,916 | $1,375,856 |
| NFTM | Forest products | $12,473,164 | $12,485,849 |
| NFRW | Recreation, heritage, and wilderness management | $3,321,906 | $3,386,968 |
| NFVW | Vegetation and watershed management | $3,612,307 | $3,671,739 |
| NFWF | Wildlife and fisheries habitat management | $5,318,848 | $5,443,205 |

| Budget Line Item | Description | Allocated FY2014 Budget | Expended in FY2014 |
|---|---|---|---|
| NFIM | Inventory and monitoring | $2,611,325 | $2,580,589 |
| NFPN | Land management planning | $1,238,140 | $1,232,999 |
| NFMG | Minerals and geology management | $1,104,753 | $1,097,403 |
| NFLM | Land ownership management | $1,398,916 | $1,375,856 |
| NFTM | Forest products | $12,473,164 | $12,485,849 |
| NFRW | Recreation, heritage, and wilderness management | $3,321,906 | $3,386,968 |
| NFVW | Vegetation and watershed management | $3,612,307 | $3,671,739 |
| NFWF | Wildlife and fisheries habitat management | $5,318,848 | $5,443,205 |
| SMSM | Management of national forest lands for subsistence uses | $947,313 | $965,842 |
| WFPR | Fire preparedness | $800,000 | $786,637 |
| CMFC | Capital improvement and maintenance - facilities | $2,742,950 | $2,752,886 |
| CP09 | Capital improvement and maintenance - facility maintenance | $1,467,796 | $1,466,889 |
| CMLG | Capital improvement and maintenance - legacy roads and trails | $416,000 | $412,242 |
| CMRD | Capital improvement and maintenance - roads | $8,221,316 | $8,209,791 |
| CMTL | Capital improvement and maintenance - trails | $1,561,328 | $1,626,675 |
| CMII | Deferred maintenance and infrastructure improvement | $0 | $0 |
| **Subtotal** | **Appropriated Funds** | **$47,236,062** | **$47,495,570** |
| CWKV | Cooperative work, Knutson-Vandenburg fund | $355,204 | $301,984 |
| CWK2 | Cooperative work, Knutson-Vandenburg KV regional projects | $0 | $0 |
| FDDS | Recreation fees - site specific | $3,024,300 | $3,438,959 |
| FDRF | Recreation fees - recreation facilities deferred maintenance | $0 | $0 |
| QMQM | Operations and maintenance of quarters | $440,000 | $473,366 |
| RTRT | Reforestation trust fund | $1,623,275 | $1,189,592 |
| SSCC | Stewardship retained receipts | $192,612 | $19,498 |
| SSSS | Salvage sale fund | $200,000 | $227,977 |
| **Subtotal** | **Permanent & Trust Funds** | **$5,835,391** | **$5,651,376** |
| **TOTAL** | | **$53,071,453** | **$53,146,946** |

Note: Permanent and Trust Funds are not appropriated by Congress. These funds are collected, as well as expended, in accordance with the applicable laws (appropriation language is specific to each permanent and trust fund). These funds are held in specific accounts and unexpended balances can generally be carried over from one fiscal year to the next until expended in accordance with the terms of the authorizing legislation.

NOTE: During FY2014 the USDA legacy Telecommunications Utilities Maintenance System (TUMS) was replaced by two contracts, one with Ameresco for utilities effective February 2014 and one with Manhattan Telecommunications for telecommunications effective January 2014. To implement this change in business operations most efficiently, for appropriated budget line items, allocations and expenditures for utilities and telecommunications payments to Ameresco and Manhattan Telecommunications (approximately $700,000 for FY2014) are now managed at the Regional Office level, i.e., are no longer reflected in the Forest-level allocations and expenditures.

# Appendix A. Tongass-wide Watershed Restoration Effectiveness Monitoring (WREM)

## Summary

Selected reaches will be incorporated into the Tongass-wide Watershed Restoration Effectiveness Monitoring (WREM) program aimed at detecting trends in biota and channel conditions over time using an extensive reach-scale, post-treatment, experimental design (EPT) within a strategic sampling panel stratified by regional channel types. Initial stream habitat assessment data and pre- and post-treatment data are collected during project design and project-level monitoring and will be available for long-term comparisons. The objectives of effectiveness monitoring are to answer the following monitoring questions:

1. Does large wood placement improve habitat in the restored reaches?
   a. Does large wood placement increase frequency, areal extent, and quality of pools?
   b. Does large wood placement increase channel complexity?
   c. Does large wood placement improve stream bank stability?
2. What are the fish characteristics (composition, relative abundance, diversity, and condition) in restored reaches?

A suite of physical habitat and biotic metrics will be used to quantify trends and results will be compared to conditions in similar unmanaged (reference) and managed but untreated reaches to evaluate Tongass-wide trends. This experimental design is preferable to the before-after-control-impact (BACI) design because it is less expensive and time intensive. Additionally, many Tongass restoration projects occur on a reach-scale, and are therefore well-suited to a reach-based design.

## Restoration Goals

Large wood placement in streams

- Maintain and increase pool habitat
- Maintain and increase habitat complexity
- Accelerate recovery of riparian areas and function; reduce timeframe for future input
- Improve stream bank stability

## Scale/Sites

Forest-wide, alluvial stream process groups (FP, MM, stable AF), reaches 20 x channel bed width stratified by channel size. Annually, six randomly selected treatment reaches (from a pooled set) are paired with control and reference reaches based on similarities in morphological features such as length, width and gradient as well as proximity to one another as much as possible.

## Design

The design is an 8-year, rotating panel of three categories, six reaches of each category, stratified by channel size (Tables 1 and 2). Sampling design is based on two coho salmon life cycles. One annually sampled fixed trio will allow for the assessment of trends more rapidly, as well as provide information on natural variability. Additionally, each year a total of five new sites of each category will be sampled. In year 5, the year 1 reaches will be re-sampled.

### Category

- Treated (< 1970s riparian harvest, large wood placement > 2006)
- Managed Control (< 1970s riparian harvest, not restored but suitable for restoration > 2018)
- Reference (un-managed watershed)

### Channel size

- Small (bed width 3 to 10 meters)
- Medium (bed width greater than 10 meters to 20 meters)
- Large (bed width greater than 20 meters, wadeable)

**WREM Table 1. FY2013 Watershed restoration effectiveness monitoring sites**

| Category | Channel Size | Location | Site |
|---|---|---|---|
| Treated | Large | POW | Twelvemile Phase I |
| Treated | Medium | POW | Snipe |
| Treated | Small | POW | Orpheus |
| Treated | Small | Kuiu | Martin |
| Treated | Small | Kuiu | Kadake 2 |
| Treated | Small | Kuiu | Kadake 3 |
| Managed Control | Large | POW | Maybeso |
| Managed Control | Medium | POW | Shaheen |
| Managed Control | Small | POW | Hydra |
| Managed Control | Small | Kuiu | Stone |
| Managed Control | Small | Kuiu | SF Saginaw |
| Managed Control | Small | POW | Tye |
| Reference | Large | POW | Big Creek |
| Reference | Medium | Kupreanof | Towers Dehydration |
| Reference | Small | Kuiu | Hiller |
| Reference | Small | Kupreanof | Towers ZZTop |
| Reference | Small | Kupreanof | Towers Rising Stream |
| Reference | Small | Kupreanof | Tunaheen SlowCole |

**WREM Table 2. FY2014 Watershed restoration effectiveness monitoring sites**

| Category | Channel Size | Location | Site |
|---|---|---|---|
| Managed Control | Small | POW | Falls Creek Tributary |
| Managed Control | Small | Kuiu | Spike Buck |
| Managed Control | Small | Baranof | Suntaheen |
| Managed Control | Medium | Chichagof | Sitkoh Creek |
| Managed Control | Medium | POW | Otter/Cable |
| Treated | Small | POW | Yellowlegs |
| Treated | Small | Kuiu | Hemloop |
| Treated | Small | Baranof | Starrigavan |
| Treated | Small | Baranof | Katlian |

| Category | Channel Size | Location | Site |
|---|---|---|---|
| Treated | Medium | Chichagof | Sitkoh Creek |
| Treated | Medium | POW | Fubar Phase1 |
| Reference | Small | Baranof | Indian River Tributary |
| Reference | Small | Chichagof | Last Ditch |
| Reference | Small | Kuiu | Fairyland |
| Reference | Small | POW | Newlundberry 2 |
| Reference | Medium | Baranof | Salmon Creek |
| Reference | Medium | POW | Elevenmile |

## Physical Metrics

All measurements follow protocols described in FSH 2090.21 unless noted, Table 2. Some data will be coordinated during project-level monitoring for efficiency.

**WREM Table 3. Physical metric data collection**

| Metric | Restoration Monitoring Objective | Notes |
|---|---|---|
| Thalweg profile | Measure habitat complexity | Thalweg points referenced to centerline tape. Water depth added to thalweg profile mid-season 2013. Points collected at defining habitat unit features (pool tail crests and max depths), or every 5 meters using an auto-level (Kaufmann and Faustini 2011, Mossup and Bradford 2006). Determine mean squared error (MSE) of thalweg profile (topographic variation about the mean slope; complexity). |
| Cross section | Measure streambank stability, width/depth ratio | Aim for one every 5 channel widths (at next riffle upstream) |
| Substrate | n/a | Once only to characterize channel, restoration response not anticipated |
| Habitat units | Measure/calculate relative pool area (pool area per total wetted area), pool frequency (Pools per km), and average residual pool depth per average channel bed width | Wetted widths measured for all units concurrent with fish sampling (3 per habitat unit) to determine surface area ($m^2$) |
| Undercut banks | Measure streambank stability | Measure presence of undercut banks deeper than 0.3 meter and longer than 1 meter on either bank. Sum for each bank and divide by the reach length to calculate total undercut bank per meter of channel |
| Large wood | Measure wood counts, clusters, correlate with fish data | Paper data form<br>Count by Tier IV size classes, clusters |

## Biotic Metrics

Captured fish will be anesthetized with Aqui-S before measuring fork length to the nearest millimeter and wet mass to the nearest 0.01 grams. All fish are identified to species and data recorded on datasheets. Metrics and data collection procedures are summarized in Table 4.

**WREM Table 4. Biotic metric data collection**

| Biotic metric | Notes |
|---|---|
| Summer relative juvenile fish abundance | Based on one 90-minute minnow trapping event in small and medium channels; based on snorkel count in large channels. Fish/$m^2$ (relative abundance or density). |
| Summer fish size and structure | Based on minnow trap event to sample subset of fish in reach. Length frequency distribution. |
| Fish species composition (diversity) | Based on above sampling. Number/percent of total species per area measure. |
| Fish species condition factor | Quantitative comparison of the condition of fish between categories based on weight and length by species. Fulton's K (condition). |

# Appendix B. Watershed Restoration Effectiveness Monitoring, FY2014 Progress Report

## Summary

The Watershed Restoration Effectiveness Monitoring (WREM) Project is an 8-year monitoring project designed to evaluate the success of in-stream restoration projects by detecting trends in channel conditions and aquatic biota in select stream reaches. In Fiscal Year 2014, we completed year 2 of the expanded sample design of forest-wide restoration projects. Under this expanded design we sampled 17 reaches (18 targeted) in one of three categories (reference, managed control, and treatment [restoration]) grouped into three channel-size ranges. The total sample size for the first 2 years is 37 reaches.

We sampled physical habitat parameters, fish composition and reach complexity in each of the 17 reaches following published methods discussed below. We held a scientific review of our methods in Fall 2013 with a combined interagency and stakeholder group and a more focused field review in September 2014 with PNW research geomorphologist, John Buffington and retired Tongass hydrologist, Steve Paustian. The latter review produced a final document that details the strengths and weaknesses of our monitoring program and makes recommendations for improvements (Buffington 2015). We will begin to implement the recommendations in FY2015.

## Restoration Objectives

The objectives of effectiveness monitoring are to detect trends in channel condition and abundance, condition, and diversity of aquatic biota that are attributable to stream restoration. The specific monitoring questions (Table 1) are focused on the hypothesis that channels affected by historical riparian harvest have seen an interruption in the supply of large wood. Over time, lack of large wood input led to decreased pool frequency and quality, and a simplification of the stream channel. This is often accompanied by a lack of stream bank stability as legacy riparian root masses decay. Restoration efforts use a combination of instream large wood placement and riparian treatment as a means to improve channel and riparian function. While specific goals vary with each project, large wood is often used to improve pool habitat and increase the overall complexity of the channel.

**WREM Progress Report Table 1. Monitoring questions and the metrics used to answer them**

| Monitoring Question | Metrics |
|---|---|
| Does large wood placement increase frequency, areal extent, and quality of pools? | Relative pool area (pool area per total wetted area), pool frequency (pools per km), and average residual pool depth per average channel bed width |
| Does large wood placement increase channel complexity? | Mean squared error (MSE) of thalweg profile (topographic variation about the mean slope; complexity) |
| Does large wood placement improve stream bank stability? | Length of undercut bank/m |
| What are the fish characteristics (composition, relative abundance, diversity, and condition) in restored reaches? | Species counts expressed as percent of total (composition), fish per $m^2$ (relative abundance or density), number of species (diversity), and Fulton's K (condition) |

## Reach Locations

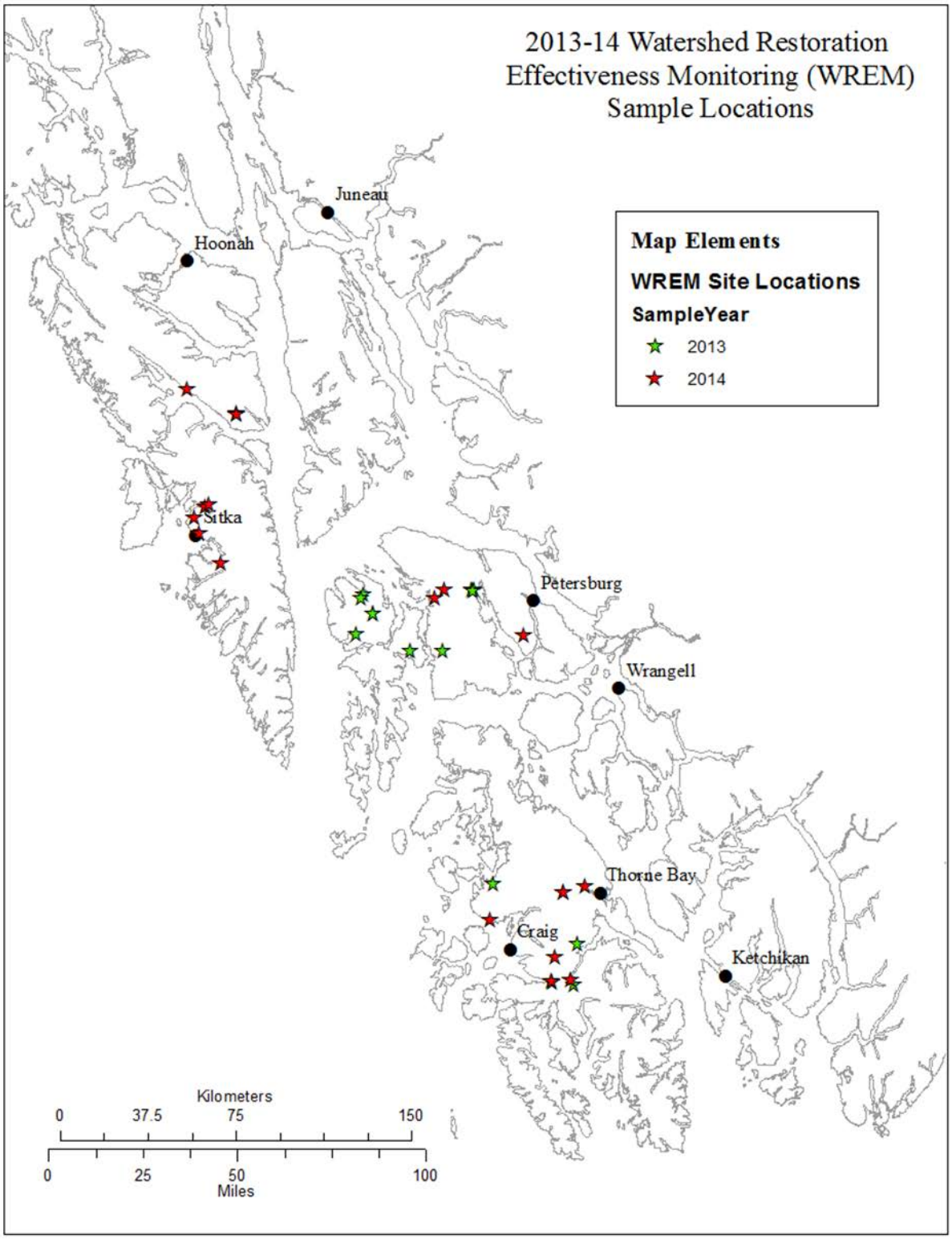
Reaches are located in low-gradient alluvial channels that provide freshwater spawning and rearing habitat for a number of anadromous and resident fish species. The reaches are primarily located on National Forest lands, but adjacent private lands will be used if no suitable sites can be identified elsewhere.

During the 2014 field season, we surveyed 17 streams reaches across the Tongass National Forest. Survey reaches were located on Chichigof, Baranof, Kupreanof, and Prince of Wales Island (Figure 1).

The reaches ranged between 100 and 355 m in length and represent small and medium floodplain (FP) and moderate mixed (MM) channels (Paustian 1992) (Table 2). The reaches were either reference, managed control, or treated, depending upon the management history. The treated reaches were restored between 1995 and 2013.

**WREM Progress Report Table 2. Characteristics of the 2014 WREM surveyed reaches. Reaches are grouped by management category and ordered by increasing width.**

| Reach Name | Channel Type | Management Category | Average width (m) | Reach Length (m) | Gradient (%) | Notes |
|---|---|---|---|---|---|---|
| Falls Ck Trib. | MMS | Managed Control | 2.7 | 105 | 3.7 | |
| Spike Buck | MMS | Managed Control | 3.9 | 105 | 2.39 | |
| Suntaheen | FPS | Managed Control | 7.0 | 143 | 0.5 | |
| Sitkoh Ck | FPM | Managed Control | 10.4 | 200 | 1.74 | |
| Otter/Cable | FPM | Managed Control | 12.5 | 250 | 0.8 | |
| Yellowlegs | MMS | Treatment | 3.3 | 100 | 2.8 | Restored 2011 |
| Hemloop | MMS | Treatment | 3.8 | 100 | 2.9 | Restored 2013 |
| Starrigavan | FPS | Treatment | 4.2 | 100 | 2.1 | Restored 1995 |
| Katlian | FPS | Treatment | 9.1 | 180 | 0.5 | Restored 2003 |
| Sitkoh Ck | FPM | Treatment | 10.3 | 206 | 2.2 | Restored 2003 |
| Fubar Phase 1 | FPM | Treatment | 15.8 | 320 | 1.2 | Restored 2006 |
| Indian R. Trib. | FPS | Reference | 2.6 | 100 | 2.2 | |
| Last Ditch | MMS | Reference | 4.0 | 100 | 3.4 | |
| Fairyland | MMS | Reference | 5,8 | 114.5 | 1.92 | |
| Newlundberry 2 | FPS | Reference | 6.8 | 140 | 1.4 | |
| Salmon Creek | FPM | Reference | 15.6 | 200 | 0.05 | |
| Elevenmile | FPM | Reference | 17.4 | 355 | 0.9 | |




**WREM Progress Report Figure 1. WREM sample locations**

## Methods

The treatment reaches were selected randomly from the set of restoration projects implemented over the last 20 years that met minimum criteria of treatment intensity and documentation. Control and reference reaches were chosen based on location, management history, similarity of channel type and accessibility. The focal reaches are low-gradient alluvial channels that are important salmon spawning or rearing habitat. We define a managed channel as having adjacent riparian harvest and a reference channel as having no harvest adjacent or upstream of the reach. Treated channels are managed channels that have undergone restoration treatments consisting of instream large wood placement. The distinction between treated and restored is that the projects rely on channel forming events to act on placed wood and achieve the restoration goals. We expect that the channels will adjust for years after the implementation.

We followed the Alaska Region Survey Protocol (USDA Forest Service 2001) to complete physical habitat surveys in all 17 reaches. Reach lengths were approximately 20 times the average channel bed-width. Reaches were sampled using the tier three protocol with the following exceptions:

- Large wood was split into twelve categories (three widths and four lengths) following the tier four criteria.
- Longitudinal profiles were measured along the deepest part of the channel (thalweg) using an auto-level to evaluate channel complexity.

Methods for collection of aquatic biota follow published methods as described by Thurow (1994) and an adaptation of Bryant (2000). Summer relative juvenile fish data collection methods are dictated by channel size. For small and medium channels, a single pass 90-minute soak using a sufficient number of 1/8-inch mesh minnow traps and disinfected egg baits placed either in perforated whirlpaks or film canisters. Block nets with 1/8-inch mesh are deployed on either end of the reach to prevent fish movement into or out of the sample reach. Total number of minnow traps used is dependent on the complexity of the sample reach and stream conditions but typically no less than 40 and upwards of 75 traps are used in a reach given that reach lengths are 20 times channel bed width. Based on work by Bryant (2000), probabilities of capture in the first sample occasion of a multiple (3 to 4 passes) sequential removal method range from 50-65 percent. Further analysis of this probability of capture will be conducted using the current forest MIS dataset to provide a better comparison of what we consider relative abundance versus the more traditional full population estimate derived from a multiple pass depletion methodology.

For large channels where it would be difficult if not impossible to saturate the wetted channel sufficiently with minnow traps, underwater observation with snorkeling gear is used to estimate relative fish abundance in pool habitat within a sample reach. Thurow (1994) generally outlines procedures. A two-person snorkel crew counts the number of fish broken out by species and size categories at all or a portion of pool habitat units within the sample reach. Snorkel methodology involves a single upstream pass through a designated pool. After snorkeling, the underwater visibility of each pool during the snorkel count is ranked using a specific scale and pools with a high amount of hiding cover or poor water clarity are dropped from any analysis. To quality check the snorkel data, a subset of pools (10-20 percent) are resampled during the same sample event but leaving sufficient time for fish to settle prior to resampling. By having at least one regular diver conducting all surveys we hope to limit variability. Habitat unit surface area is calculated by measuring total length of the unit and measuring wetted width at three or more equally spaced or best representative intervals. Densities of fish are calculated using an area measure of $m^2$ or 100 $m^2$. For replicated counts, the mean (average density) and variance are calculated, and confidence limits placed around the mean value.

To gather fish length-weight data on the large channels, ten 1/8-inch minnow traps are placed within the reach, after snorkel crews have passed through so as not to bias snorkel counts. Traps are set for 90 minutes using disinfected egg baits.

Fish condition, denoted as K, are calculated using the Fulton condition factor equation (Anderson and

Neumann 1996) and comparisons made on a species basis stratified by management types and channel size. The value of K is influenced by a variety of physical and environmental factors including sex, gut fullness and season. We hope to minimize variability of these influences by sampling at the same time of year and under similar conditions (low flows). Species composition is based on sampling.

## Analysis

The final product of this project will consist of several types of comparisons. These comparisons include trend analysis at individual and group sites, comparative analysis of individual sites to Tongass-wide metrics, and comparative analysis of groups of sites. We expect to improve our analysis methodology through refinement of the study plan over the course of this project.

- Trend analysis will measure the change in specific metrics over time. As this is the second year of a 4-year rotating panel design, we do not have sufficient data for establishing trends at the majority of sites.
- Comparison to Tongass-wide metrics. The Tongass maintains a database of reference sites that is our best estimate of the natural range of variation (NRV) for our habitat objectives. We will compare data collected for this project with the (NRV) to assess the relationship of individual sites to the natural ranges.
- Comparison of group means. We will compare means for specific variables using standard statistical techniques (probably a t-test), developed in consultation with a statistician.

## Preliminary Results

The preliminary results are summarized by reach into a standard suite of metrics known as fish habitat objectives (USFS, 2008). A subset of the fish habitat objectives are the focus of this project and these metrics will be compared over time to reference data for similar channel types.

**WREM Progress Report Table 3. Summary metrics for the 2014 sample set**

| Reach Name | Key Wood | Complexity (MSE method) | Pool Spacing | AveRPD/CBW | Undercut Banks | Relative Pool Area |
|---|---|---|---|---|---|---|
| **Units** | **Piece per meter** | **Average deviation (mean square error) from a linear interpolation of bed slope** | **Number of channel bedwidths per pool** | **n/a** | **Length per meter** | **Pool area per total wetted area** |
| Falls Creek Tributary | 0.13 | 0.03 | 2.77 | 0.09 | 0.14 | 0.32 |
| Spike Buck | 0.05 | 0.02 | 6.77 | 0.10 | 38.00 | 0.26 |
| Suntaheen | 0.07 | 0.03 | 2.54 | 0.07 | 0.22 | 0.72 |
| Sitkoh Creek | 0.06 | 0.10 | 1.93 | 0.05 | 0.17 | 0.51 |
| Otter/Cable | 0.06 | 0.04 | 1.83 | 0.04 | 0.20 | 0.51 |
| Yellowlegs | 0.34 | 0.03 | 3.79 | 0.07 | 0.41 | 0.28 |
| Hemloop | 0.09 | 0.03 | 4.39 | 0.07 | 25.00 | 0.19 |
| Starrigavan | 0.26 | 0.03 | 7.94 | 0.07 | 0.24 | 0.18 |
| Katlian | 0.07 | 0.01 | 0.00 | 0.00 | 0.18 | 0.00 |
| Sitkoh Creek | 0.06 | 0.07 | 0.95 | 0.04 | 0.16 | 0.41 |
| Fubar Phase1 | 0.09 | 0.11 | 4.06 | 0.05 | 0.00 | 0.38 |
| Indian River Tributary | 0.12 | 0.03 | 3.88 | 0.13 | 0.80 | 0.57 |

| Reach Name | Key Wood | Complexity (MSE method) | Pool Spacing | AveRPD/CBW | Undercut Banks | Relative Pool Area |
|---|---|---|---|---|---|---|
| **Units** | **Piece per meter** | **Average deviation (mean square error) from a linear interpolation of bed slope** | **Number of channel bedwidths per pool** | **n/a** | **Length per meter** | **Pool area per total wetted area** |
| Last Ditch | 0.07 | 0.03 | 4.17 | 0.07 | 0.28 | 0.21 |
| Fairyland | 0.11 | 0.08 | 3.30 | 0.05 | 0.33 | 0.71 |
| Newlundberry 2 | 0.06 | 0.10 | 3.41 | 0.46 | 0.07 | 0.64 |
| Salmon Creek | 0.10 | 0.07 | 1.07 | 0.04 | 0.36 | 0.87 |
| Elevenmile | 0.06 | 0.10 | 1.70 | 0.03 | 0.29 | 0.55 |

Biotic metrics will be compared over time as trend analyses (shift over time looking at frequency) and compared to reference and control reach data for similar channel types. Non-parametric statistical analyses will be best suited for use in this case since it is unlikely that the data will have a normal distribution. Again, statistical techniques will be developed in consultation with a statistician. Below in table form are general fish characteristics derived from each sampling event. These are preliminary numbers and further analysis and figure development is underway. Standard deviations calculations as well as other descriptive length and weight stats are forthcoming.

**WREM Progress Report Table 4. Fish characteristics in the 2014 WREM surveyed reaches**

| Reach | Mgmt catagory[1] | Species | Relative density (fish/m$^2$) | Biomass (g/m$^2$) | Mean length (mm) | Mean weight (g) | Condition (K) |
|---|---|---|---|---|---|---|---|
| Falls Ck Trib. | MC | Coho | -- | 0.003 | 29 | 0.85 | -- |
| | | Dolly Varden | 0.07 | 0.32 | 74 | 4.35 | 1.00 |
| | | Cutthroat | 0.92 | 0.56 | 82 | 6.11 | 1.02 |
| Spike Buck | MC | Coho | 0.03 | 0.11 | 65 | 3.66 | 1.20 |
| | | Dolly Varden | 0.02 | 0.30 | 110 | 15.18 | 0.84 |
| | | Cutthroat | 0.03 | 0.64 | 111 | 19.97 | 0.98 |
| Suntaheen | MC | Coho | 0.09 | 0.20 | 53 | 2.23 | 1.19 |
| | | Dolly Varden | 0.07 | 0.40 | 83 | 5.79 | 0.94 |
| | | Sculpin | 0.03 | 0.11 | -- | -- | 1.19 |
| Otter Cable | MC | Coho | 0.04 | 0.16 | 67 | 4.17 | 1.67 |
| | | Dolly Varden | 0.01 | 0.12 | 102 | 10.38 | 0.94 |
| | | Steelhead | 0.01 | 0.16 | 105 | 12.96 | 1.03 |
| | | Sculpin | 0.02 | 0.16 | 81 | -- | 1.11 |
| | | Cutthroat | 0.00 | 0.01 | 121 | 17.09 | 0.96 |
| Sitkoh Ck | MC | Coho | 0.28 | 0.29 | 45 | 2.03 | 1.12 |
| | | Dolly Varden | 0.04 | 0.22 | 80 | 6.33 | 0.97 |
| | | Sculpin | 0.01 | 0.10 | -- | -- | -- |
| | | Cutthroat | 0.01 | 0.04 | 87 | 7.02 | 0.98 |

| Reach | Mgmt catagory[1] | Species | Relative density (fish/m$^2$) | Biomass (g/m$^2$) | Mean length (mm) | Mean weight (g) | Condition (K) |
|---|---|---|---|---|---|---|---|
| Yellowlegs | T | Coho | 0.07 | 0.21 | 59 | 2.92 | 1.19 |
| | | Dolly Varden | 0.003 | 0.03 | 95 | 10.21 | 1.19 |
| | | Sculpin | 0.003 | -- | -- | -- | -- |
| Hemloop | T | Data summary unavailable at time of progress report | | | | | |
| Starrigavan | T | Coho | 0.18 | 0.28 | 50 | 1.58 | 1.12 |
| | | Dolly Varden | 0.18 | 0.67 | 67 | 3.64 | 1.05 |
| Katlian | T | Coho | 0.05 | 0.67 | 47 | 1.45 | 1.07 |
| | | Dolly Varden | 0.05 | 0.15 | 63 | 2.76 | 1.01 |
| Sitkoh Ck | T | Coho | 0.51 | -- | 46 | 2.58 | 1.14 |
| | | Dolly Varden | 0.06 | 0.27 | 80 | 5.05 | 1.00 |
| | | Cutthroat | 0.003 | 0.03 | 94 | 9.49 | 1.00 |
| Fubar Phase1 | T | Coho | 0.05 | 0.11 | 56 | 2.37 | 1.11 |
| | | Dolly Varden | 0.03 | 0.15 | 81 | 4.96 | 0.89 |
| | | Steelhead | 0.001 | 0.12 | 117 | 16.65 | 1.00 |
| Indian R Trib. | R | Coho | 0.70 | 0.89 | 45 | 1.29 | 1.13 |
| | | Dolly Varden | 0.32 | 1.89 | 82 | 5.99 | 0.96 |
| Last Ditch | R | Coho | 0.02 | 0.04 | 54 | 1.92 | 1.15 |
| | | Dolly Varden | 0.27 | 1.41 | 80 | 5.31 | 0.94 |
| | | Sculpin | 0.02 | -- | -- | -- | -- |
| Fairyland | R | Data summary unavailable at time of progress report | | | | | |
| Newlundberry 2 | R | Coho | 0.04 | 0.09 | 57 | 2.40 | 1.16 |
| | | Dolly Varden | 0.03 | 0.16 | 79 | 5.01 | 0.96 |
| | | Steelhead | 0.01 | 0.07 | 78 | 5.27 | 1.12 |
| | | Cutthroat | 0.01 | 0.17 | 101 | 11.90 | 0.99 |
| Salmon Creek | R | Coho | 0.46 | -- | 59 | 3.85 | 1.12 |
| | | Dolly Varden | 0.20 | -- | 80 | 6.16 | 0.56 |
| | | Steelhead | 0.02 | -- | 84 | 6.20 | 0.99 |
| | | Cutthroat | 0.004 | -- | 89 | 7.36 | 0.98 |
| | | Sculpin | 0.002 | -- | -- | 4.64 | -- |
| Elevenmile | R | Coho | 0.10 | 0.52 | 75 | 5.17 | 1.19 |
| | | Dolly Varden | 0.07 | 1.14 | 114 | 15.44 | 0.97 |
| | | Steelhead | 0.01 | 0.18 | 95 | 12.48 | 1.09 |

[1] Management categories are as follows: MC=Managed Control; T=Treatment; R=Reference

## Preliminary Results and Discussion

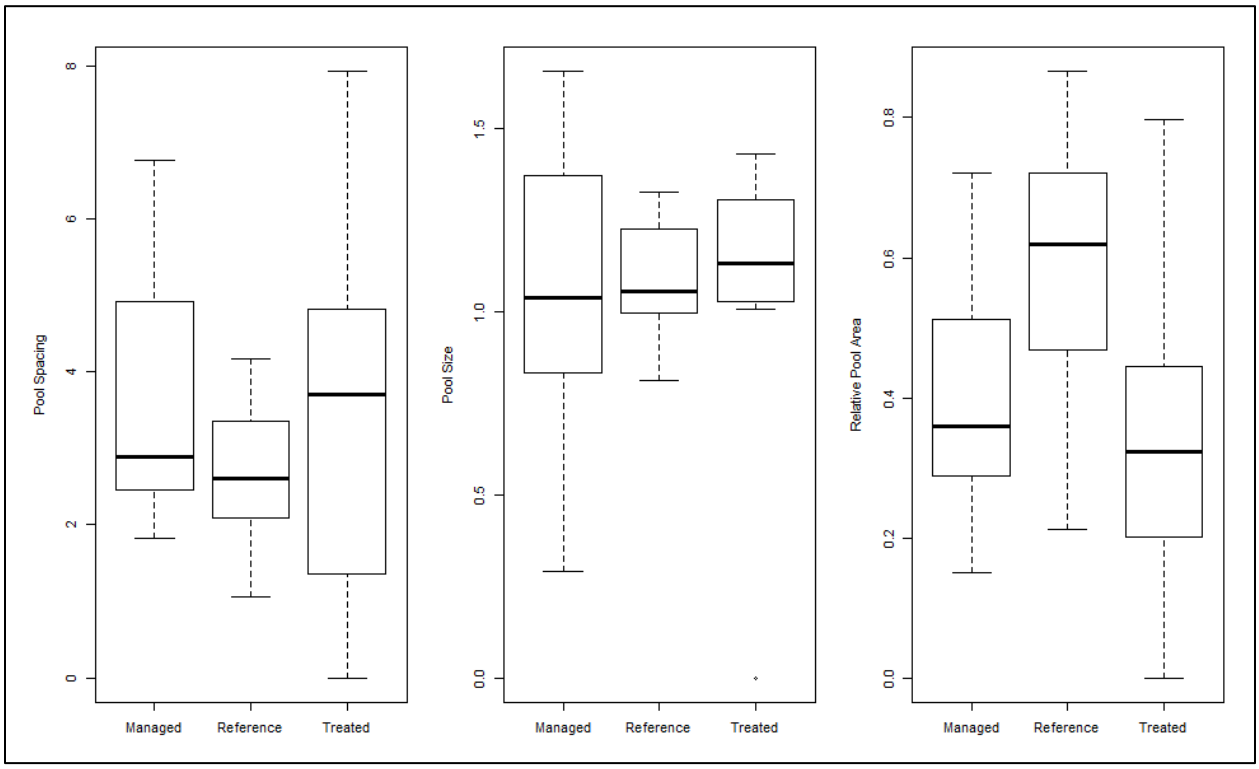
### *Pools*

The distribution and quality of pool habitat is one of the key areas for the project and are core parameters of the Alaska Region habitat survey. Figure 2 shows the reach summaries for pool spacing, pool size and relative pool area for all WREM reaches (n=37) sorted by treatment.

Pool spacing illustrates the distribution of pools throughout the reach in units of channel widths per pool. Higher values indicate fewer, more widely spaced pools (Montgomery 1995). Pool size is a measure of pool quality – average residual pool depth scaled by the reach average bankfull depth. Relative pool area shows the percentage of the wetted stream channel that is in pool habitat.

In each of these summary variables, we hypothesize that we will see differences between the reference condition and that of the managed and treatment categories and over time. The data to date show high variability and no obvious trends. While there appears to be a higher relative pool area in the reference

reach compared to the managed and treated reaches, there remains overlap in all categories. There is less variability in pool size amongst categories than pool spacing or relative pool area; however, the managed reaches remain variable.




**WREM Progress Report Figure 2. Pool summary metrics by management category**

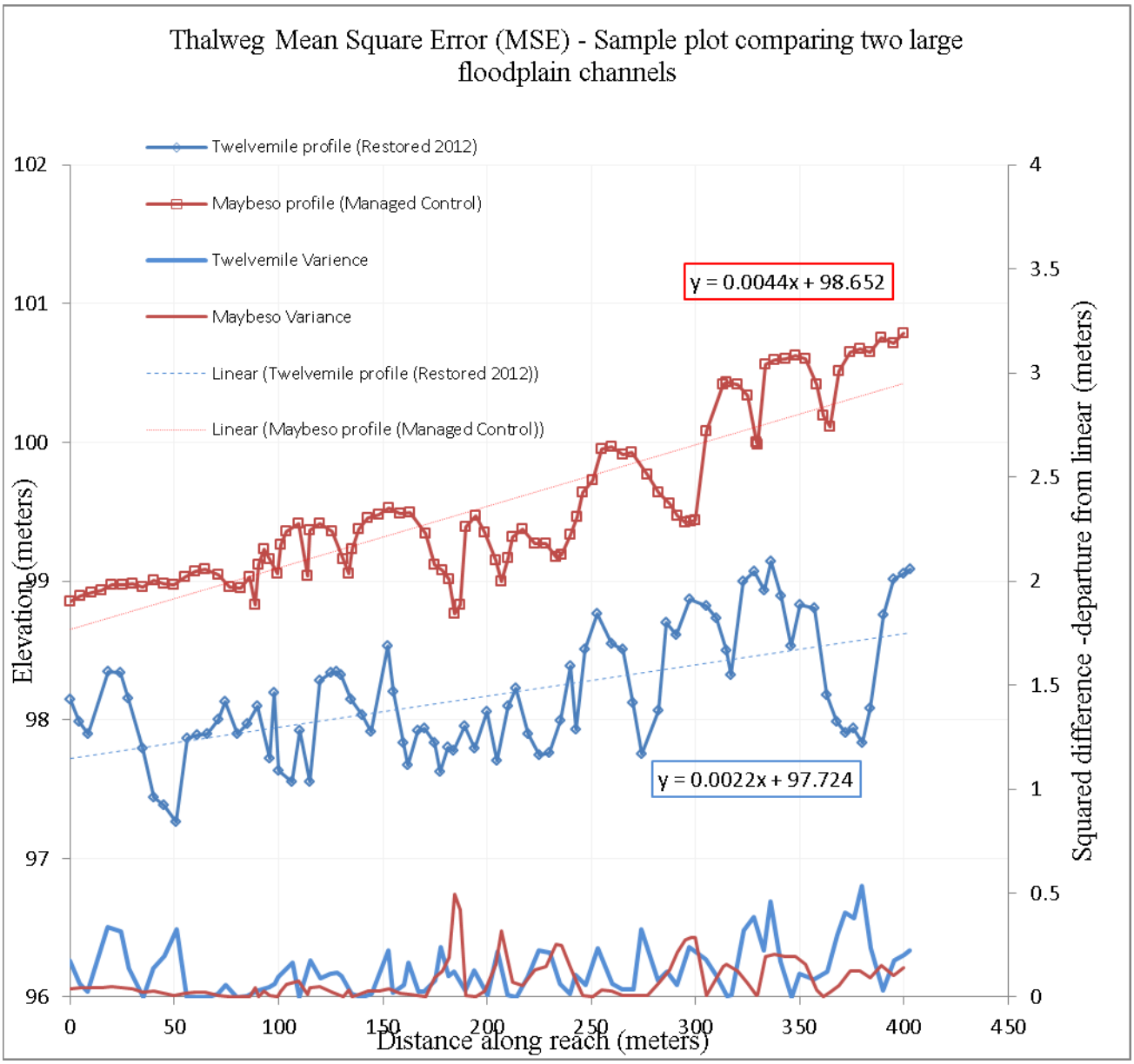
### *Channel Complexity*

We use a thalweg profile to evaluate vertical channel complexity. One method of complexity evaluation is the mean square error (MSE) method (Mossop and Bradford 2006). It defines complexity as the absolute amount of variation in the bed profile (Figure 3) and summarizes this variable as the average of the squared differences between the data and a best-fit line for each data point. Differences in the mean among channels of similar size and gradient (Figure 4) indicate that this technique has promise in differentiating between managed and reference reaches.

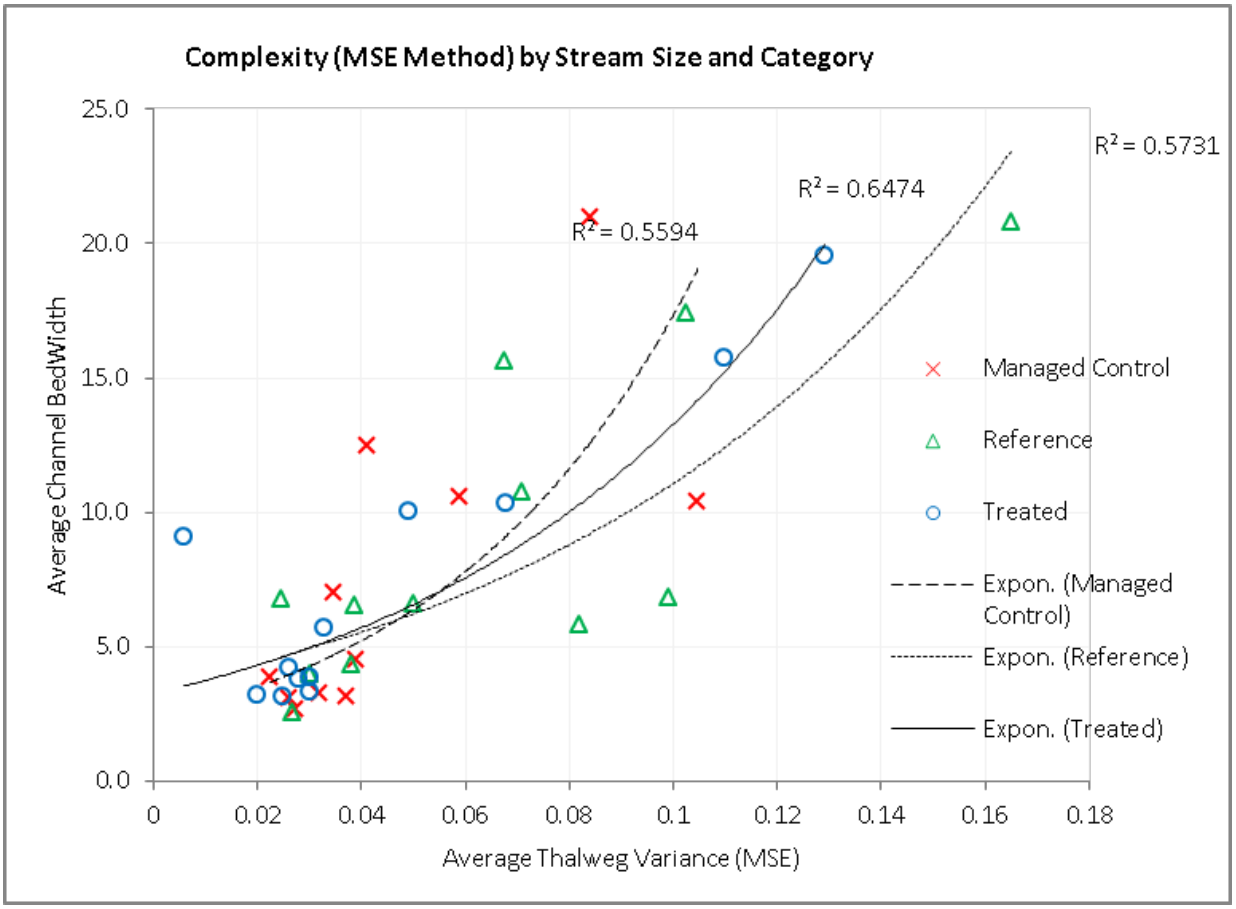
The MSE ranged between 0.01 and 0.11 (Table 3). In all channel sizes and categories there was an increase in MSE with an increase in channel size. The small dataset shows no significant trends at this point however there does appear to be greater MSE per average channel bed width in the reference reaches compared to the managed control and treated reaches.

### *Stream Bank Stability*

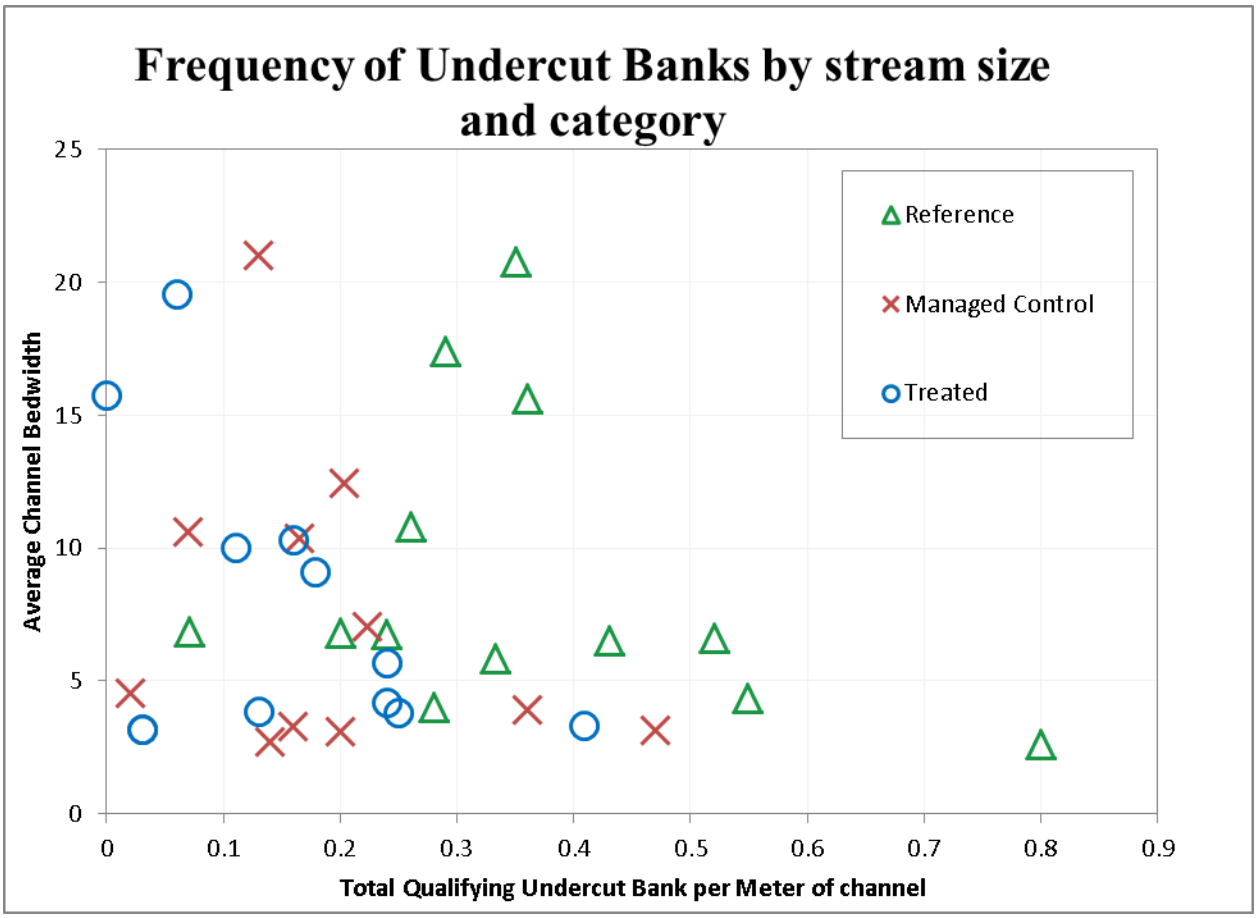
The presence of undercut banks can be used as an indicator of channel stability. We hypothesize that undercut banks are more likely to occur where the channel banks are vegetated and stabilized by roots. Under such stable conditions the stream can erode under the banks without causing bank failure. Reference conditions would have higher values and restored channels would trend towards higher values. This measurement is currently under analysis for feasibility of measurement and sensitivity over the course of the restoration monitoring cycle (Figure 5).




**WREM Progress Report Figure 3. Detail of the channel complexity metric. The upper two line graphs depict the measured thalweg profiles while the lower lines show the squared deviation from the dotted trend lines. Each site is summarized to a single value representing the average of the deviations.**




**WREM Progress Report Figure 4. Complexity measured as the mean squared deviation to a best fit linear trend of the bed profile. This figure emphasizes the difference in total magnitude based on channel width and the differences between different categories.**




**WREM Progress Report Figure 5. Undercut banks 2013-2014**

## Citations

Anderson, R.O. and R.M. Neumann. 1996. Length, weight, and associated structural indices. In: B.R. Murphy and D.W. Willis, editors. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, Maryland. pp 447-482.

Bryant, M.D. 2000. Estimating fish populations by removal methods with minnow traps in southeast Alaska streams. North American Journal of Fisheries Management. 20: 923-930.

Buffington, J. 2015. A review of the watershed restoration effectiveness monitoring program (WREM). USDA Forest Service, Alaska Region, Tongass National Forest.

Montgomery, D.R., J.M. Buffington, R.D. Smith, K.M. Schmidt and G. Pess. 1995. Pool spacing in forest channels. Water Resources Research. 31(4): 1097-1105.

Mossop, B. and Bradford, M.J. 2006. Using thalweg profiling to assess and monitor juvenile salmon (*Onchorhynchus* spp.) habitat in small streams. Canadian Journal of Fisheries and Aquatics Sciences. 63: 1515-1525.

Paustian, S.J., 1992. A channel type users guide for the Tongass National Forest, Southeast Alaska. Technical Paper 26. Juneau, AK: USDA Forest Service, Alaska Region.

Thurow, R.F. 1994. Underwater methods for study of salmonids in the Intermountain West. General Technical Report. INT-GTR-307. Ogden, UT: USDA Forest Service, Intermountain Research Station. 28 p.

USDA Forest Service. 2001. Aquatic habitat management handbook. Forest Service Handbook 2090.21 Chapter 20, R10 Amendment 2090-2001-1. Juneau, AK: USDA Forest Service, Alaska Region.

USDA Forest Service. 2008. Tongass Land and Resource Management Plan. Management Bulletin. R10-MB-603b. Juneau, AK: USDA, Forest Service, Alaska Region, Tongass National Forest.

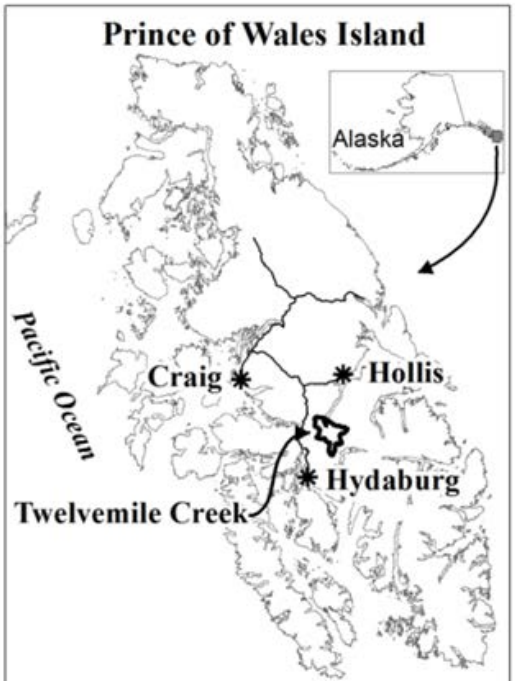
# Appendix C. Twelvemile Creek Juvenile Salmonid Smolt Investigation Summary Report, FY2014

The work captured in this summary report is a component of the overall Tongass Watershed Restoration Effectiveness Monitoring (WREM) program, and while it stands alone as a contribution to the management of anadromous salmonids and their habitat, it also plays a key role within the WREM program.

Enumerating the number of smolts or downstream migrants emigrating from a watershed or a stream reach is a critical parameter for habitat restoration projects for anadromous fishes. Solazzi et al. (2000), Cederholm et al. (1997), Reeves et al. (1997) used downstream migrant traps to estimate the number of smolts produced from stream reaches and watershed restoration efforts. Smolt traps can be an effective tool for assessing watershed-scale success of habitat restoration actions on anadromous fish production and survival. On small streams including tributaries, a weir with downstream migrant trap can be constructed to estimate the number of migrating fish moving out of a particular sub-watershed. Rotary screw traps are used on larger rivers. A five foot rotary screw trap and downstream weirs with box traps were used in the Twelvemile Creek watershed to capture smolt to estimate growth, survival, and a suite of other life history characteristics.

## Investigation Area

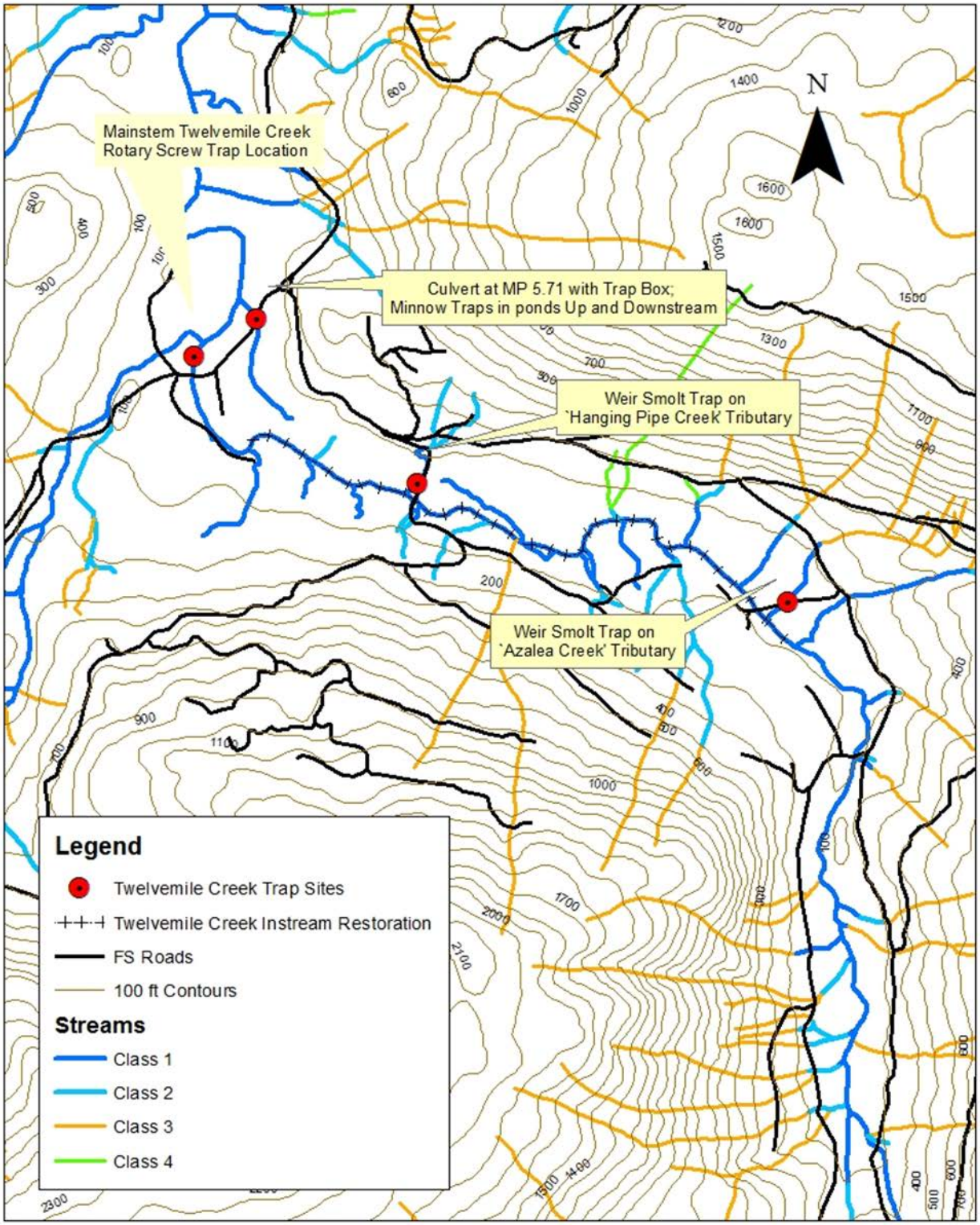
Twelvemile Creek (Photo 1) is located on Prince of Wales Island, southeast of the community of Craig and north of the community of Hydaburg. Twelvemile Creek, (ADF&G Catalog Number 102-60-10720) is listed as a producer of coho, pink, and chum salmon and steelhead trout in the ADF&G Catalog of Waters Important for Spawning, Rearing, and Migration of Anadromous Fishes. A network of forest roads are present, the result of previous timber harvest. Tributary instream log placement projects and riparian thinning were initiated in 2007 and 2012 and mainstem log placement and off-channel reconnections were implemented in 2012-2013.




*Twelvemile Photo 1. Location of Prince of Wales Island and Twelvemile Creek in Southeast Alaska*

The mainstem location of the rotary screw trap allows for nearly complete watershed population estimates such as the majority of coho salmon and steelhead smolt emigrating from Twelvemile Creek, with the exception of the contribution from Cave Creek (tributary of Twelvemile Creek) and a palustrine channel that enters the river opposite from Cave Creek confluence. In addition to the rotary screw trap operation, traps with live boxes were positioned within two small tributary streams in Twelvemile Creek, Azalea Creek and Hanging Creek to capture all outmigrating fish (Figure 1). An additional two traps were placed in lower Twelvemile drainage at outlets of beaver pond complexes which drain into the estuary.

The Twelvemile Creek watershed supports coho, pink, and chum salmon, as well as steelhead and cutthroat trout, and Dolly Varden char. Other fish species include sculpin *Cottus* spp., stickleback and eulachon in the lowest estuary-floodplain transitional mainstem reach.




**Twelvemile Creek Figure 1. Locations of outmigration traps on Twelvemile Creek during 2014**

## Project Objectives

1. Estimate emigrating juvenile coho salmon and steelhead in the Twelvemile watershed (mid-April through the end of May).
2. Document the timing, size, and age distribution of migrating coho salmon, Dolly Varden, and steelhead trout.
3. Coded wire tag (CWT) a portion of the emigrating coho smolts to enable the determination of marine survival and harvest rates for Twelvemile Creek.

Additional tasks for the 2013 field season:

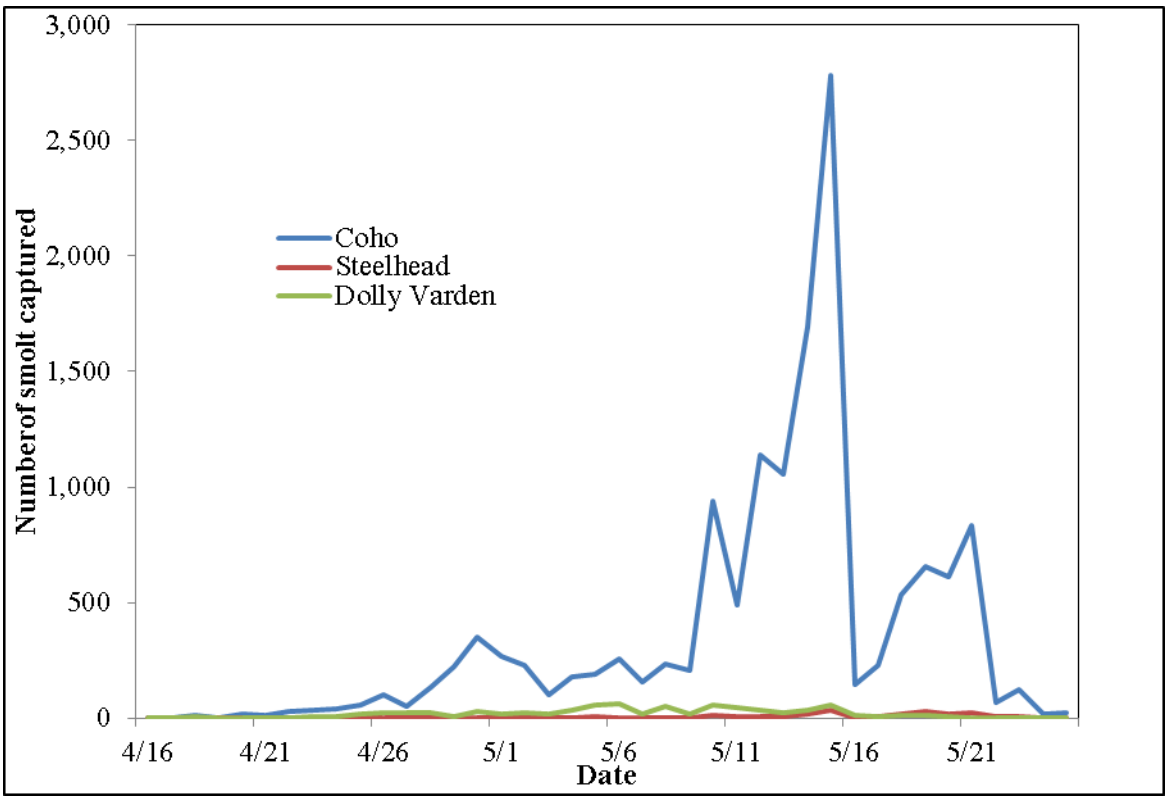
1. Count all salmonids (other than coho and steelhead) encountered at the smolt weirs and screw trap.
2. Count all non-salmonids (i.e., sculpin) encountered at the smolt weirs and screw trap.
3. Weigh and measure any previously PIT tagged fish captured.
4. Determine the condition factor using the fish length and weight data.

In fall 2014, adult coho escapement will be monitored and sampled for marked CWT coho to determine ocean exploitation and survival rates.

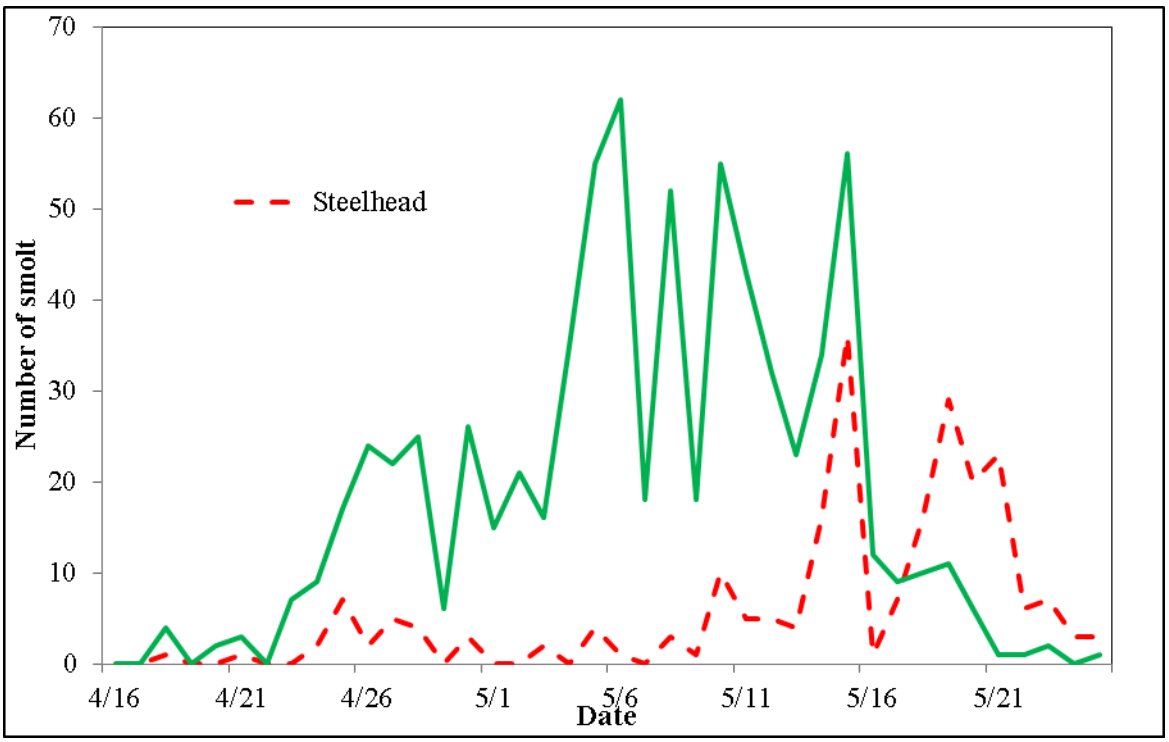
## Draft Results

### *Main Stem Trapping*

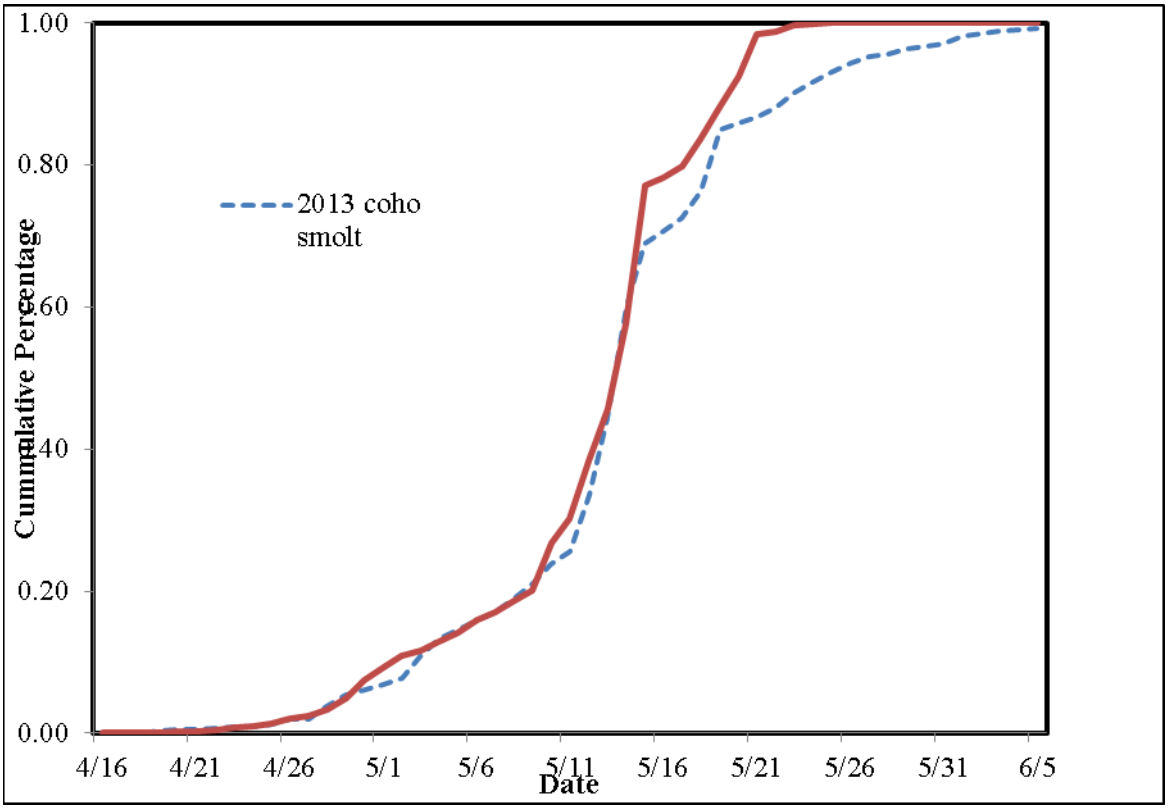
A 5-foot rotary screw trap was operated in mainstem Twelvemile Creek from April 15 through May 25, 2013 during the peak of the coho salmon smolt out-migrant season. Along with the screw trap, juvenile emigrants were also captured at remote locations in the lower Twelvemile drainage. Emigration timing appeared very similar to 2013, assuming the number of smolt captured is somewhat indicative of run timing. A total of 14,199 coho salmon smolt, 205 steelhead smolt, and 733 Dolly Varden smolt were captured in the screw trap (Figures 2 and 3). The total number of smolt captured by the screw trap was higher in 2014 than in 2013 for all three species of smolt; 14,199 vs 8,467 for coho, 205 vs 100 for steelhead, and 733 vs 595 for Dolly Varden (Figure 4). It is unclear at this point if this is due to increased abundance in 2014 or capturing a larger proportion of the emigration, or a combination of the two. A total of 18,309 coho salmon smolt were coded wire tagged in 2014 with 18 post-tagging mortalities for a total of 18,291 tagged coho released.




**Twelvemile Creek Figure 2. Daily number of coho, steelhead and Dolly Varden smolt captured in the screw trap on Twelvemile Creek, 2014**




**Twelvemile Creek Figure 3. Daily number of steelhead and Dolly Varden smolt captured in the Twelvemile Creek screw trap, 2014.**




**Twelvemile Creek Figure 4. The cumulative portion of the 2013 and 2014 Twelvemile Creek coho smolt emigrations captured in the screw trap.**

Because the screw trap fails to sample 100 percent of the water column, only a portion of the total number of downstream migrants are captured. A variety of factors, including changing streamflow, changing fish size, behavior, and species composition can influence the proportion of the total migrant population captured by the trap (trap efficiency). To address this, mark-recapture experimentation utilizing catch and an estimate of trap efficiency on a daily basis were used to estimate species smolt abundance. Recapture rates for coho and Dolly Varden used in efficiency tests were both higher in 2014 than in 2013: 18.3 percent vs 14.3 percent for coho and 5.1 percent vs 1.7 percent for Dolly Varden; but lower for steelhead, 11.0 percent vs 13.0 percent. Catches were expanded based on seasonal trap efficiency estimates and resulted in estimates of 80,677 (SE 2,995) coho salmon smolt; 1,983 (SE 361) steelhead smolt; and 14,794 (SE 2,249) Dolly Varden smolt for the 2014 season. Potential bias lies in some aspects of the trap efficiency assumptions; thus these are considered very general estimates. Overall, the smolt monitoring provided valuable information on species diversity, fish size and condition.

In addition to the screw trap, two box and weir traps were installed within the lower portion of the watershed to capture coho smolt from two beaver pond complexes downstream of the screw trap site. The primary purpose of capturing and tagging these additional coho smolt was to increase the precision and accuracy of a smolt abundance estimate, as well as marine survival and marine harvest estimates, of coho smolt from the Twelvemile Creek watershed. Using a two-event mark-recapture experiment, where marking the smolt with an adipose fin clip is event one, and event two is sampling returning mature fish for marks, abundance of smolt can be estimated using Chapman's modification of the Petersen estimator for a closed population. A total of 18,309 coho salmon smolt were coded wire tagged in 2014 with 18 post-tagging mortalities for a total of 18,291 tagged coho released.

A systematic sample of every 35th coho smolt was measured for length and weight and had a scale sample taken to estimate age. This resulted in an unbiased sample of 405 smolt from the screw trap, 82 smolt from the estuary beaver ponds, and 38 from the culvert beaver ponds. Tables 1 and 2 provide a summary of the length, weight and age data for sampled coho smolt. Scale-derived age data is considered estimated age. Based on circuli patterns and the size of the fish, it was assumed that the specialist who read the scales correctly estimated the age on the vast majority of the samples. Having aged scales in the past with the aid of being able to compare scale samples to 'known age sample', the specialist understood that ages are often over-estimated due to the appearance of a 'false annulus'. It was suspected that the majority of the Twelvemile samples had a false annulus as most of the fish had a small section of tight circuli at about the third circuli.

**Twelvemile Creek Table 1. Estimated age composition, and mean length- and weight-at-age of emigrating coho smolt captured in the screw trap at Twelvemile Creek in 2014.**

| | Age 1 | Age 2 | All smolt[1] |
|---|---|---|---|
| **Sample size** | 342 | 58 | 405 |
| **Estimated composition (percent)** | 85.5 | 14.5 | 100 |
| **SE composition (percent)** | 1.7 | 1.7 | |
| **Mean length (mm)** | 85.3 | 101.0 | 87.7 |
| **SE mean length** | 0.5 | 1.4 | 0.5 |
| **Mean weight (g)** | 6.2 | 10.0 | 6.7 |
| **SE mean weight** | 0.1 | 0.5 | 0.1 |

[1] Includes 5 smolt that were not successfully aged due to regenerated scales.

**Twelvemile Creek Table 2. Estimated age composition, and mean length- and weight-at-age of emigrating coho smolt captured from the beaver ponds (estuary and culvert traps combined) at Twelvemile Creek in 2014.**

| | Age 1 | Age 2 | All smolt[1] |
|---|---|---|---|
| **Sample size** | 97 | 20 | 117 |
| **Estimated composition (percent)** | 82.9 | 17.1 | 100 |
| **SE composition (percent)** | 3.4 | 3.4 | |
| **Mean length (mm)** | 84.9 | 102.2 | 88.0 |
| **SE Mean length** | 0.9 | 2.6 | 0.6 |
| **Mean weight (g)** | 5.5 | 9.7 | 6.2 |
| **SE mean weight** | 1.0 | 1.5 | 0.0 |

[1] Includes 2 smolt that were not successfully aged due to regenerated scales.

### *Tributary Traps*

A weir and box trap were installed in Hanging Pipe Creek on April 15 in about the same location as in 2013. The trap was fished continuously until it was dismantled on May 22. The trap appeared fish tight for the entire season. A total of 16 fish were captured during the season at Hanging Pipe, including 2 steelhead smolt with PIT tags. On most days no fish were captured and the channel was often dry near the trap.

A weir and box trap were also installed at Azalea Creek on April 15. The trap was fished continuously until it was dismantled on May 24. The trap appeared fish tight for the entire season. A total of 686 fish were captured at Azalea Creek for the season, predominantly steelhead parr (44 percent of all fish), followed by coho smolt (22 percent), and Dolly Varden parr (19 percent). Overall, 3 times as many fish were captured in 2014 as the previous year in Azalea Creek.

## Discussion

Project objectives were met during the 2014 field season. Recommendations for 2015 include improve the current study plan, install hobo temperature probes in various locations within the system, consider how best to analyze efficiency data for smolt estimates and compare to mark-recapture event using CWT coho and adult fish captured in the river.

## Citations

Cederholm, C.J., R.E. Bilby, P.A. Bisson, T.W. Bumstead, B.R. Fransen, W.J. Scarlett and J.W. Ward. 1997. Response of juvenile coho salmon and steelhead to placement of large woody debris in a coastal Washington stream. North American Journal of Fisheries Management. 17: 947–963.

Reeves, G.H., D.B. Hohler, B.E. Hansen, F.H. Everest, J.R. Sedell, T.L. Hickman and D. Shively. 1997. Fish habitat restoration in the Pacific Northwest: Fish Creek of Oregon. In: J.E. Williams, C.A. Wood, and M.P. Dombeck, editors. Watershed restoration: principles and practices. American Fisheries Society. Bethesda, Maryland: 335-359.

Solazzi, M.F., T.E. Nickelson, S.L. Johnson and J.D. Rodgers. 2000. Effects of increasing winter rearing habitat on abundance of salmonids in two coastal Oregon streams. Canadian Journal of Fisheries and Aquatic Sciences. 57: 906–914.

# Appendix D. Best Management Practice Trip Reports

# Corner Bay Facility Maintenance, Sitka Ranger District, Tongass National Forest

August 11, 2014

## Background

An interdisciplinary group evaluated best management practices (BMPs) on facility maintenance at the Corner Bay facility. This work was accomplished in 2014. The Corner Bay facility has potable water supplied from a spring or surface source through Alaska Department of Environmental Conservation (ADEC) public water #AK2131139 and AK2131140. The potable water system #152PWS uses raw water collected from upland-upslope creek at an "impoundment on the creek" to intake at a pump house.

## Water System #152PWS

The implementation questions evaluate practices used to minimize water quality impacts.

The pump house collapsed into the "impoundment". This site needs to have material from the creek removed because bedload filled in the impoundment, limiting water collection. This stream is labelled a Class I, anadromous fish stream.

### *Corrective Actions*

Before corrective actions can be taken to fix the pump house and remove bedload from the impoundment, permits will be needed from the Corps of Engineers and concurrence must be received from the Alaska Department of Fish and Game for maintaining this water system in the stream. We may also need the Alaska Department of Natural Resources water rights approval for the stream.

## Corner Bay Septic System #152SS

The current wastewater system is rated at 500 gallons/day in a drain field to meet ADEC requirements to construct and approve operable and new systems with secondary treatment and new drain field as required for "Approval to construct and Approval to Operate".

### *Corrective Actions*

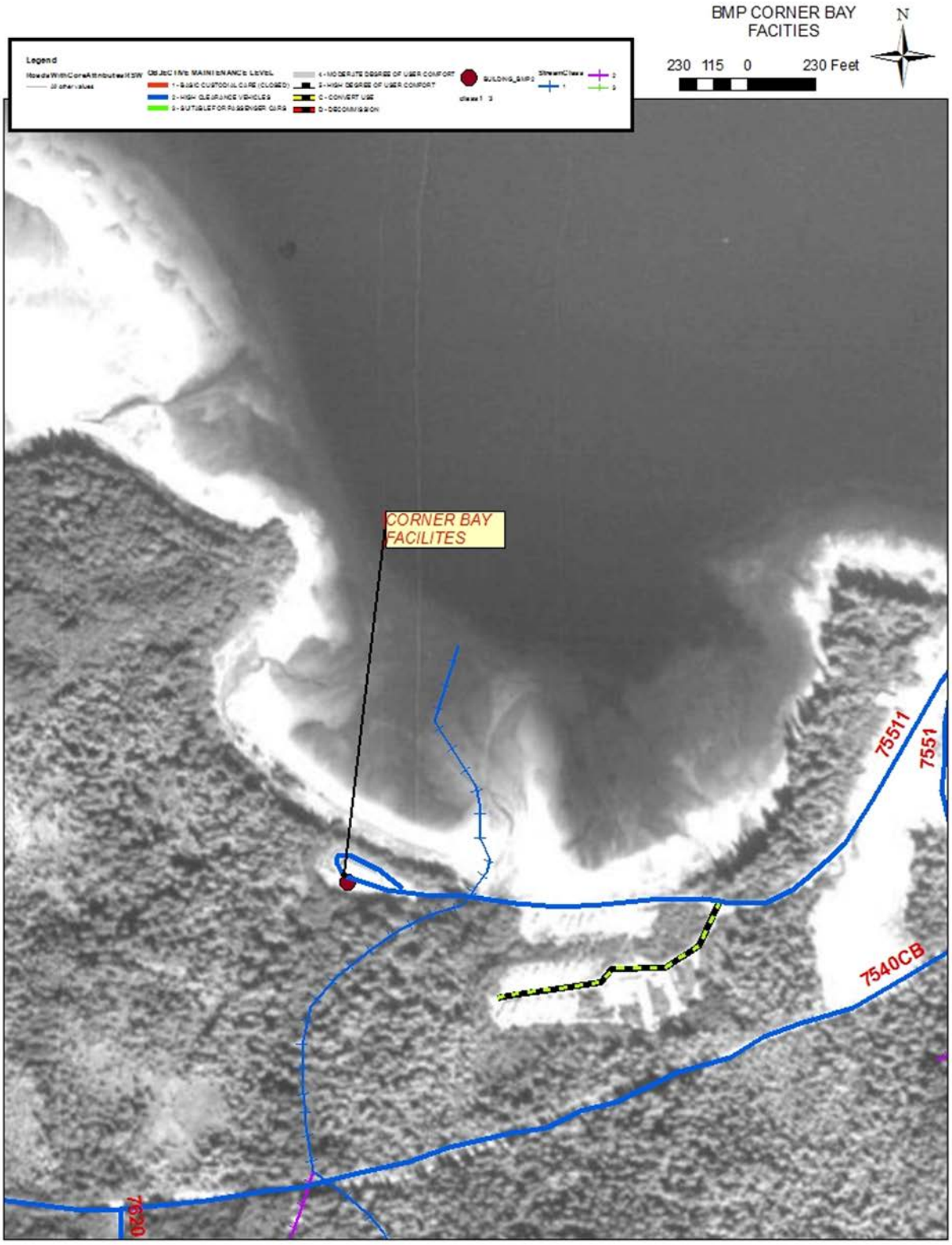
No corrective actions were listed for the septic system.

## Fuel Tanks

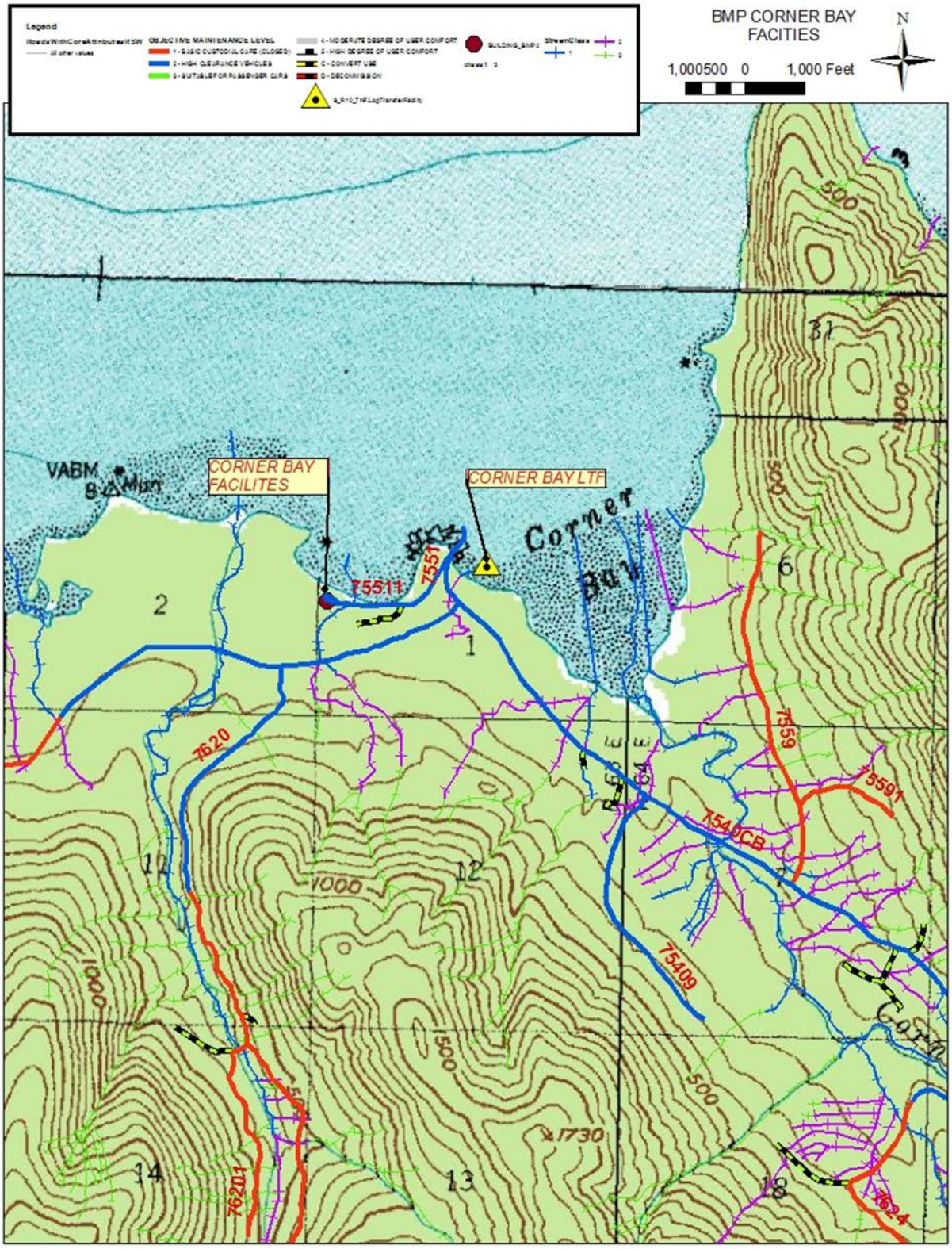
The facility review found that there were two 1,000 gallon double walled fuel tanks filled with sludge. These tanks do not have the potential to affect water quality or aquatic health. There are no leaks from the tanks (Photo 3).

### *Corrective Actions*

Corrective actions were not listed in the review.




**Corner Bay Figure 1. Location map 1 for the Corner Bay facilities located on the Sitka Ranger District**




**Corner Bay Figure 2. Location map 2 for the Corner Bay facilities on the Sitka Ranger District**

*Corner Bay Photo 2. Kitchen facilities*

*Corner Bay Photo 1. Water damage and mold due to roof leak, which has been repaired.*

*Corner Bay Photo 3. Fuel Tank*

*Corner Bay Photo 4. Propane Storage*

*Corner Bay Photo 5. Hazmat sign*

*Corner Bay Photo 6. Used oil container*

# Harbor Mountain, Road 7576, Sitka Ranger District, Tongass National Forest

August 11, 2014

## Background

An interdisciplinary group evaluated best management practices (BMPs) on completed road maintenance (Vaughn Hazel, COR/Engineer; Jackie Foss, Soil Scientist; and Carol Seitz Warmuth, Inventory and Monitoring Coordinator). This work was accomplished on road 7576 in 2014. The Sitka Ranger determined that these actions fall under Categories of Action Excluded from Documentation in an Environmental Impact Statement (EIS) or Environmental Analysis (EA) as established by the Chief, FSH 1909.15.30 (31.1b) #4: “Repair and maintenance of roads, trails and landline boundaries”.

The road is located near Sitka in the vicinity of the Starrigavan Campground. The Harbor Mountain road maintenance is for 3.3 miles from the end of the Benchlands road to the bridge. Portions of this road were covered in a landslide, so part of the contract included removing debris from the road surface and surrounding ditches. This road work was done by a Forest Service contractor and the intent of the work was to provide grading, rolling and ditch cleaning. This road is seasonally-closed with a gate.

## BMP Implementation

The implementation questions evaluate practices used to minimize water quality impacts. All applicable BMPs were implemented during the road maintenance. The contract included blading the roads with a compaction B with roller and the haul and place the slide and slough material away from the site. No spills or leaks occurred on this road segment during maintenance operations.

### *Corrective Actions to Improve Implementation*

No corrective actions were noted for the road maintenance.

### *Adaptive Management Actions to Improve Implementation*

No adaptive management actions were noted for the road maintenance.

## BMP Effectiveness

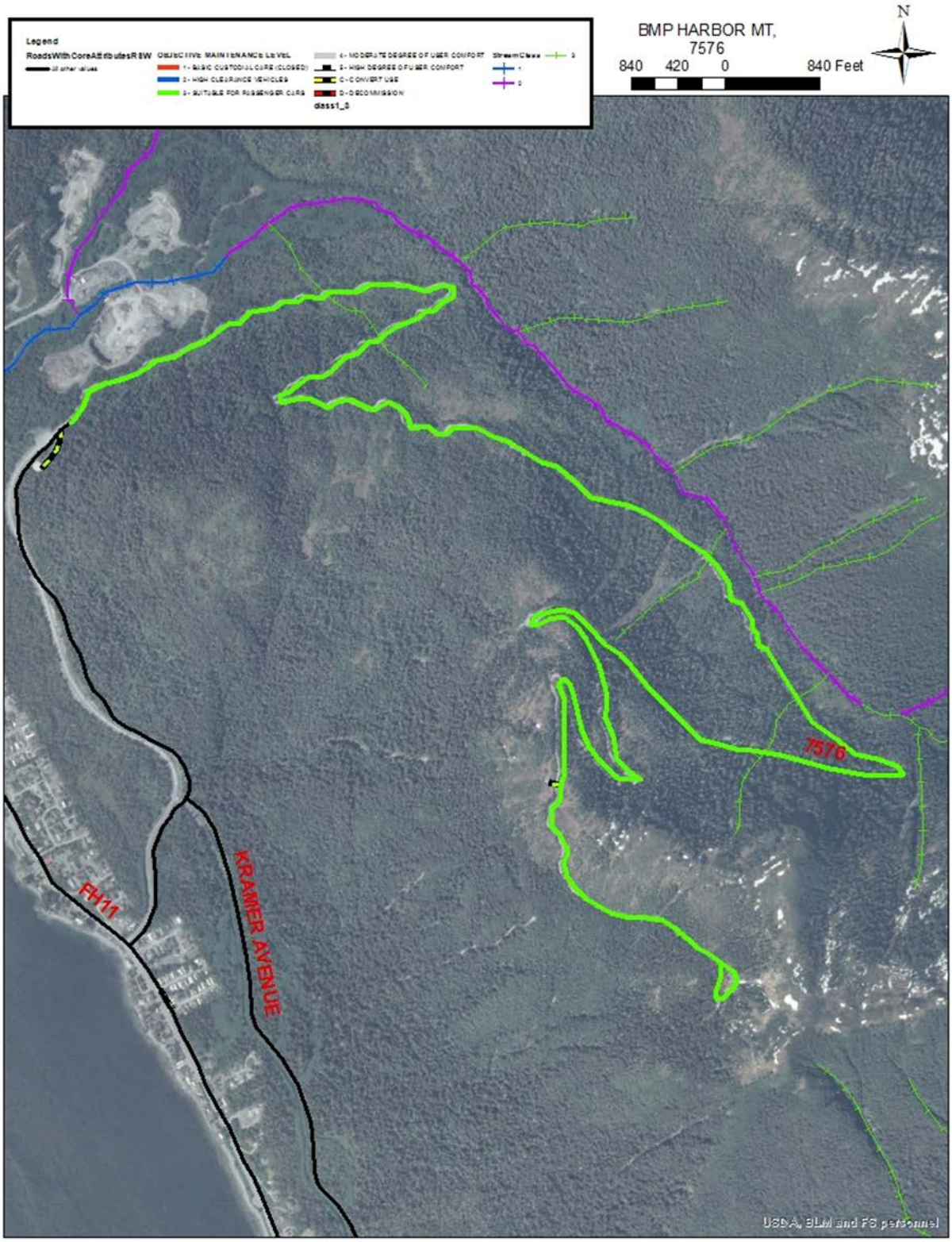
The effectiveness questions evaluated evidence of potential or current impacts to water quality. No evidence of erosion or sedimentation was noted at the water bodies or their approaches.

### *Corrective Actions to Improve Effectiveness*

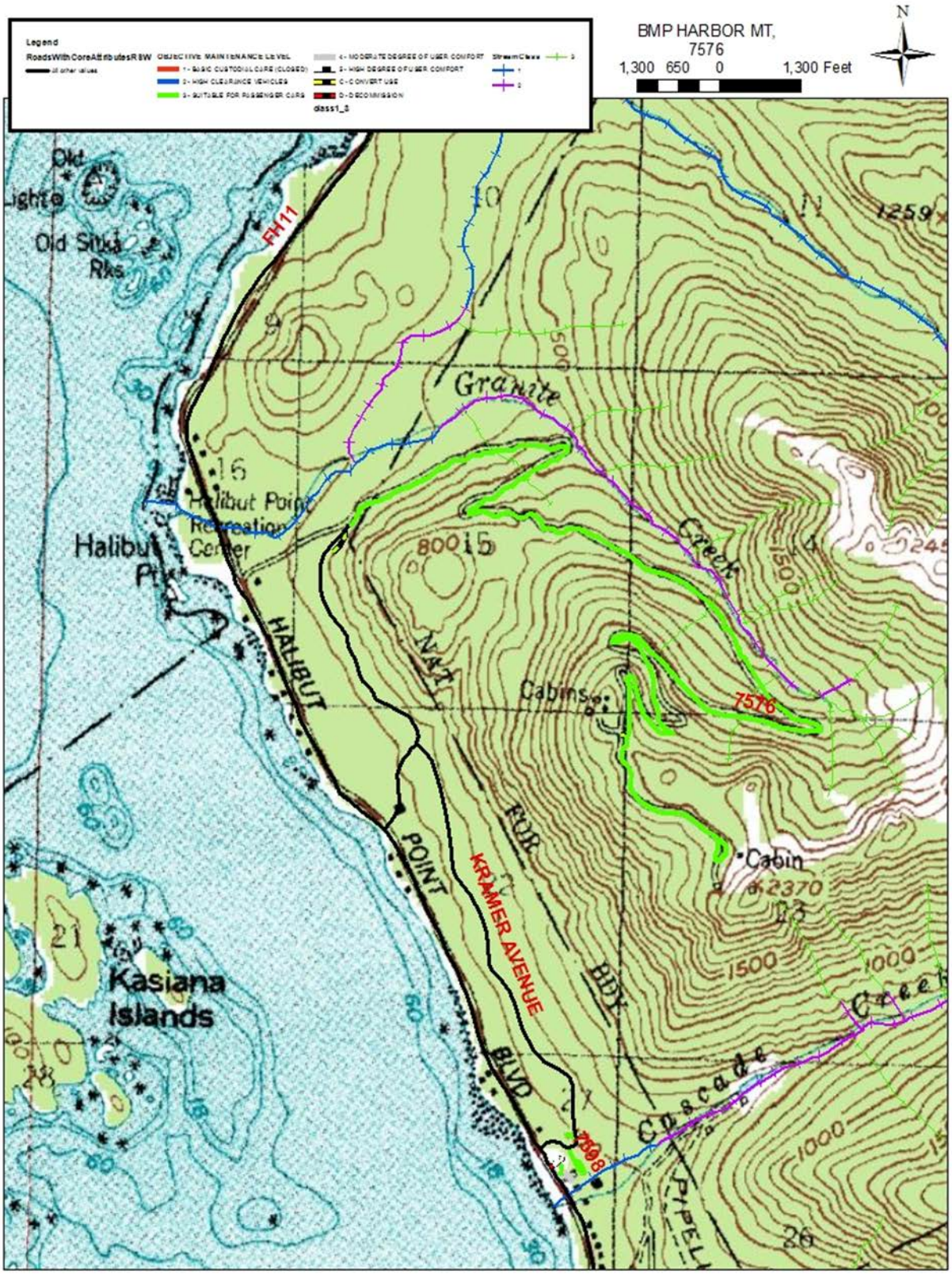
No corrective actions, survey noted that surface was well intact and the road was in excellent condition.

### *Adaptive Management Actions to Improve Effectiveness*

No adaptive management actions were noted.




**Harbor Mountain Figure 1. Construction map 1**




**Harbor Mountain Figure 2. Construction map 2**

*Harbor Mountain Photo 1. Harbor Mountain road 7576*

*Harbor Mountain Photo 2. Harbor Mountain road, looking downslope*

*Harbor Mountain Photo 3. 36-inch corrugated metal pipe (CMP), looking downstream*

*Harbor Mountain Photo 4. CMP looking upstream*

# Kensington Gold Mine, Juneau Ranger District, Tongass National Forest

September 10 and 11, 2014

## Background

Kensington Gold Mine is located in Berners Bay, north of Juneau, Alaska, on the Juneau Ranger District. It was randomly selected in 2014 for Best Management Practices (BMP) review using the National BMP Monitoring Protocol. On September 11, 2014, Katherine Prussian (Forest Service Hydrologist), Brad Orr (Juneau District Ranger), Quentin Smith (Forest Service Engineer), Curtis Caton (Forest Service Minerals Specialist), Sheila Jacobson (Forest Service Fish Biologist), Pete Schneider (Forest Service Fish Biologist), Shilo Williams (Alaska Department of Environmental Conservation [DEC]), and Jeff Hoagland (DEC) performed a Soil and Water BMP review of the Kensington Mine. Matt Reece (Forest Service Minerals Specialist), Will Collingwood (DEC), and David Wilfong (Alaska Department of Natural Resources) also were also part of the office portion of this review but did not participate in the field review. Coeur Environmental Manager, Kevin Eppers, coordinated the transportation on-site, and answered questions from the BMP team. This is the first time the Tongass National Forest has attempted to evaluate BMPs at an active mine using the national protocol. A draft monitoring form was pilot tested by the Interdisciplinary Team (IDT).

The National BMP monitoring protocol suggest using the Mineral A form for the Kensington Mine review. Using this protocol, the group gathered at the Juneau Ranger District on September 10$^{th}$ for 4 hours to discuss the protocol and review the documents. During this review, we looked through planning documents, discussed the history of the mine relative to soil and water practices, and completed the initial 4 pages of the Mineral A form. The following day, the group went to the Kensington Mine for a field review. At the mine, we visited the camp facilities, wastewater treatment facilities, settling ponds, the tailings pond, two leachate locations, graphitic phyllite waste sites (burritos), the mine, several roads and bridges, and the waste dump sites (Comet and Jualin). The focus of the review was the effects of mine operations on soil and water resources. The following topics were considered and discussed: erosion and sedimentation, fuels or hazardous chemicals, heavy metals and/or leachate, sanitary waste, and waterbody alterations. Some photos and dialog from the site visit are included below.

The documents utilized in the review, but not limited to, were the Environment Impact Statement and Record of Decision, Stormwater Pollution Prevention Plan (SWPP) and its amendments, the General Permit, the Kensington Plan of Operations, Kensington BMP Plan, the Quality Assurance and Protection Plan (QAPP), 2013 ADF&G Aquatic Studies Technical Report No. 14-01, Reclamation Plan, and the Tongass Land and Resource Management Plan.

## Erosion and Sedimentation

Erosion and sedimentation are often associated with roads, stream crossings, and any exposed soils or rock such as tailings, waste rock piles, rock pits, etc. At Kensington, road runoff and stormwater are addressed in the Stormwater Protection Plan, also known as the SWPP, which identifies freshwater and stormwater routing, settling ponds, outfalls and other erosion control items.

In most cases, stormwater runoff is routed to drainage ditches, settling ponds, then out through a stilling well and released at designated outfalls. The field review included a subset of drainage ditches and settling ponds. The settling ponds were filtered, surrounded by HDPE liner with silt curtains, and water was released via a stilling well (Photo 2). The settling pond used for snow was an exception – no filter, geotextile, nor stilling well (Photo 6). Several sections of silt fencing were full or failing, and in need of maintenance (Photos 4, 11 and 14). Sediment accumulated in the diversion ditch near Bridge 2 (Johnson Creek) had been cleaned out; however, the sediment was placed along the ditch (Photo 1). These sediments need to be removed and disposed of appropriately (BMP Plan C-64).

*Kensington Photo 1. Drainage ditch along the main road near Bridge 2 across Johnson Creek. Solids from the ditch are excavated and placed on the banks of the ditch.*

*Kensington Photo 2. Settling pond collecting road runoff. Notice the triple filter and HDPE liner around the perimeter. A standpipe at the far end of the pond drains the runoff onto the hillslope below which flows into the surface water creek.*

*Kensington Photo 3. A settling pond at the base of a hill. The settling pond was capturing runoff from the stormwater drainage ditch. A portion of the road runoff was not routing to the settling pond. Note the runoff along the edge of the road that routes to the bridge. Improved road grading could route more of the road runoff to the drainage ditch and /or settling pond.*

*Kensington Photo 4. A silt fence which was full and not capturing all flow.*

*Kensington Photo 5. An example of silt fencing around a curve that was keeping road runoff and turbidity from reaching surface waters.*

*Kensington Photo 6. An old settling pond which was no longer sealed and was leaking. This pond is currently used for snow dumping. The sediments from the snow are not properly filtered using this settling pond.*

The SWPP indicates freshwater and stormwater drainage in Figures 1-12. In most cases (of those visited) the plan had been implemented on the ground. An exception was noted near the lower batch plant area just up-road of the Johnson Creek Bridge 2 crossing. In this location there is a culvert which flows directly into Johnson Creek. There is a silt fence across the stream mid-way down the slope (Photo 10). The silt fence was put in place to reduce the velocity of the water and prevent erosion from occurring early in the spring when there is no vegetation present. The SWPP shows no direct runoff (freshwater nor stormwater drainage) going into Johnson Creek at this location. Instead, stormwater is routed to the Batch Plant fines pond, then to outfall 5, and freshwater is routed to Outlet #5.

Turbid waters were identified in wetland ponds downstream of a settling pond and adjacent to Johnson Creek (Photo 10). The source of the sediment was not confirmed; however, likely sources included the road or the settling pond (both located within 50 feet of turbid waters). The turbid waters were within the riparian area of Johnson Creek.

All bridges had filter material across the entire bridge; however, sediment was reaching surface waters (below the bridge) in two locations (Photos 7 and 9). In both cases, road runoff was directed to the bridge with no relief, hence the runoff transports sediments to the bridge, where it settles out and may work its way through the filter.

*Kensington Photo 7. Bridge over Upper Sherman Creek, a resident fish stream.*

*Kensington Photo 8. Bridge over South Fork of Sherman Creek, a resident fish stream.*

*Kensington Photo 9. Bridge over Johnson Creek, a resident fish stream.*

*Kensington Photo 10. Turbid waters adjacent to Johnson Creek, just upstream of the Johnson Creek bridge. Exact source of this turbidity was difficult to determine, but could have been the road runoff or settling pond.*

The log stringer bridges on the Comet side (No Name Creek and Sherman Creek) were in various stages of structural failure (which could be lending to the sedimentation under the bridge). A 2013 report (Quentin Smith) indicates structural concerns of these bridges and suggests replacement for both safety and water quality purposes. Kevin Eppers said the bridges are identified for replacement; however, had no idea when they would be replaced. Coeur did not receive copies of the 2013 report and have not seen water quality impacts in their routine water quality testing, so they assumed the bridges were not of an immediate concern.

*Kensington Photo 11. Failed silt fencing on a creek draining directly into Johnson Creek. The source was a culvert draining from the batch plant area. The silt fence was put in place to reduce the velocity of the water and prevent erosion from occurring early in the spring when there is no vegetation present.*

*Kensington Photo 12. The bench at the lower end of the development rock pile.*

Turbidity and road sedimentation was seen at the termination of the inboard ditch in the Slate Cove area. The ditch ended in the parking lot for the marine facility. Stormwater drainage in this area is designed (per SWPP) to terminate into a French drain infiltration area. It appeared to be either not implemented or not fully effective because runoff and sediment were entering the marine waters of Slate Cove in this location (no photo). A settling pond or some sort of improved filtration in this location would reduce sedimentation into Slate Cove.

Sediment and waste rock from the Comet Portal Development rock pile extend into Ophir Creek (Photos 12-14). The Comet Portal development rock pile is an extension of the pre-existing Kensington development pile. This

large, steep, waste rock pile extends to the edge of the Ophir Creek, a resident fish (Dolly Varden char) stream (see ADF&G Aquatic Studies at Kensington Mine, 2013 for more information). The riparian area for this channel type (alluvial fan) would generally be 100-140 feet in width. A topographic bench was evident (Photo 12); however there was no buffer between the surface waters of Ophir Creek and the base of the development pile (Photo 13).

The SWPP (Figure 12, SWPP) show silt fencing extending approximately 1000 feet along the toe of the Comet development rock pile. There was some silt fencing in this location; however, it was not maintained and had partially fallen down. The extent of the silt fencing appeared to be less than the designed length in Figure 12 of the SWPP. Maintenance of the silt fencing may reduce potential for silts and sediment to enter Ophir Creek.

Stormwater drainage, as seen in Figure 12 of the SWPP, is supposed to be routed across the base of the Comet Development Pile to a catchment basin near the Comet settling ponds. There was no evidence of an effective stormwater diversion across the base of the development pile; rather it appears that drainage from the development pile flows downhill into Ophir Creek and the adjacent wetlands. The bench at the lower end of the development rock pile.

*Kensington Photo 13. This photo shows and the lack of riparian buffer between Ophir Creek and the development rock pile. The people are standing on the bench at the lower end of the rock pile. Ophir Creek is in the trees on the right side of the photo.*

*Kensington Photo 14. Silt fencing between the rock pile and Ophir Creek. Ophir Creek appears to be an alluvial fan type channel which carries a high volume of rock naturally. There is no effective buffer between the rock pile and Ophir Creek.*

## Fuels or Hazardous Chemicals

All of the fuel storage areas seen on the field trip included secondary containment. However, in some cases the secondary containment contained water which minimizes the volume of secondary containment available. These sites need to be drained daily or covered from rainfall to maintain effective use of the secondary containment.

*Kensington Photo 15. Fuel storage facilities. Notice the water in the secondary containment. The tank is dual walled and does not require secondary containment. The low volume containment is not intended to capture a leak from the tank. It's intended to capture a spill during the filling of the tank. The water is extracted prior to filling the tank.*

*Kensington Photo 16. Fuel storage facilities.*

*Kensington Photo 17. The secondary containment in this picture was no longer working; however, Kevin said that the container was no longer used for hazardous materials storage.*

A fuel spill had occurred on the ramp leading to Lynn Canal beach on the Comet Side. This spill was reported on July 24, 2014 (personal communication Shilo Williams, DEC). The contaminated material had been excavated and was stockpiled nearby. Results of soil samples taken on August 13, 2014 led to additional excavation. The contaminated soils were covered, and Kevin said they were waiting for agency direction regarding disposal of the material.

*Kensington Photo 18. Fuel spill in the tidal area of Lynn Canal. The contaminated material is under the white cover (upper left portion of photo) and the excavated site was covered by the black material (middle of photo).*

*Kensington Photo 19. Beach along Lynn Canal. Photo taken from the ramp where the spill occurred.*

## Heavy Metals and/or Leachate

Leachate was seen in the Lower Slate Lake area of the mine. Lower Slate Lake is used for tailings deposition. The lake is dammed to accommodate tailings, while freshwater and stormwater are diverted around the lake. Two of the three (planned) levels of the dam have been implemented. A third level is planned to be constructed in the future. Timber harvest has occurred around the perimeter of the lake and an access road was developed. There was no evidence of excessive erosion in the harvested area, nor along the road. The road had been contoured along the western edge. There is an access road to the north end of Lower Slate Lake tailings treatment facility (TTF), along the eastern edge of the lake, and to the dam and lime treatment plant on the south end of the lake.

The TTF is designed to settle out solids from the slurry that is resultant of the milling process (Photo 20). The TTF serves as a subaqueous deposition of tailings to produce an anoxic environment, which stabilizes the tailings. Some process water is recycled back to the mill from the TTF and some water is treated and discharged under ADEC permits into Slate Creek.

Solids are removed from the water treatment system by a filter press. The solids are temporarily stored near the water treatment facility until they can be deposited underground, incased in a cement mixture that is engineered specifically for the working stopes (Photos 21 and 22). The solids were contained on three sides; however, open to one side and covered by a plastic tarp. The tarp was not maintained and water was getting into the solids storage area. While these solids are classified as non-hazardous (per Kevin Eppers), they should be better contained to reduce exposure to rainfall and potential for transport into local waters.

*Kensington Photo 20. Inside the tailings treatment facility water treatment plant.*

*Kensington Photo 21. Solids containment outside the TTF. These solids are stockpiled, and then transported for cement mixture and placed underground for stope filling.*

*Kensington Photo 22. The tarp was not maintained and water was getting into the solids storage area.*

Leachate[1] was discovered around Lower Slate Lake during Phase I of construction. Leachate was not expected in this location, thus not discussed in the EIS or operating plan. There have been numerous follow-up investigations and documents regarding the leachate. Because leachate has been identified at the areas excavated for dam construction, Coeur received support from Golder Associates Inc. to evaluate and characterize excavated overburden materials at the Kensington mine. A subsequent graphitic phyllite plan was composed in 2013 by DEC (waste management). Acid base accounting was conducted to predict the acid generation characteristics of material and is based on the relative difference between net acid generation potential and net neutralization potential of the material. Kinetic testing (humidity cell testing) did not provide an accurate representation of field conditions. Therefore, a series of barrel tests are currently being conducted with 4 differing amounts of sulfur (Photo 29). This barrel test is intended to determine a timeframe for the acidification to occur in the rock. In the meantime, the 'potentially acid producing' leachate (ARD graphitic material) is being stored in fully enclosed, impermeable, plastic 'burritos' (Photo 25). No water appeared to be infiltrating the enclosed material.

This BMP review noted that visible leachate associated runoff was being routed to a sump at the north end of Lower Slate Lake (Photo 32). The sump was designed to accommodate the runoff; however, already this year, the sump was inundated due to rising water levels in the TTF, and had to be moved. Runoff from the sump is pumped to a holding tank, then another holding tank, and then transported to the lime treatment facility. After treatment, the treated water is released into an infiltration gallery located adjacent to the TTF. We did not visit the infiltration gallery.

Leachate was seen visually around the southern portion of the lake on the west side (Photos 24, 30 and 31). There was no evidence of leachate from the east side which was designed as storage for graphitic phyllite material (Photos 23 and 26). The west side was covered with shotcrete to minimize the exposure to water and air. Lines of leachate were seen along the shotcrete. Surface water runoff from both sides were collected below the dam and transported to the lime treatment facility for treatment (Photo 26).

[1] Leachate is the water that has percolated through the graphitic phyllite (a mineral).

*Kensington Photo 23. Natural hillslope along the eastern edge of Lower Slate Lake dam, where leachate was discovered.*

*Kensington Photo 24. Hill slope with shotcrete covering where leachate was discovered during Phase I of the dam.*

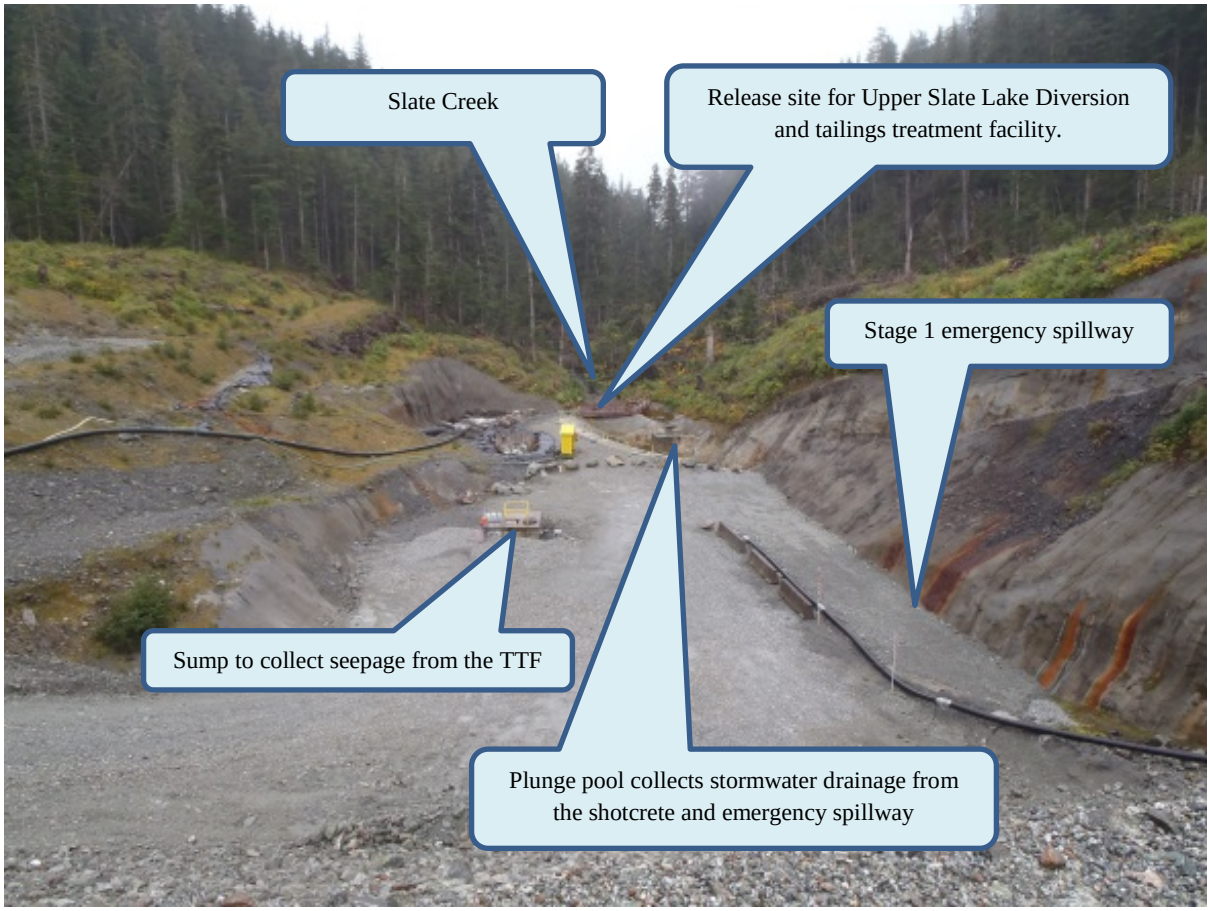
*Kensington Photo 25. A 'burrito' of leachate material which is impervious to water and air.*

*Kensington Photo 26. An engineered storage pile of graphitic phyllite material. The pile is only open on the surface layer which is diorite and has an overall net neutralization effect. The green building is the lime treatment facility.*

*Kensington Photo 27. Emergency spillway at the west side of the dam. Shotcrete has been placed on the native material to minimize exposure to oxygen and water. Notice the leachate staining on the shotcrete and ponded water in the spillway.*

*Kensington Photo 28. Leachate staining on the shotcrete at the upper end of the overflow channel. This pipe is from a 50-foot sump that is capturing seepage from fractures in the bedrock beneath the dam. The water is pumped from the sump back into the TTF.*

*Kensington Photo 29. Barrel testing site for graphitic phyllite weathering.*




*Kensington Photo 30. This photo includes the leachate runoff sumps, Lower Slate Lake Stage 1 emergency spillway, Slate Creek and the release site for Upper Slate Lake diversion and the treated wastewater. The left side of the photo is the collection sump. Seepage is collected and goes back to the TTF. On the right side of the photo is the emergency spillway for Phase I. Stormwater runs from the shotcrete, collects here in the emergency spillway, and is pumped to the graphitic batch treatment plant. Upper Slate Lake is routed through a pipe to the location just beyond these sumps (center back of the photo). This is also the location where the TTF disperses treated 'clean' water (meets Alaska Water Quality Standards). Water quality and other aquatic monitoring occur in Slate Creek just downstream of this photo.*

*Kensington Photo 31. Up close photo of the plunge pool, emergency spillway, Upper Slate Lake diversion release site, and Slate Creek. Notice the shotcrete overlying much of the bedrock in an effort to reduce infiltration and exposure to rainfall and stormwater.*

*Kensington Photo 32. Leachate was visually observed in this northern end of Lower Slate Lake. The excavated material is from Phase 1 construction of the dam. There is topsoil/overburden in this pile which is resulting in acid rock drainage (ARD). The sump located in this photo is designed to collect the ARD. Runoff is pumped to the holding tanks and eventually transported to the lime treatment facility. A sump was constructed up-gradient and the ARD leachate captured prior to the lower sump becoming inundated with water.*

## Trash or Human Sanitary Waste

We did not view any sanitary waste sites besides the outhouses located in the remote areas. Sewage from the office and camp location is treated and dispersed across a drain field on private land. The outhouses are pumped, and then sewage is transported to the Juneau sewage treatment facilities. Trash is burned at an incinerator and otherwise carried offsite.

## Waterbody Alterations

Waterbody alterations at Kensington include diversion of Upper Slate Lake, pumping of groundwater for drilling, capture of groundwater underground, release of waters at designated outfalls, and routing of surface and subsurface waters along roads and other mine infrastructure. Much of the water alterations are addressed in the SWPP and were discussed in the erosion/sedimentation or leachate portions of this report. We did not visit any pumping locations. We did visit the inlet and flume along the Upper Slate Lake diversion. High rainfalls, and possibly underestimated seasonal runoff, have resulted in flooding of the road and diversion pipe in the Lower Slate Lake area. The road had been inundated with water on at least two occasions (personal communication, C. Caton) and Kevin had commented that flow capacity through the diversion pipe had been exceeded.

*Kensington Photo 33. Cofferdam/inlet to Upper Slate Lake diversion.*

*Kensington Photo 34. Diversion pipe*

*Kensington Photo 35. Flume along diversion pipe*

*Kensington Photo 36. Water treatment facility on the Comet side. Notice the settling ponds in front of the buildings and the geo fabric bags on the mid-right side of the photo.*

A water treatment facility is located on the Comet side (Photo 36). The source of this water is mine drainage and stormwater from the Comet development pile. This water is treated for solids and also for the chemicals used for flocculant. There are two flocculunt treatments – one outside and one inside the building. Solids are dredged from the ponds then placed in the black geo fabric bags (Photo 37). The geo fabric bags decant the water which is pumped back into pond 1. The sludge removed by the filter press in the water treatment plant is deposited back into the Comet development pile. The solids from the geo fabric super sacks are deposited on the Comet portal development rock pile and surrounded with diorite (Photos 12-14). Treated water is diverted to Sherman Creek outfall (Photos 38 and 39). At the time of the visit, there was visual sediment at the outfall; however, it was fairly localized in extent (Photo 40).

*Kensington Photo 37. Filter bags of solids. These bags are manually brushed to keep the porous material from being clogged. The secondary containment captures the runoff which is then pumped back into the settling ponds. There were several spots where spillage was occurring around these bags. General housekeeping of the filter fabric would reduce risk of sedimentation into local waters.*

*Kensington Photo 38. These lines disperse the (Comet) treated water into Sherman Creek at Outfall 001. Water quality monitoring occurs just downstream of this location.*

*Kensington Photo 39. The waters were generally clear in this location with only minor turbidity noticed in few water locations.*

*Kensington Photo 40. Sediment instream at Sherman Creek outfall.*

## Other

Canada thistle, an invasive weed, was seen on the Comet Beach near the old administrative site. A white paper identifies additional invasive species that have been seen in the Comet Beach and Slate Creek Marine areas, and suggests strategies for eradication. It is currently in review at the Juneau Ranger District.

# Kruzof North Beach ATV Area, Sitka Ranger District, Tongass National Forest

September 9, 2014

## Background

This interdisciplinary trip was conducted on the Sitka Ranger District on September 9, 2014. The participants included: Chris Leeseberg (Wildlife/Fish Biologist), Katherine Prussian (Hydrologist), Mike Mullin (Recreation Specialist), Shelia Jacobson (Fish Biologist), and Jacqueline Foss (Soil Scientist).

The North Beach OHV use area was monitored under the Nationwide BMPs Rec E. Motorized Vehicle Use areas protocol. The OHV use area is a small strip of beach on the north side of Shelikof Bay on the outside of Kruzof Island. The area was very briefly addressed in the Sitka Ranger District Access and Travel Management Plan (ATM) Environmental Assessment (EA) in 2006. The area is open to all OHV use throughout the year.

## BMP Review

The OHV use area was established in 1993 as a way to separate OHV users from non-motorized users. The North Beach cabin is near the use area and users have access to the beach. A small Class II stream runs along the southern end of the use area that changes outlets annually due to shifting sands and wave action. This stream is not mapped in GIS SEAKHydro geodatabase or surveyed elsewhere that anybody on the IDT could find (Figure 1).

**Kruzof North Beach Figure 1. Use area with circle over the cabin. Note lack of stream mapping near the cabin.**

A few years ago (it is not well-documented how many) this stream turned northwest and began running between the un-vegetated sands of the beach area and a sandy bluff. This stream is eroding the bluff at a rapid rate (Photo 1). The bluff is the habitat of the rare dune tansy. Users are not supposed to ride on any vegetated areas, but since the beach started eroding, they were using the bluff for access. Some fencing and signs were placed to protect the rare plant.

*North Kruzof Beach Photo 1. Stream running between beach (foreground) and the bluff with the cabin (blue trap, background)*

## Monitoring Results

The IDT found evidence of OHV use outside of the designated OHV use area. The OHV use area is delineated only on the MVUM and in the Sitka ATM. The OHV use area includes "…only the unvegetated beach area off Shelikof Bay; extending from the mean high tide line to the high tide line, and is bounded on the southeast by a rock outcrop. The area also includes the tidal portion of the stream on the northwest end".

The use area also includes access to three unmarked dispersed campsites and a trail between the North Beach cabin and the use area.

Currently there are five trails between the North Beach cabin and the use area, all of which cross an unmapped, un-surveyed stream (Photo 1). This stream is at least Class II and possibly Class I. There are several user created trails in the vegetated areas adjacent to the OHV use area. The IDT did not measure or investigate these trails. Some of the trails between the cabin and the use area are very steep and actively eroding.

*North Kruzof Beach Photo 2. OHV trail in a vegetated area. The foreground is along the unvegetated sandy area. The grasses are colonizing the sands and are found in the transition areas between the unvegetated sands and forest.*

Several trails initiate in the legal portion (the unvegetated sands) of the OHV use area and go into the woods (unauthorized/illegal portion). Three of these are legal trails to access the three dispersed campsites cited on the MVUM but since they are unmarked the IDT could not determine which the legal trails were and which were not legal (Photo 2). Many of these trails terminate in openings that could be used as campsites. Since the IDT was confused, the user may be confused as well.

There was evidence of minimal to considerable OHV use in some vegetated areas adjacent to the use area. Some of the vegetated areas have very sparse plant growth and some OHV users may confuse these travel restricted areas with the unvegetated open areas (Photo 2).

The OHV use area on the MVUM allows some use in the tidal portion of the stream at the northern end. It is unclear from the MVUM where users are actually allowed to ride adjacent to this anadromous stream, but it is clear they are riding on the banks of the stream (Photo 3). The OHV area is inaccessible at high tides so users resort to traversing a short section of vegetated beach area to round the corner from North Beach proper to the open finger along the anadromous stream.

*North Kruzof Beach Photo 3. OHV use on the banks of an anadromous stream*

## Corrective Actions to Improve Implementation

Map and survey the Class II stream near the North Beach Cabin. Knowing more about this stream will drive any future management of the use area.

Add language to the MVUM that clarifies what exactly is open along the anadromous stream at the northern portion of the use area. The stream itself through the open area is tidal and so could be construed as open.

Create a management plan that clears up some of the vague language in the ATM and MVUM. Also, this document should describe why and how the district will allow OHV crossings of the currently unmapped stream. It is important to clarify what is/is not considered "vegetated." Some of the places with OHV use were mostly sands with a few plants colonizing the area. The USFS should decide which percent cover constitutes vegetated.

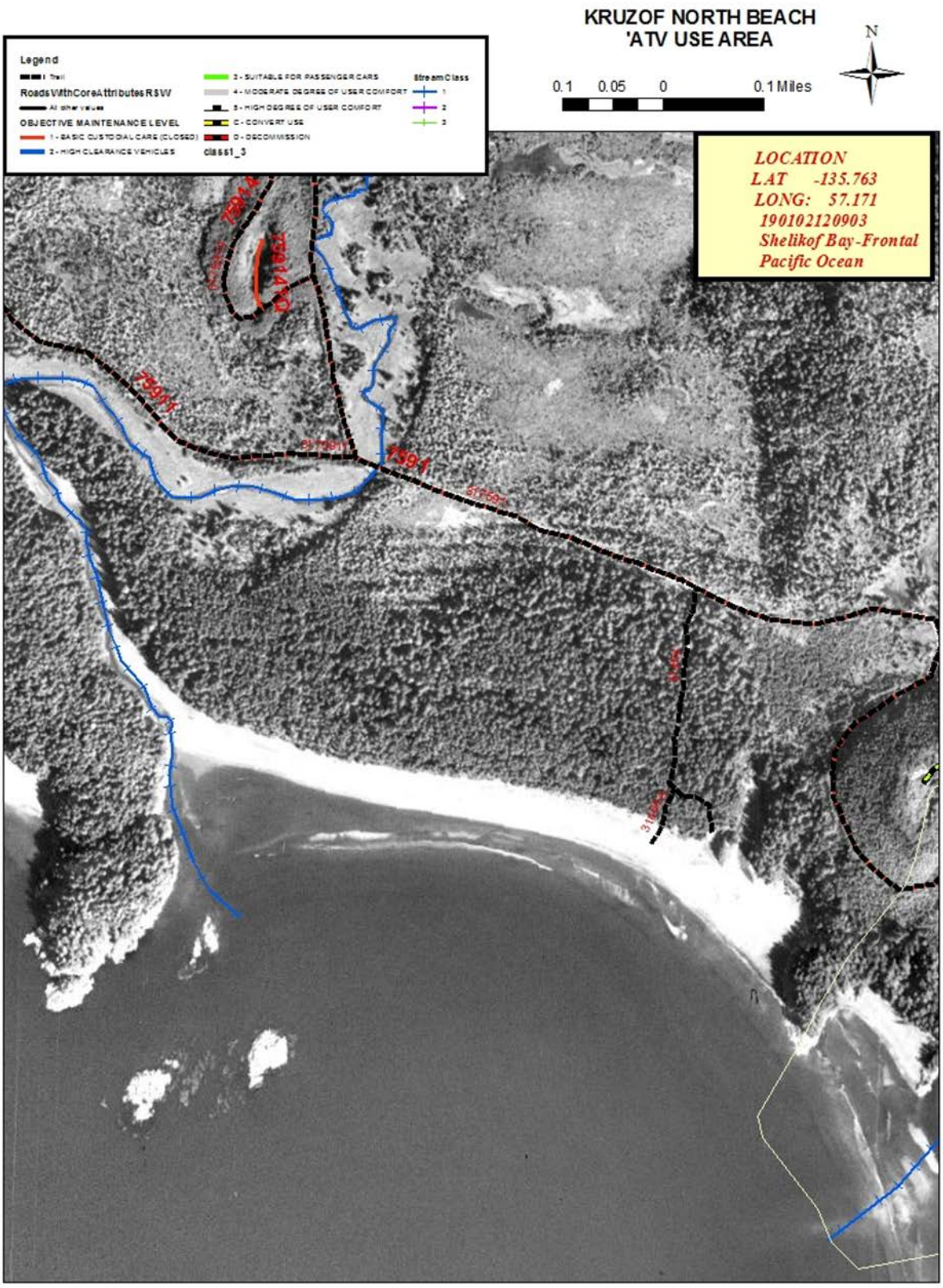
This plan would disclose the resource impacts associated with OHV use.

Place signs, blazes, or other features to delineate the high tide line and designate the legal trails and dispersed campsites. This could be outlined in the management plan. The use area has seemingly expanded from the unvegetated beach sands and designated campsites located in the adjacent forest fringe into travel restricted areas. If something looks like a trail, it will likely continue to be used as a trail unless measures are taken to control access. These areas should be designated as trails or blocked.

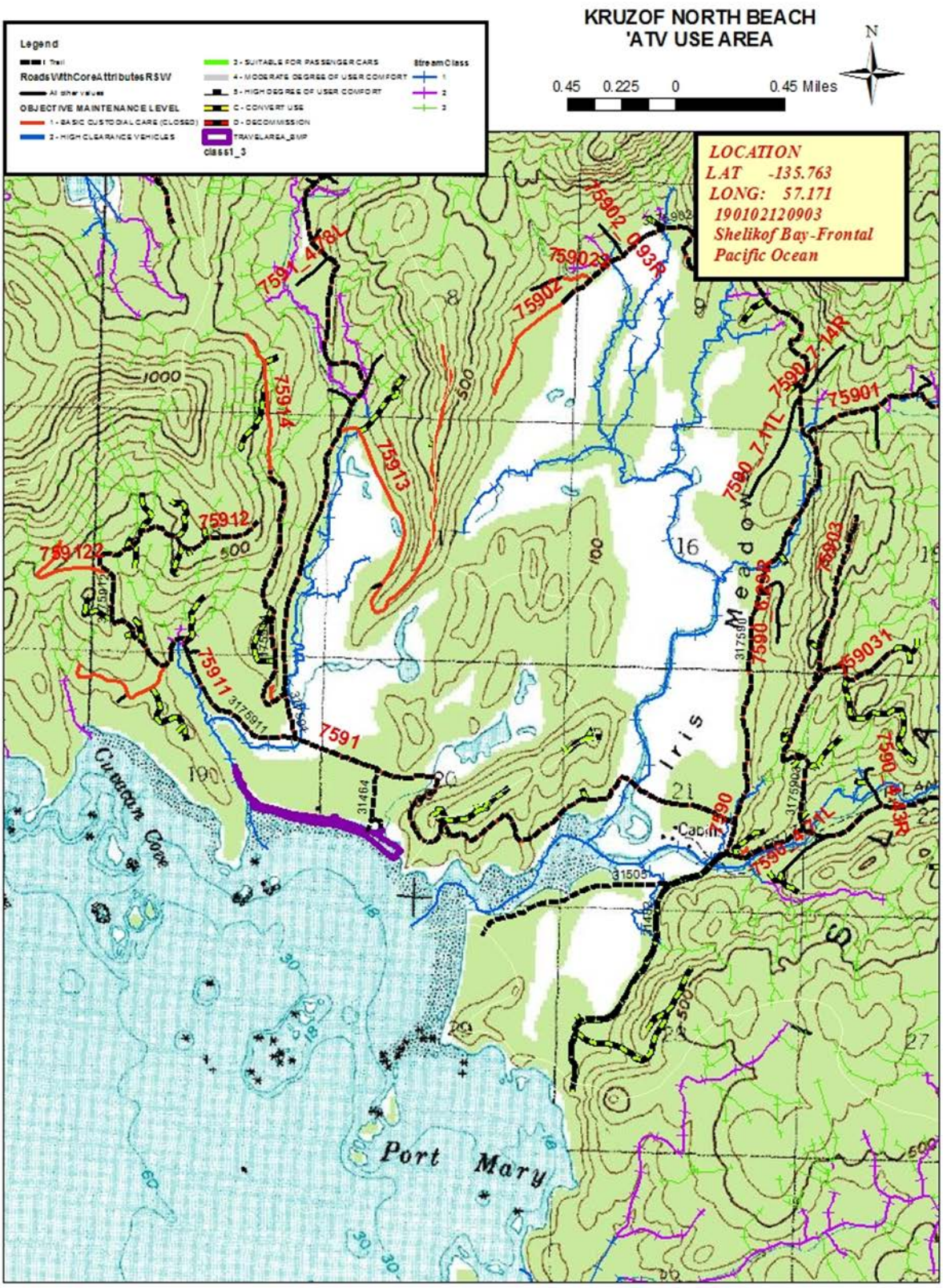
One or more restroom facilities near designated campsites and/or additional education of leave no trace principles pertaining to human waste management might help curb the unsightly and unsanitary waste disposal practices employed by some users.

*North Kruzof Beach Photo 4. OHV use area sign*

*North Kruzof Beach Photo 5. OHV use area*




**Kruzof North Beach Figure 2. Orthophoto of Kruzof North Beach ATV use area**




**Kruzof North Beach Figure 3. Map of Kruzof North Beach ATV use area**

# North Pole Unit 1, Thorne Bay Ranger District, Tongass National Forest

September 16, 2014

## Background

An interdisciplinary group (Dennis Landwehr, Tongass Soil Scientist Program Manager; Delilah Brigham, Thorne Bay Planning Program Specialist; Rachelle Huddleston-Lorton, Thorne Bay District Ranger; Carol Seitz-Warmuth, Tongass Inventory and Monitoring Coordinator) evaluated best management practices (BMPs) on completed timber harvest. This unit was clearcut shovel-logged with a 100-foot stream buffer and 75-foot riparian management area (RMA) buffer along an unnamed stream. The unit was approved as part of the Goose Creek Environmental Assessment (EA).

## BMP Implementation

The implementation questions evaluate practices used to minimize water quality impacts. No adverse actions were reported during implementation.

### *Corrective Actions to Improve Implementation*

The aquatic management zone (AMZ) buffers could be wider at four places.

Debris needed to be removed from the Class IV stream. The stream was probably hard to identify because it was intermittent with no defined channel.

### *Adaptive Management Actions to Improve Implementation*

The sale administrator could flag water bar locations, but since these plans change, they usually go over this with the contractor prior to road closure.

## BMP Effectiveness

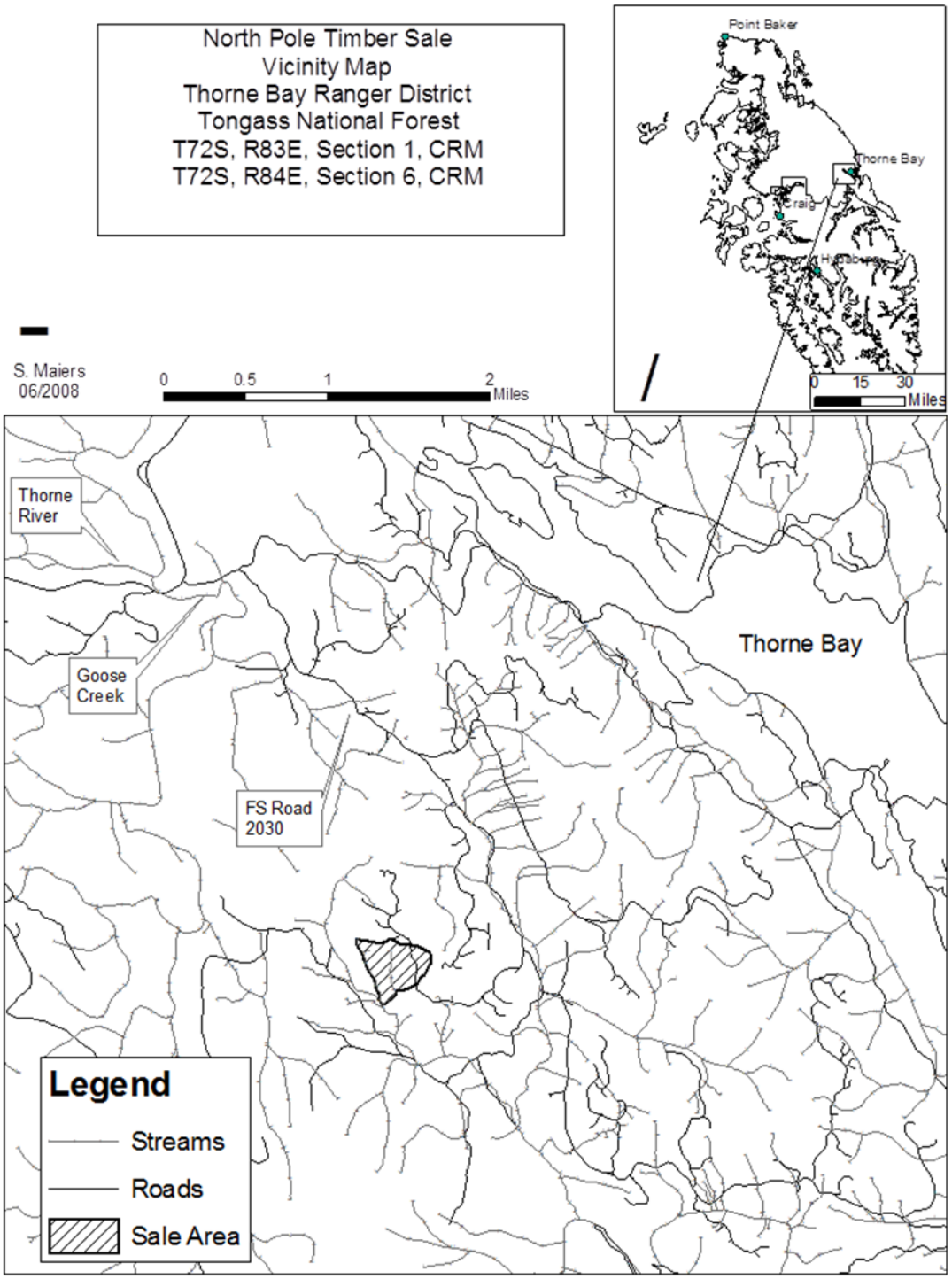
The BMPs seem effective in limiting potential or current impacts to water quality.

### *Corrective Actions to Improve Effectiveness*

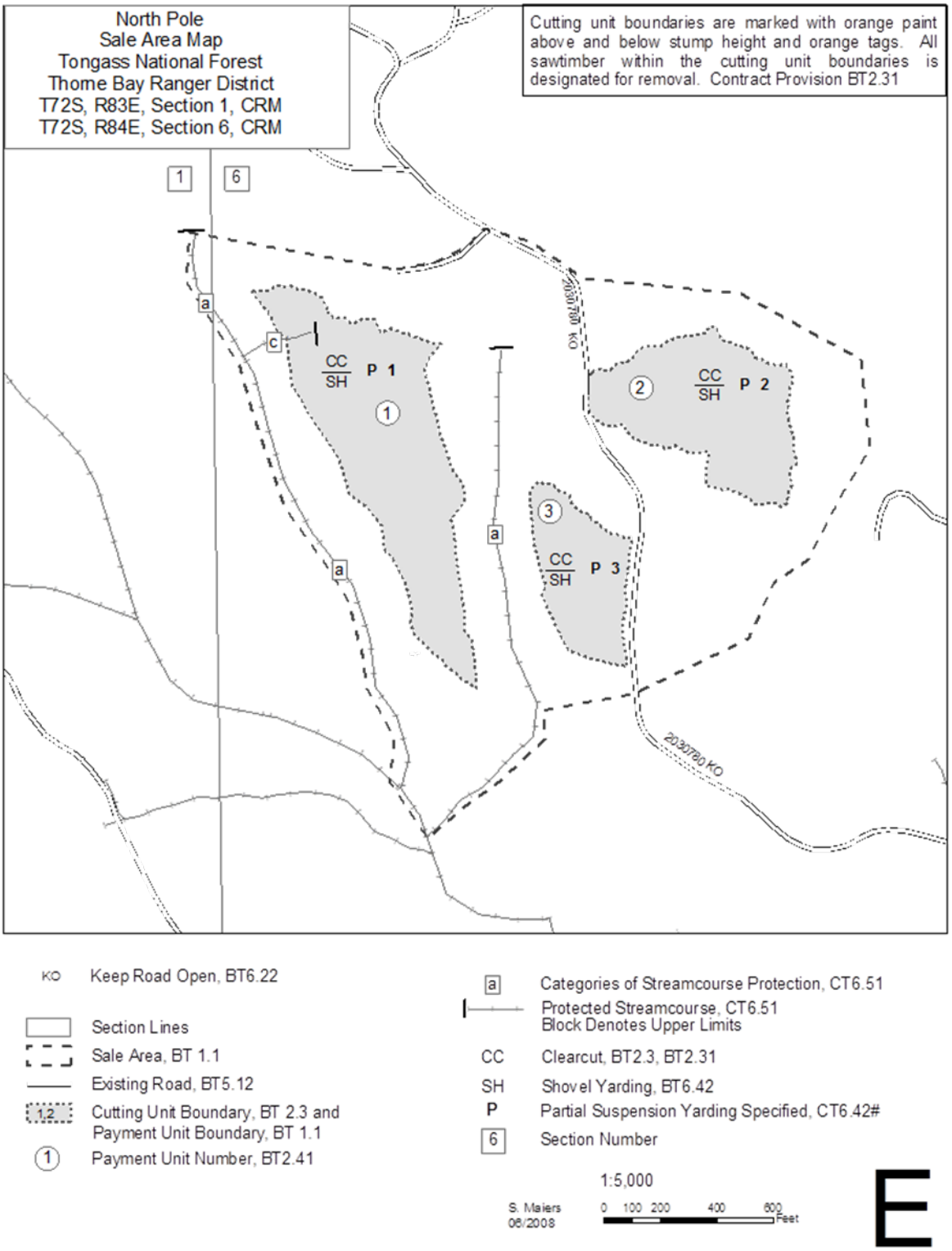
Consider adding water bars and cross drains to temporary roads.

### *Adaptive Management Actions to Improve Effectiveness*

No adaptive management actions were noted.




**North Pole Unit 1 Figure 1. North Pole Timber Sale vicinity map**




**North Pole Unit 1 Figure 2. North Pole Timber Sale unit map**

*North Pole Unit 1 Photo 1. North Pole Unit 1*

*North Pole Unit 1 Photo 2. North Pole Unit 1 (west)*

*North Pole Unit 1 Photo 3. Stream buffer, Unit 1*

*North Pole Unit 1 Photo 4. Stream buffer*

*North Pole Unit 1 Photo 5. Unit 1*

*North Pole Unit 1 Photo 6. Unit 1 clearcut*

# Raven Trail Construction, Petersburg Ranger District, Tongass National Forest

September 8, 2014

## Background

An interdisciplinary group evaluated best management practices (BMPs) on completed trail construction. This work was accomplished on Raven Trail in 2014. The Petersburg District Ranger determined (June 22, 2010) that these actions fall under categories of action excluded from documentation in an environmental impact statement (EIS) or environmental analysis (EA) as established by the Chief, FSH 1909.15.30 (31.1b) #4: "Repair and maintenance of roads, trails and landline boundaries". The Raven Trail has been in existence since the 1970s, providing access to Raven's Roost cabin. The trail is 4.2 miles long but only the first 2,600 feet were rebuilt this year. The trailhead was relocated for safety and accessibility reasons. The original trail location was close to the city rock pit creating hazards to hikers. It is now located across Sandy Beach Road from the Sandy Beach Park. The newly constructed trail is free of barriers and fully accessible. The Raven Trail is one of the few substantial trails near the community of Petersburg and is within walking distance of downtown making it one of the most popular trails on Mitkof Island.

## BMP Implementation

The implementation questions evaluate practices used to minimize water quality impacts. All applicable BMPs were implemented at the trail. A review of the maintenance project files documented aquatic specialist review and recommendations.

*Raven Trail Photo 1. Trail surface is graded aggregate.*

The newly constructed trail is 6.5 feet- to 8 feet-wide, graded aggregate with rest areas, benches, culverts and signposts (Photo 1). The contract of work included clearing and grubbing, excavation and construction including seven culverts. Impacts were minimized by including specific measures in the contract that included regular meetings with the COR for inspections and communication with both parties. Special care was taken to dispose of materials off-site, minimize rutting and erosion by using construction mats, installing corduroy or geotextile, grading trail bed and installing temporary drainage. To provide sediment control, filter cloth was installed during construction. The site was re-vegetated using plugs that were originally removed from site during the clearing and grubbing stage (Photo 2).

The group noted culvert locations and spacing's were designated and installed at the designated locations. The trail location was designated on the plans and on the ground. Techniques to construct cross drains and water crossings were specified in the contract. Supplemental erosion control was applied after construction by the Forest Service. Project inspections were performed throughout the contract and at critical times. Corrective actions included rerouting the trail to minimize grade and crossings, as well as bringing in soil to promote vegetation growth to minimize erosion. They also surfaced the trail with fine gravel to compact the trail surface and provide improved tread. The trail overall was in excellent condition and minimized impacts to the wetland and intermittent stream crossings.

### *Corrective Actions to Improve Implementation*

One corrective action was suggested during the monitoring trip. Specific BMPs in the NEPA document would have been helpful in implementing trail construction.

### *Adaptive Management Actions to Improve Implementation*

No adaptive management actions were noted for the Raven Trail during the monitoring review.

*Raven Trail Photo 2. Vegetative plugs near the rest area.*

## BMP Effectiveness

The effectiveness questions evaluated evidence of potential or current impacts to water quality. No evidence of erosion or sedimentation was noted at the water bodies or their approaches. A 50-foot aquatic management zone (AMZ) surrogate was left adjacent to the wetland because no Class II streams were crossed in the segment of trail monitored. The monitoring crew reviewed a small intermittent drainage that flows from the muskeg down the slope in the V-notch. There was a Class II stream located in the V-notch roughly 200 feet below the trail that transitions to a Class I stream at the road.

At the minor intermittent stream, a culvert was installed to transport water across the trail. There was evidence of sediment transport as noted in very minor pedestal erosion in isolated locations adjacent to the water flow from the muskeg (Photo 3). The sediment transport amounted to an area two feet by one foot adjacent to a culvert on the fill slope. The low energy water did not transport the sediment beyond the immediate area. This erosion resulted from unhardened crossing approaches on the bare ground from heavy rains. No diversion potential was noted at this crossing. Soil was placed along the fill slope of the trail to provide soil structure for vegetation growth. Later, it was determined that soil contained residual amounts of non-native plant seed. No evidence of chemical or fuel spills were noted.

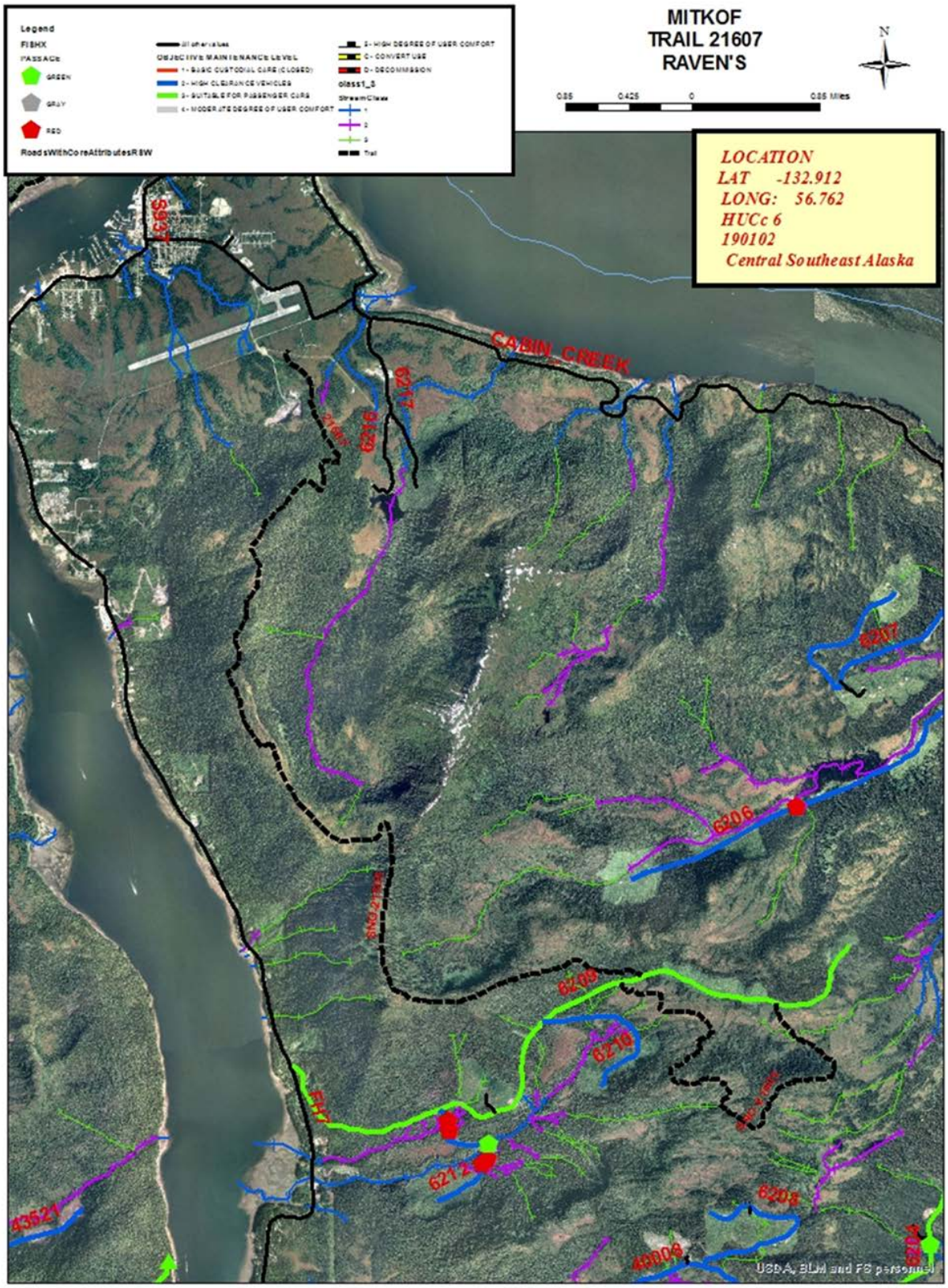
### *Corrective Actions to Improve Effectiveness*

No corrective actions were noted for the Raven Trail.

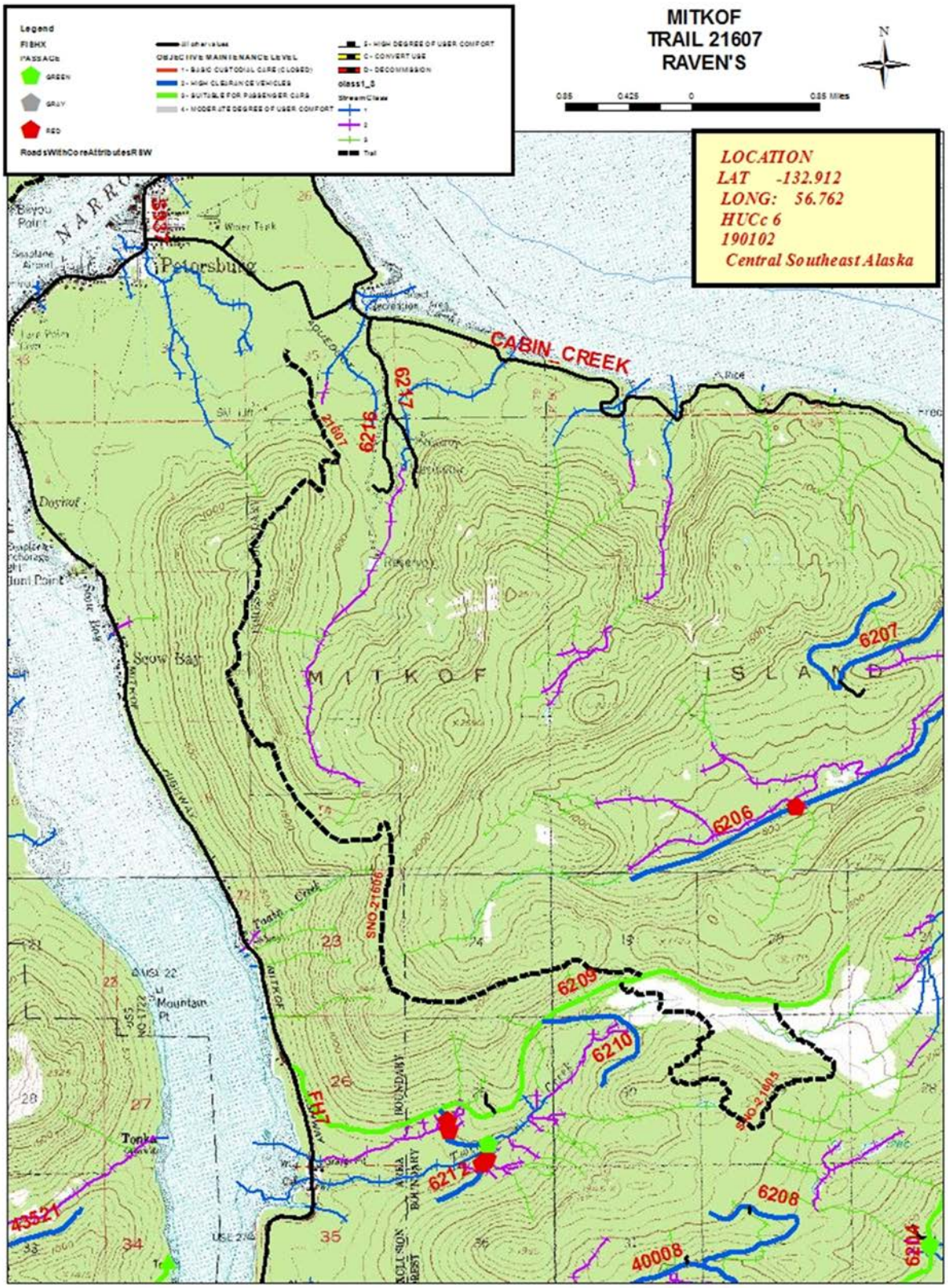
### *Adaptive Management Actions to Improve Effectiveness*

No adaptive management actions were noted for the Raven Trail.

*Raven Trail Photo 3. Low energy water body crossing with minor pedestal erosion.*




**Raven Trail Figure 1. Raven Trail construction map 1**




**Raven Trail Figure 2. Raven Trail construction map 2**

# Road 3015, MP 1.773 and 8.743, Thorne Bay Ranger District, Tongass National Forest

September 16, 2014

### Background

An interdisciplinary group (Dennis Landwehr, Tongass Soil Scientist Program Manager; Delilah Brigham, Planning Program Specialist; Rachelle Huddleston-Lorton, District Ranger; Carol Seitz-Warmuth, Tongass Inventory and Monitoring Coordinator) evaluated Best Management Practices (BMPs) on completed road maintenance.

**MP 1.773 –** This culvert is three years old and was graded this year (2014). The length of road evaluated was 0.5 mile. The length of the road segment near the aquatic management zone (AMZ) was 240 feet.

**MP 8.743 –** Reconstruction on this pipe was completed in July. Small fish were present at the pipe during this review. The length of the road segment evaluated is 532 feet. The length of the road segment near the AMZ is 280 feet. Silt fencing was used downslope of the culvert during installation.

### BMP Implementation

**MP 1.773 –** It took a year or two for rock to get into the pipe. The simplified stream simulation surcharges sediment above the pipe and the stream moves it into the pipe. This one did not fill immediately.

**MP 8.743 –** Stream armored at inlet to direct water into corrugated metal pipe (CMP). Also note that armoring adjacent to ditch directs water into the culvert.

#### *Corrective Actions to Improve Implementation*

**MP 1.773 –** Surcharge was placed on the banks instead of in the stream. It took two large flow events last winter and this spring to move the material into the pipe.

#### *Adaptive Management Actions to Improve Implementation*

Place surcharge material in the stream or further down on the banks so it moves into the pipe at lower flow events.

### BMP Effectiveness

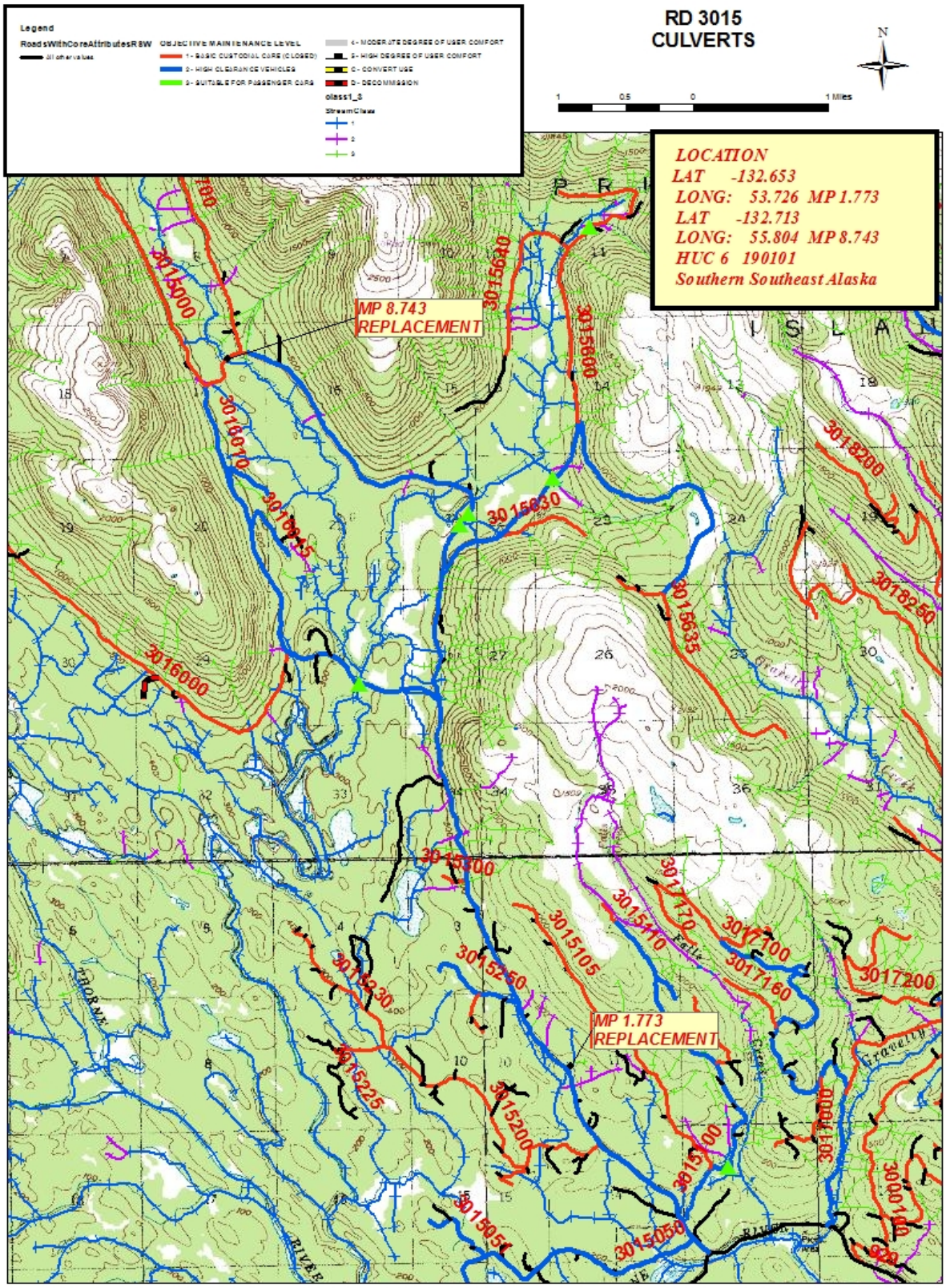
The BMPs seem effective in limiting potential or current impacts to water quality.

#### *Corrective Actions to Improve Effectiveness*

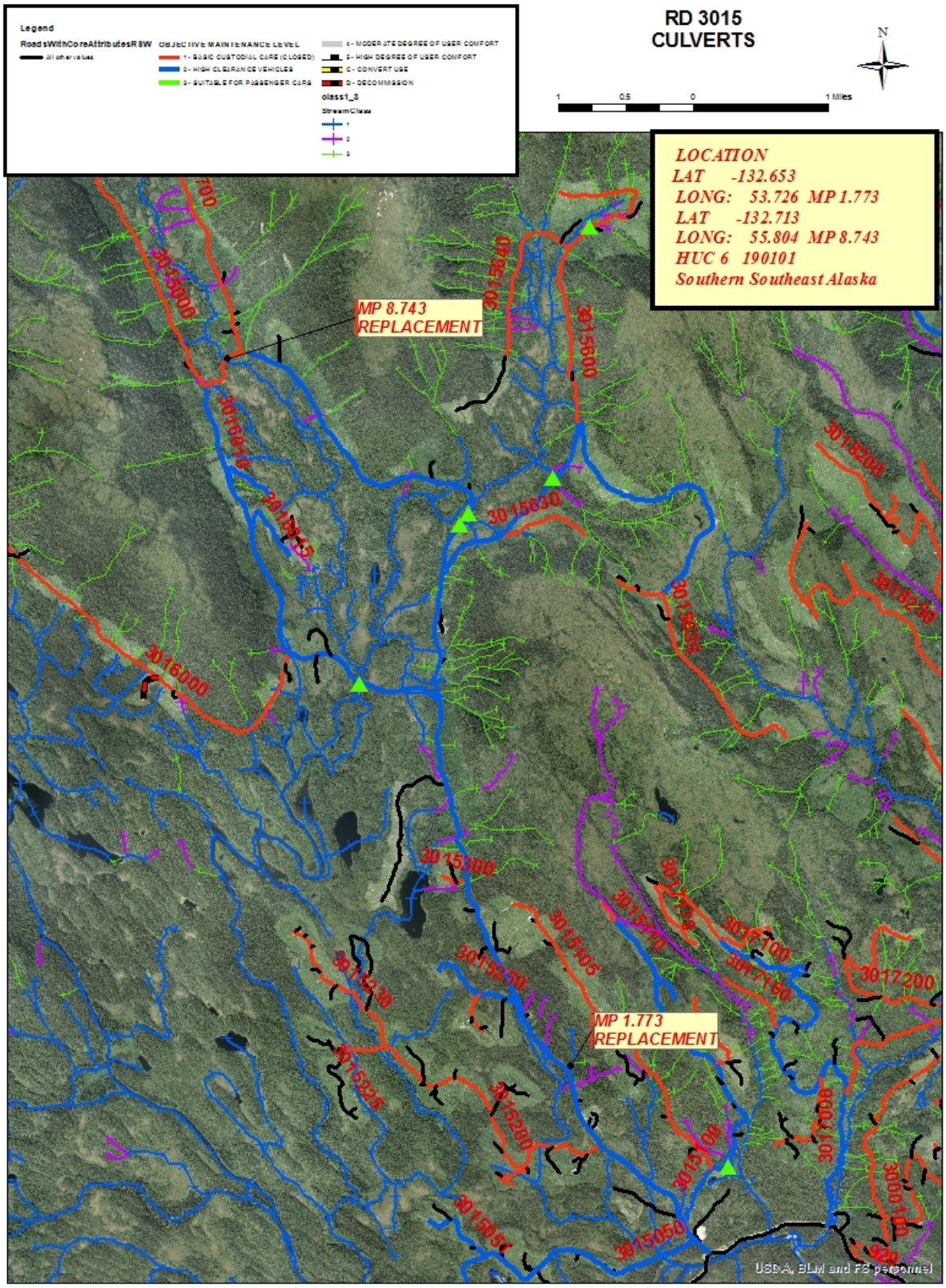
No corrective actions were listed in the review.

#### *Adaptive Management Actions to Improve Effectiveness*

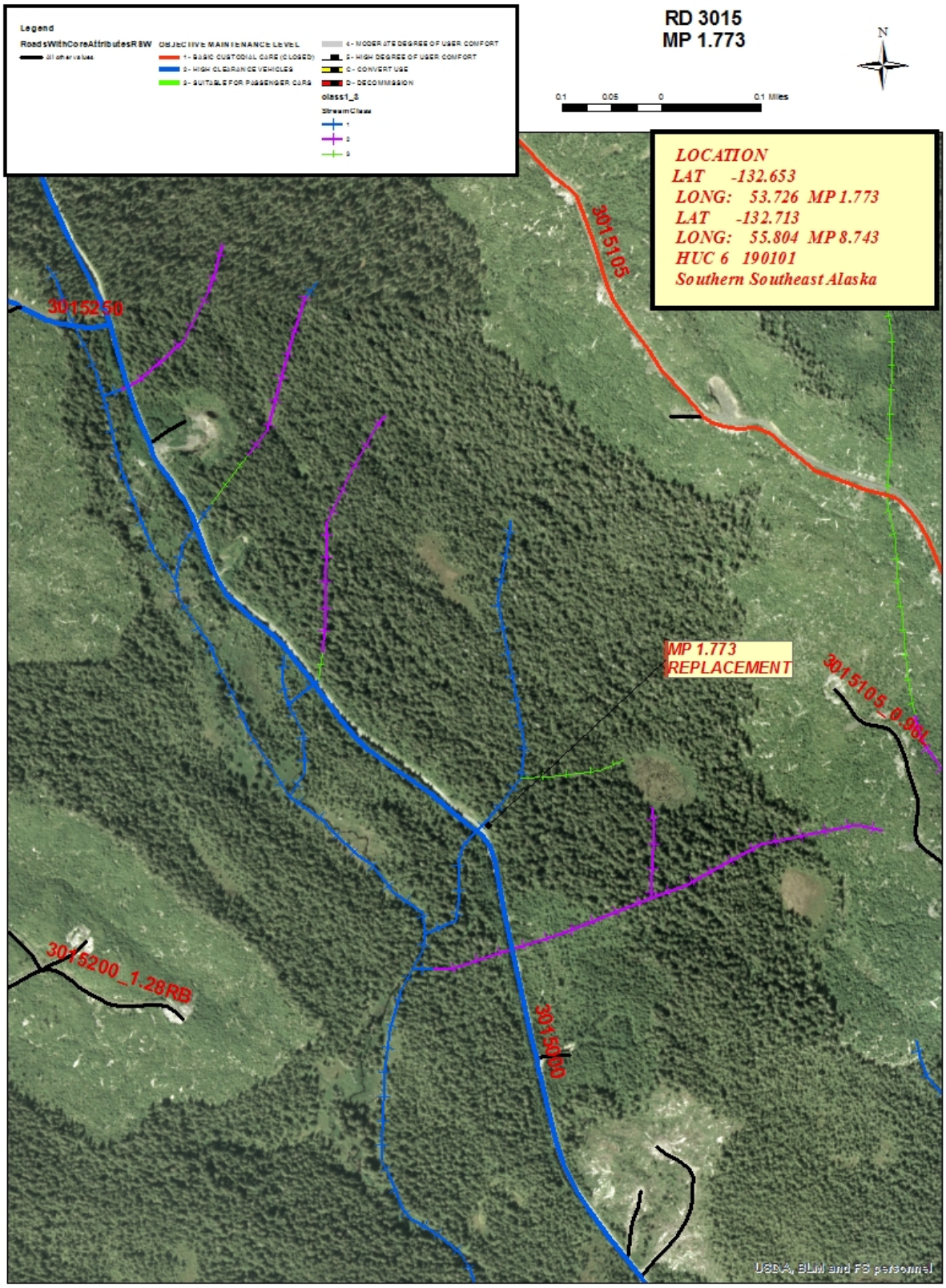
No adaptive management actions were noted.



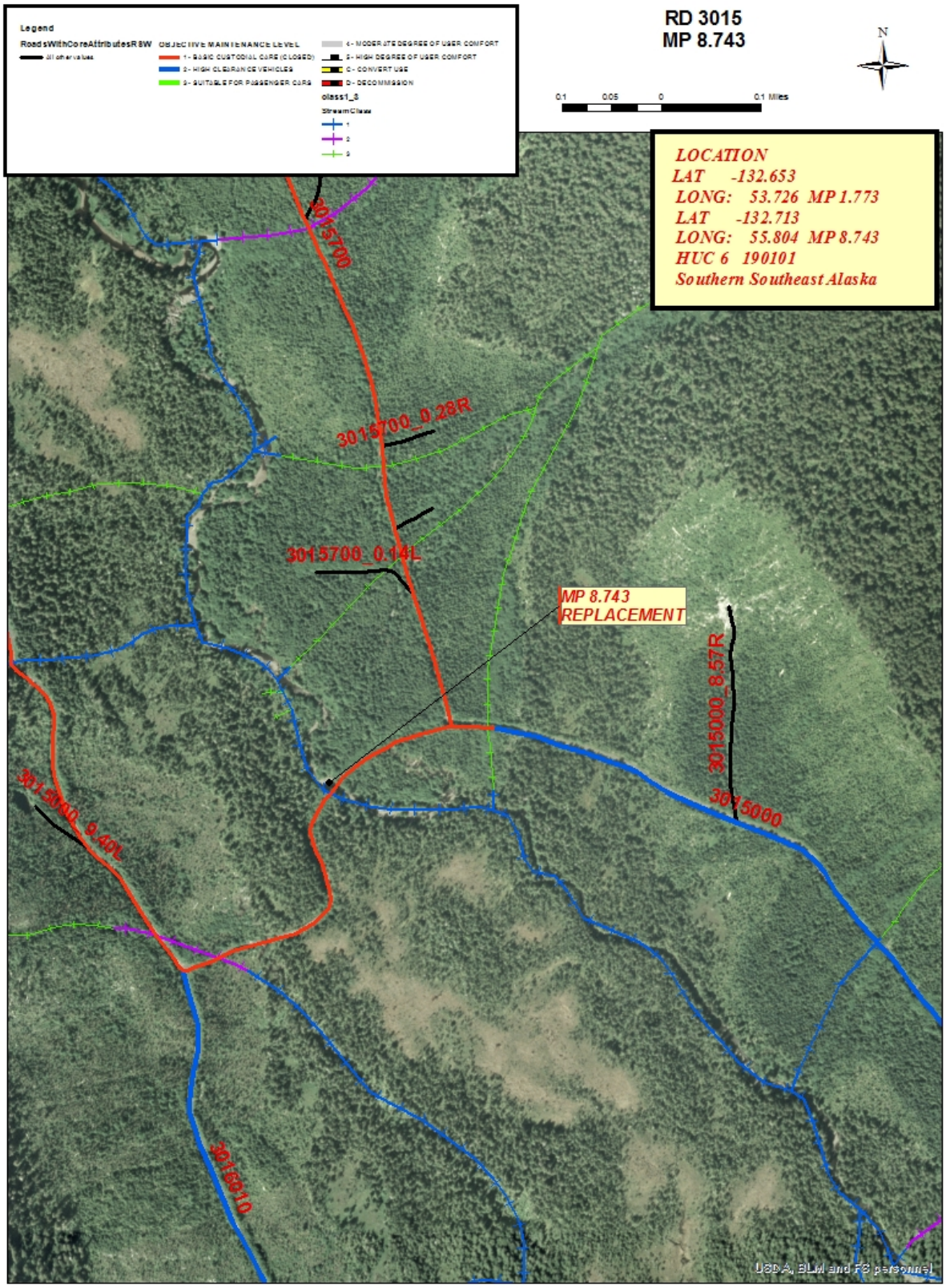

**Road 3015 Figure 1.** ***Vicinity Map***




**Road 3015 Figure 2.** ***Ortho photo culverts***




**Road 3015 Figure 3.** ***Milepost 1.773***




**Road 3015 Figure 4.** ***Milepost 8.743***

Road 3015 Photo 1. *Vehicles on road 3015*

Road 3015 Photo 2. *View of road surface*

Road 3015 Photo 3. *Two views of the milepost 1.773 CMP outlet*

Road 3015 Photo 4. *Milepost 1.773 CMP inlet*

Road 3015 Photo 5. *Milepost 8.743 CMP outlet*

Road 3015 Photo 6. *Milepost 8.743 CMP inlet*

Road 3015 Photo 7. *Brushy low point at CMP mid-approach to the 8.743 milepost crossing.*

Road 3015 Photo 8. *Two more views of a brushy low point at CMP mid-approach to the 8.743 milepost crossing*

# Road 6208 (Frenchy), Petersburg Ranger District, Tongass National Forest

September 11, 2014

## Background

An interdisciplinary group (Angela Coleman, Hydrologist; Jason Powell, Tongass Road Planner; Dennis Landwehr, Tongass Soil Scientist Program Manager; Marie Messing, Transportation Engineer; Bill Trembley, R10 Wilderness and Trails; Heidi Lombard, Fisheries Biologist; Pam Edwards, Research Hydrologist; Julianne Thompson, Hydrologist-Watershed Program Manager and Carol Seitz-Warmuth, Tongass Monitoring and Inventory Coordinator) evaluated best management practices (BMPs) on Road 6208, known as the Frenchy road due to proximity to Frenchy Ridge. This work was routine maintenance accomplished in 2014. The Petersburg District Ranger Jay Anderson determined that these actions fall under categories of action excluded from documentation in an environmental impact statement (EIS) or environmental analysis (EA) as established by the Chief, FSH 1909.15.30 (31.1b) #4: “Repair and maintenance of roads, trails and landline boundaries”. The Frenchy road is 2.91 miles long and listed on the access and travel management plan as a Level 2 road, assigned to open roads by high clearance vehicles. The road was constructed in 1989. The road information was updated in INFRA in 2013.

## BMP Implementation

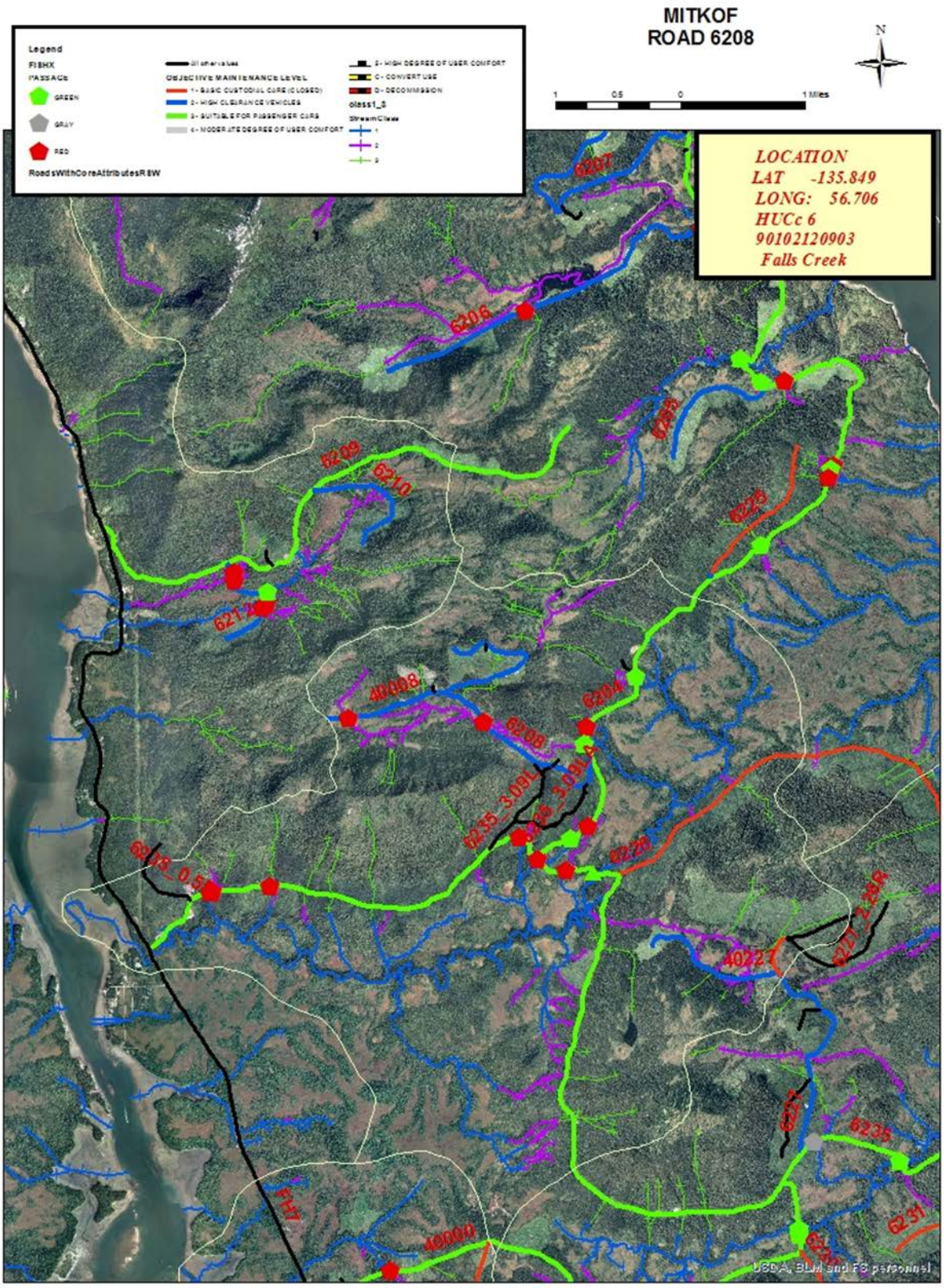
The 6208 road has had regular maintenance. The only area noted was an aquatic management zone (AMZ) wetland. This area had some, limited, evidence of erosion.

### *Corrective Actions to Improve Implementation*

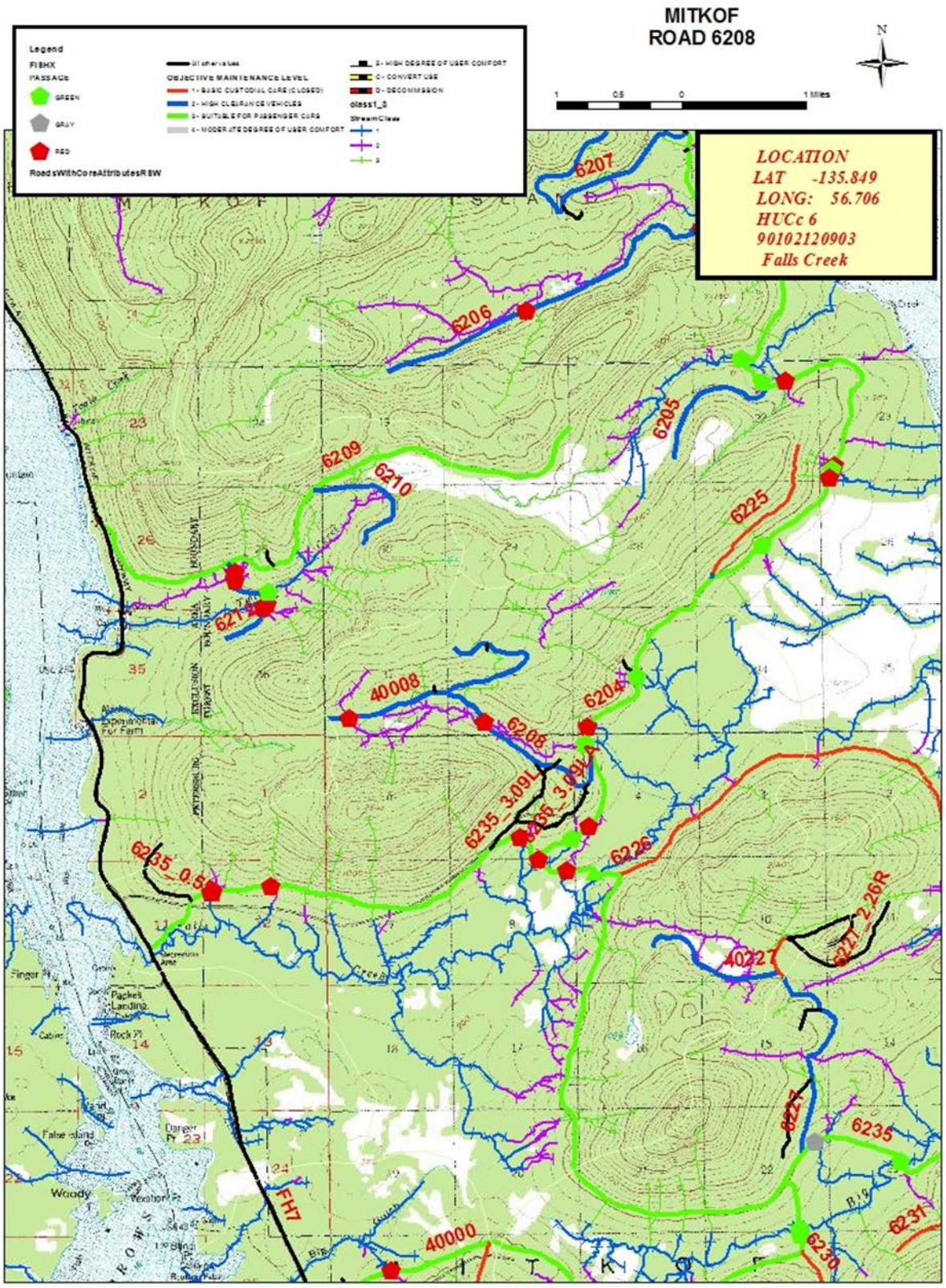
No corrective actions were listed on the form.

### *Adaptive Management Actions to Improve Effectiveness*

Need to resurface or recrown road for future timber sales or future activity. This is low priority.




**Road 6208 Figure 1. Ortho photo of the Frenchy area**




**Road 6208 Figure 2. Frenchy area map**

# Completed Waterbody Crossing Reconstruction, Road B Form, Road 8448, MP 0.380, Ketchikan-Misty Fiords Ranger District, Tongass National Forest

August 20, 2014

Summarized by Darin Silkworth

## Background

An interdisciplinary group monitored best management practice (BMP) implementation and effectiveness on a waterbody crossing of Road 8448 on the Upper Carroll road system. This segment of reconstructed road was randomly selected for monitoring. Participants included: Darin Silkworth (Tongass Soil Scientist), Jon Hyde (Ketchikan-Misty Fiords Ranger District Fish and Wildlife Staff Officer), Rozie Berry (Ketchikan-Misty Fiords Ranger District Contract Officer), and Kevin Hanley (Alaska Department of Environmental Conservation).

BMPs were fully implemented and were effective.

## BMP Implementation

There was an approved erosion control plan for this reconstruction project as shown in the environmental assessment (EA) and access and travel management plan. The status of whether this road segment was open or closed was determined in the District's Access and Travel Management Plan. Reconstruction and the applicable BMPs were outline in an Environmental Assessment (EA). R10 BMPs were also implemented.

### *Corrective Actions to Improve Implementation*

During implementation, the original contract was voided and replaced with a contract that better addressed erosion control and sedimentation. Erosion control included applying grass seed, which was applied twice, once outside of the seeding window and a second time in the spring. Sedimentation concerns were addressed during implementation.

No spills or leaks occurred on this road during or following construction or reconstruction.

### *Adaptive Management Actions to Improve Implementation*

The original contract should have included sufficient clauses to address sedimentation and erosion control.

## BMP Effectiveness

Implementation was effective. The waterbody crossing structure has no debris, sediment or damage. There is no evidence of erosion or sedimentation. All applicable inspections or administration were conducted at critical times, or activities were conducted to avoid critical times.

*Upper Carroll Photo 1. Reconstructed road segment*

*Upper Carroll Photo 2. Hillside above the road segment*

*Upper Carroll Photo 3. Looking below the reconstructed road segment*

*Upper Carroll Photo 4. West approach to the reconstructed road segment*

*Upper Carroll Photo 5. Reconstructed crossing, looking east*

# Aquatic Habitat Improvement, Mainstem of Saginaw Creek, Petersburg Ranger District, Tongass National Forest

July 17, 2014

## Background

An interdisciplinary group (Heath Whitacre, Petersburg Ranger District Hydrologist; Julianne Thompson, Tongass Hydrologist-Watershed Program Manager; Quentin Smith, Tongass Supervisory Civil Engineer; Jacquie Foss, Tongass Soil Scientist; Ted Sandhofer, Tongass Sale Administration Program Manager; Heidi Lombard, Petersburg Ranger District Fisheries Biologist) evaluated best management practices (BMPs) on the Saginaw Creek aquatic habitat improvement project. The Petersburg District Ranger, Jay Anderson, determined that these actions fall under categories of action excluded from documentation in an environmental impact statement (EIS) or environmental analysis (EA) as established by the Chief, FSH 1909.15.30 (32.2)(7) "Modification or maintenance of stream or lake aquatic habitat improvement structures using native materials or normal practices".

Stream restoration on the mainstem of Saginaw Creek began on July 7, 2014. The work included aquatic habitat improvement and bank stabilization with locally-sourced logs. The logs were used for instream and floodplain restoration on 2.4 miles of anadromous fish streams. The project required heavy equipment to place approximately 1,000 large wood (LW) pieces in four streams and their floodplains. The contractor implemented 30-minute rest periods where no machines were working in the water to let the sediment settle out and give the fish a break.

## BMP Implementation

Puncheon trails were used for the heavy equipment to operate on to prevent soil disturbance. Project maps for the puncheon trails were very helpful. The trails average about 10 meters in width and were created by felling 46-year-old young-growth trees and laying down a nearly continuous mat of cull logs and slash. Under repeated passes with equipment, the cull logs and slash were forced into the soil to a depth of 20 to 30 centimeters, altering the structure of the O, E, and upper B soil horizons. The puncheon trail was fluffed after stream restoration was complete. Fluffing broke up the dense slash mat and likely loosened the upper layers of soil that the slash had penetrated. Fluffing did not move all of the slash and some slash is still evident in the upper mineral soil horizons.

*Saginaw Creek Photo 1. Puncheon access trail with felled young-growth as a mat.*

The contractors forgot booms on the first day of work, so no work occurred until booms were on site. Contractors were fast to respond and had them at the work site within 3 hours. This was a short delay.

There were hydraulic leaks twice during project implementation. One leak occurred while working in the stream and one while working on a puncheon trail. The contractors'

deployed absorbent pads immediately, replaced the o-ring, and the problem was fixed. The spills were not reported to the Alaska Department of Environmental Conservation (ADEC) because the contractors were using biodegradable, vegetable-based hydraulic fluids. We did not know if this type of spill requires reporting, since it is not petroleum-based.

*Saginaw Creek Photo 2. Another puncheon access trail with a felled young-growth mat.*

The review team was impressed by project innovations that occurred on the fly.

### *Corrective Actions to Improve Implementation*

Puncheon trail rehabilitation is needed. Hand-slash and seed for bare areas were recommended by soil scientist. Seeding was not mentioned in the NEPA but is going to occur with force account funds.

### *Adaptive Management Actions to Improve Implementation*

An erosion control plan needs to be required in the contract. Consider including seeding in the contract as part of the erosion control plan so it can be done immediately after work is completed. Erosion control seeding had not been completed at the time of monitoring, but was completed soon after.

Consider using a log loader for this type of project instead of an excavator; this will allow for narrower clearing limits on puncheon trails and less time working in the stream due to easier handling of the wood.

Clearing limit widths should be defined for puncheon trails in the contract, so they are not larger than needed.

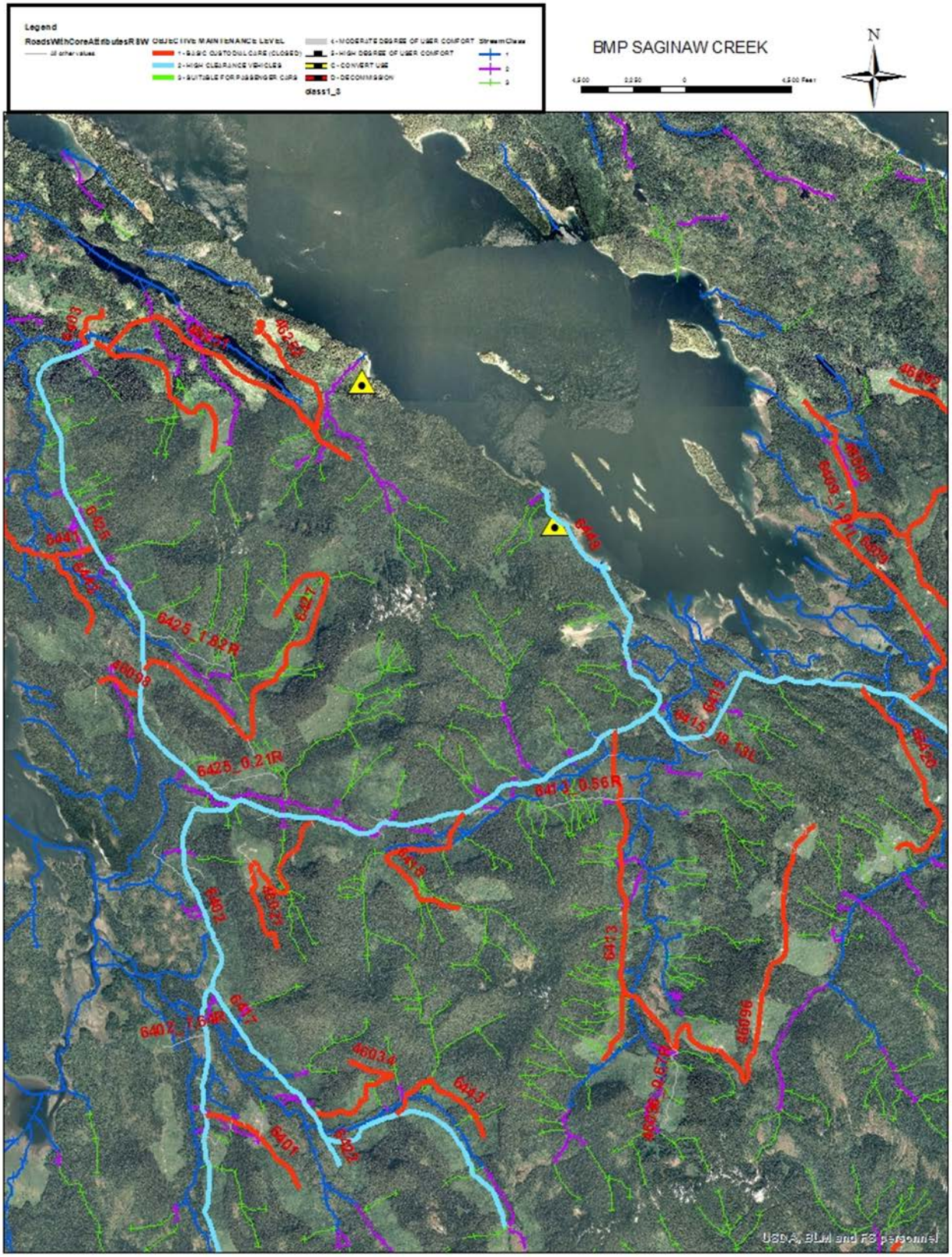
## BMP Effectiveness

### *Corrective Actions to Improve Effectiveness*

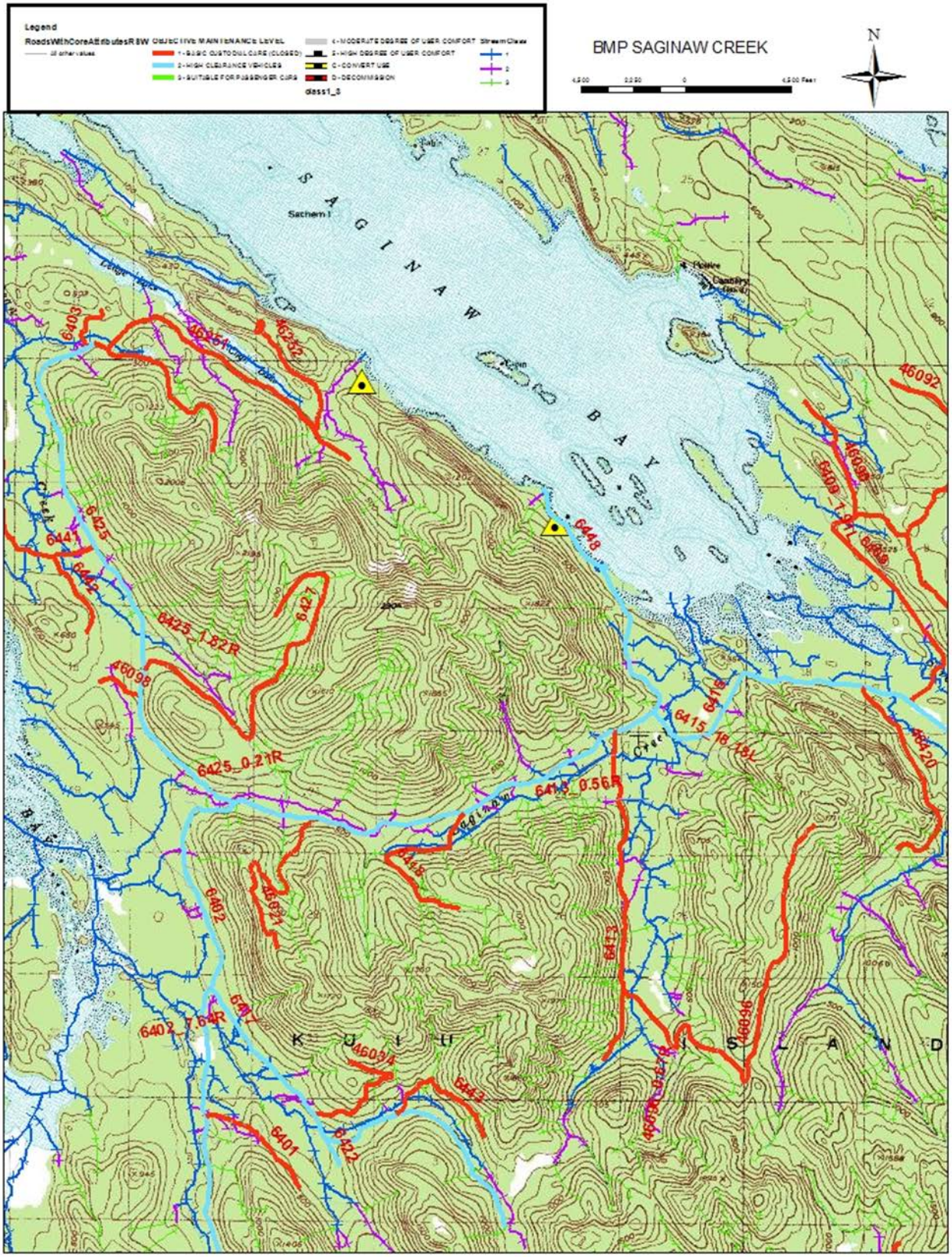
Staging decks of logs should not occur on puncheon trails in the riparian management areas (RMAs) to minimize disturbance to the RMA and to minimize the footprint of the puncheon trail.

### *Adaptive Management Actions to Improve Effectiveness*

Consider trade-offs of rock roads instead of puncheon trails for this type of project in the future.




**Saginaw Creek Figure 1. Ortho photo of Saginaw Creek**




**Saginaw Creek Figure 2. Saginaw Creek map**

# Completed Construction of Transmission Lines, Facilities C Form, Swan-Tyee Intertie, Shrimp Road System Crossing, Ketchikan-Misty Fiords Ranger District, Tongass National Forest

August 21, 2014

Summarized by Darin Silkworth

## Background

An interdisciplinary group monitored best management practices (BMP) implementation and effectiveness on a crossing of the Shrimp road system, a randomly selected segment of the Swan-Tyee Intertie. Participants on the interdisciplinary trip included Darin Silkworth, Tongass Soil Scientist; Jon Hyde, Ketchikan-Misty Fiords Ranger District Fish and Wildlife Staff Officer; and Aaron Steuerwald, Ketchikan-Misty Fiords Ranger District Forester.

BMPs were fully implemented and were effective.

## BMP Implementation

During implementation, provisions were made for protecting water, aquatic and riparian resources.

No problems occurred; therefore, no corrective actions were needed.

No spills or leaks occurred during past five years.

### *Corrective Actions to Improve Implementation*

No corrective actions needed to improve implementation.

## BMP Effectiveness

There is no evidence of erosion or sedimentation, or chemical or fuel spills, leaks or waste containers.

Project inspections were performed at critical times, or activities were conducted to avoid critical times.

### *Adaptive Management Actions to Improve Effectiveness*

Although unrelated to BMPs, contract specifications required utilization of merchantable timber within 2 miles of an LTF. This segment was within the 2-mile limit, but it appears no merchantable timber was salvaged. See the photos below of merchantable timber that was not used.

# Single Pit Area 1, Thorne Bay Ranger District, Tongass National Forest

September 16, 2014

## Background

An interdisciplinary group (Dennis Landwehr, Tongass Soil Scientist Program Manager; Delilah Brigham, Thorne Bay Ranger District Planning Program Specialist, Rachelle Huddleston-Lorton, Thorne Bay District Ranger; Carol Seitz-Warmuth, Tongass Inventory and Monitoring Coordinator) evaluated best management practices (BMPs) on completed timber harvest. This unit was clearcut shovel logged with a 100-foot stream buffer and 75 foot riparian management area (RMA) buffer along an unnamed stream. Treatment began in 2008 and was concluded in July 2014. The unit was approved as part of the Goose Creek Environmental Assessment (EA).

## BMP Implementation

The implementation questions evaluate practices used to minimize water quality impacts. No adverse actions were reported during implementation.

### *Corrective Actions to Improve Implementation*

No corrective actions were listed in the review.

### *Adaptive Management Actions to Improve Implementation*

No adaptive management actions were listed in the review.

## BMP Effectiveness

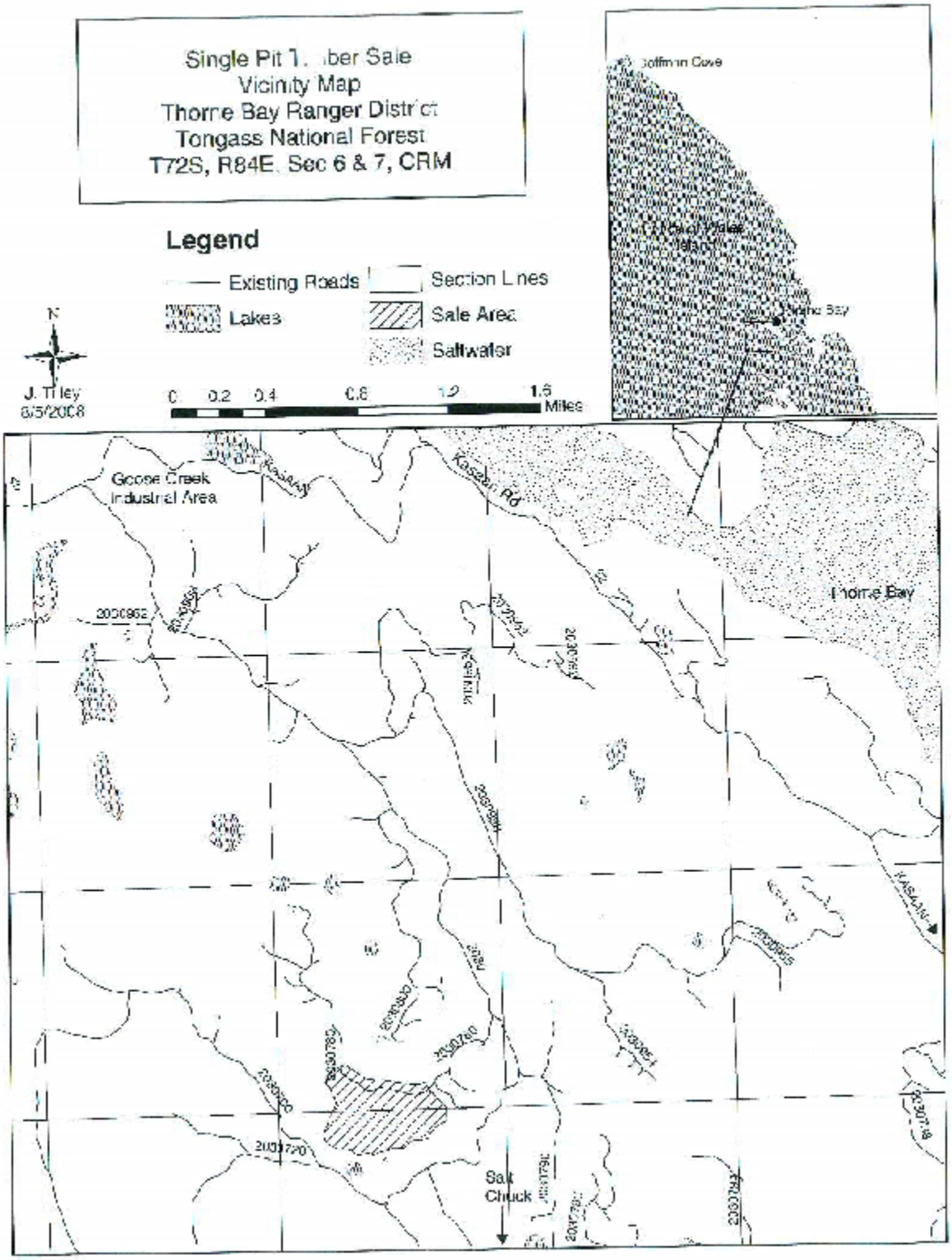
The BMPs seem effective in limiting potential or current impacts to water quality.

### *Corrective Actions to Improve Effectiveness*

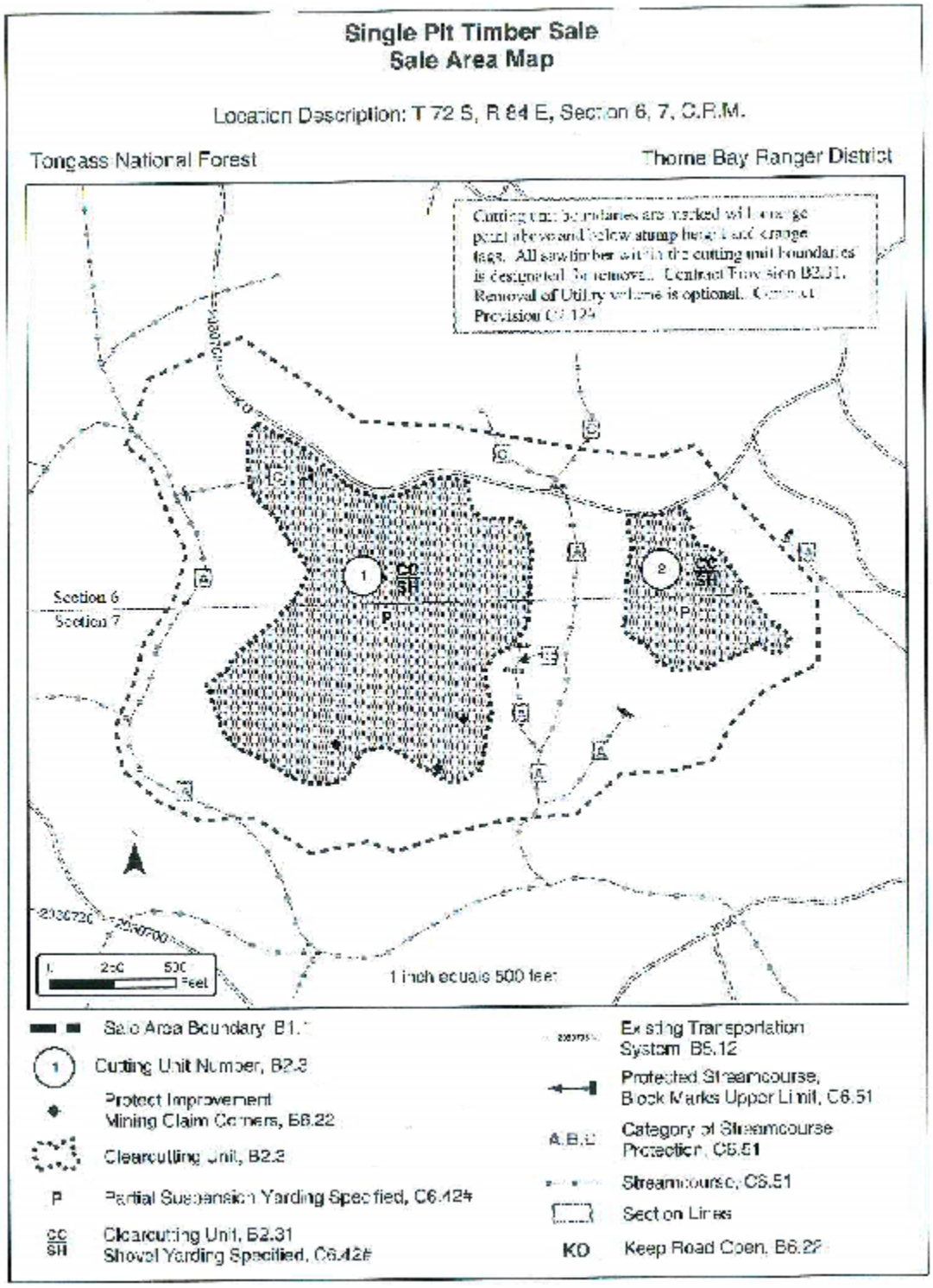
No corrective actions were listed in the review.

### *Adaptive Management Actions to Improve Effectiveness*

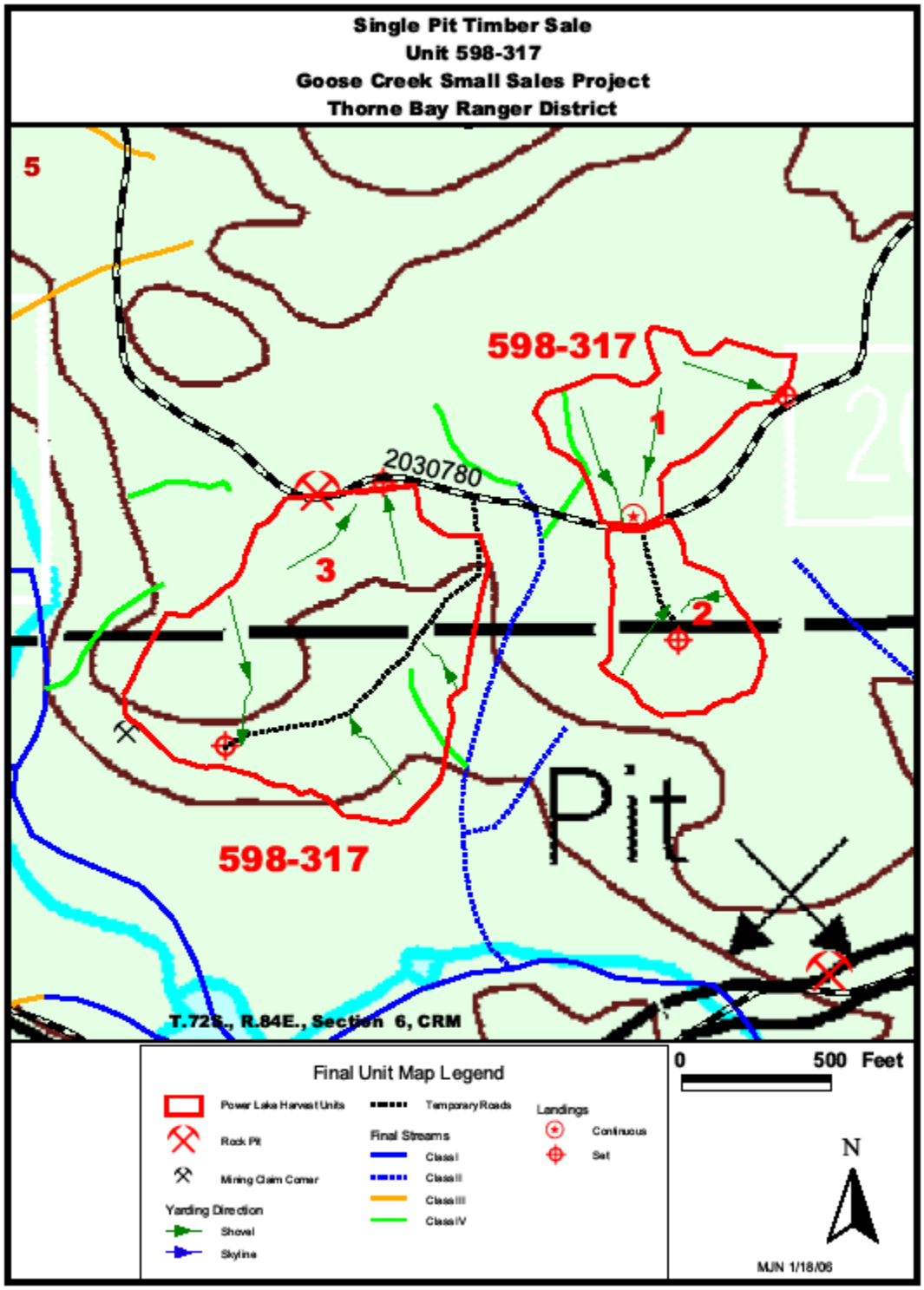
No adaptive management actions were noted.




**Single Pit Sale Figure 1. Vicinity map of the Single Pit Timber Sale**




**Single Pit Sale Figure 2. Sale area map for the Single Pit Timber Sale**




**Single Pit Sale Figure 3. Unit Map**

*Single Pit Sale Photo 1. Temporary road accessing the Single Pit Timber Sale unit*

*Single Pit Sale Photo 2. Stream buffer*

*Single Pit Sale Photo 3. Clearcut*

*Single Pit Sale Photo 4. Clearcut*

# Starrigavan Road 7513, Sitka Ranger District, Tongass National Forest

August 11, 2014

## Background

An interdisciplinary group evaluated best management practices (BMPs) on road 7513 in Starrigavan Recreation Area. The work was completed on the road in 2014. The Sitka District Ranger determined that these actions fall under categories of action excluded from documentation in an environmental impact statement (EIS) or environmental analysis (EA) as established by the Chief, FSH 1909.15.30, 32.12 "Repair and Maintenance of roads, trails and landline boundaries". This road accesses Starrigavan Recreation Area, a popular recreation area, and Harbor Mountain Road and is located near the community of Sitka. It includes an estuary, recreation facilities including camping, picnic sites, an artesian well and several different recreation trails. It is regularly graded and very popular with tourists and locals alike. The road switch backs up a steep gradient.

During the BMP monitoring, 760 feet of road were evaluated and of those 400 feet were located within an Aquatic Monitoring Zone (AMZ). The road crosses one perennial stream/river with a baffled culvert with a headwall on the downstream side, covered in graded aggregate.

The need for continued use of this road has been documented in an Access and Travel Management Plan (ATM) and road objectives have been developed. This road is closed by gate for winter travel.

## BMP Implementation

The implementation questions evaluate practices used to minimize water quality impacts. All applicable BMPs were implemented at the road. A review of the maintenance project files documented aquatic specialist review and recommendations. The work was completed by a Forest Service Contractor. The work included blading the road with a compaction B and all the roads within in the campground were graded and rolled twice. The first grading occurred in July and the second in September. The section selected for monitoring was focused on a Class II stream that transported water from the side slope across the road and toward a Class I stream. This site was selected because it was the shortest distance between the crossing and the Class I stream. The Forest Service inspector was onsite during critical times of the road the grading. The BMPs were fully implemented at the site.

### *Corrective Actions to Improve Implementation*

No corrective actions were noted for this road.

### *Adaptive Management Actions to Improve Implementation*

No adaptive management actions were noted for the road.

## BMP Effectiveness

The effectiveness questions evaluated evidence of potential or current impacts to water quality. The road segment included one waterbody crossing, designated as a perennial stream/river and a Class I and II stream. No evidence of erosion or sedimentation was noted at the waterbody crossing or its approach. The road grade was consistent with no rills or ruts. No diversion potential noted. The streams were flowing in their natural channel and the culverts were designed to transport water across the road.

### *Corrective Actions to Improve Effectiveness*

No corrective actions were noted for the road.

### *Adaptive Management Actions to Improve Effectiveness*

No adaptive management actions were noted for the road.

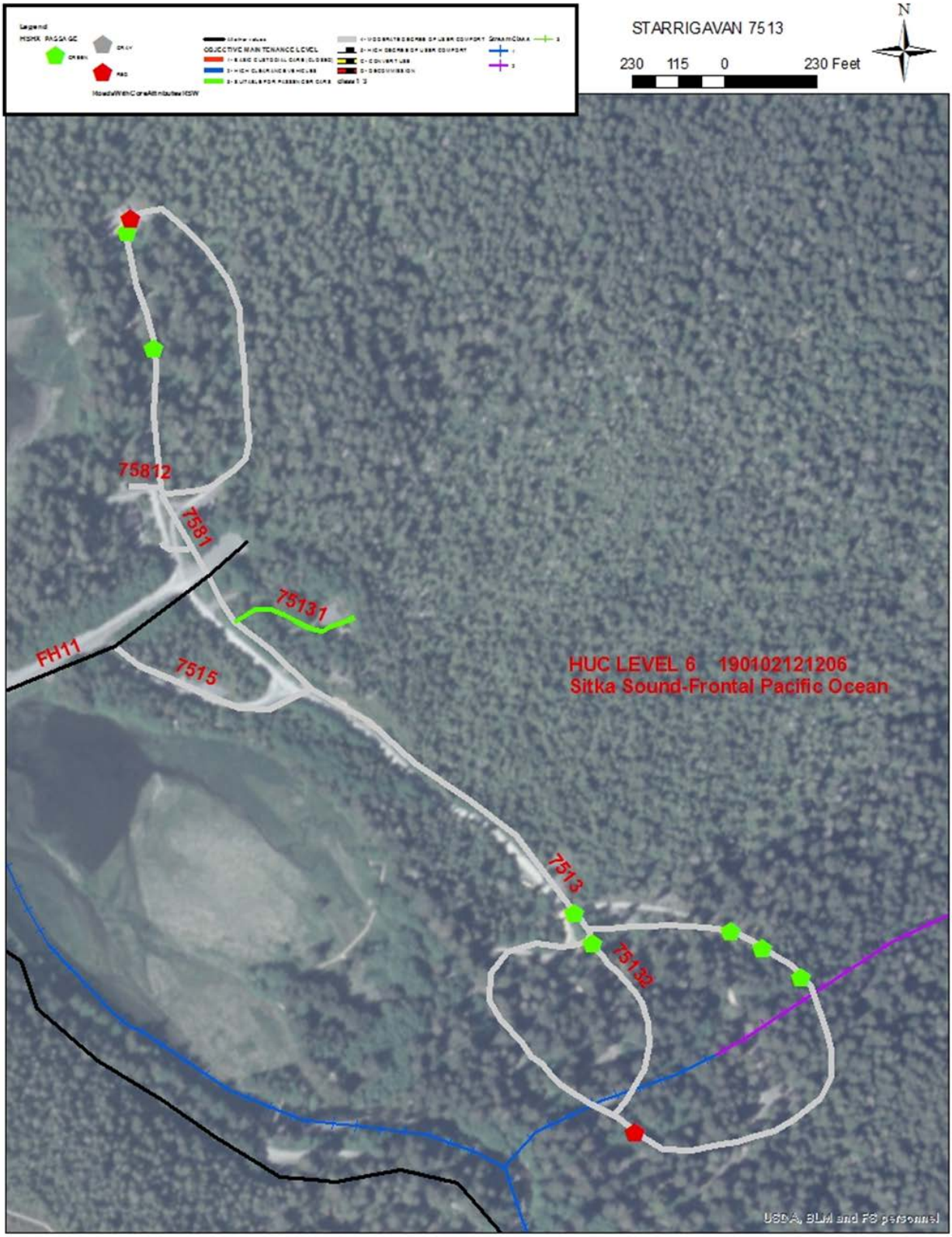
*Starrigavan Road Photo 1. Starrigavan road surface*

*Starrigavan Road Photo 2. Downstream culvert*

*Starrigavan Road Photo 3. Downstream culvert*

*Starrigavan Road Photo 4. Upstream culvert*

*Starrigavan Road Photo 5. Starrigavan road looking west and east*




**Starrigavan Road Figure 1. Ortho photo of Starrigavan recreation area**

# Tonka Stewardship Contract, Petersburg Ranger District, Tongass National Forest

September 10, 2014

Summarized by Carol Seitz Warmuth

## Background

An interdisciplinary group evaluated best management practices (BMPs) on the Petersburg Ranger District in September 2014. The intent of the BMP review was to provide quality control to the BMP implementation and effectiveness monitoring effort on the Forest. Participants on the interdisciplinary trip included Teresa Streuli, Petersburg Ranger District Timber Sale Administrator; Brett Uppencamp, Petersburg Ranger District Harvest Inspector; Dennis Landwehr, Tongass Soil Scientist Program Manager; Heidi Lombard, Petersburg Ranger District Fish Biologist; Jason Powell, Tongass Road Planner; and Carol Seitz Warmuth, Tongass Monitoring and Inventory Coordinator.

The interdisciplinary team (IDT) monitored two units, specified road 6341, the Tonka sort yard and LTF as part of the BMP implementation and effectiveness monitoring. The Tonka Timber Sale units included 609 and 610. The unit evaluation focused on the stream reaches that showed the highest potential for sediment transport to a significant drainage down slope, as well as soil disturbance within the unit. The road evaluation focused primarily on the road crossing. The IDT monitoring group selected the water crossing that showed the most potential for water quality impacts as the focal point of the road monitoring and monitored roughly 0.25 mile on both sides of the crossing.

The Tonka timber harvest is part of the Tonka Stewardship Contract, developed under the Tonka Timber Sale environmental impact statement (EIS). The record of decision (ROD) for the Tonka EIS was signed March 28, 2012 although planning occurred before the 2008 Forest Plan Amendment. Upon review and evaluation, the units were found consistent with the standards and guidelines of the 2008 Forest Plan Amendment. This EIS has incorporated direction from the 2008 Decision on the Tongass Land and Resource Management Plan (Forest Plan) responding to the Tongass Adaptive Management Strategy. These units were harvested under the 2008 Forest Plan ROD. The 2008 Standards and Guidelines apply to all units. The logging systems are shovel, skyline cable and helicopter systems although only shovel units were reviewed by the IDT. Erosion control plans were completed for this timber sale and signed by the operator. Spill prevention, control and countermeasure plans were developed for this timber sale and copies submitted for IDT monitoring review. The timber was hauled to the Tonka log transfer facility (LTF).

Change analyses were completed for the Tonka Timber Sale. The change analysis focused on changes relative to the environmental effects of key issues identified by the (IDT). Noted changes included modification to increase the number of eve- age harvest units and decrease the number of uneven-age treatments. Specific to the units monitored, the unit boundaries on most of the units were adjusted to conform to local terrain, adjacent stream buffer requirements and logical settings. During implementation of Tonka Timber Sale, minor changes were made on the stream mapping. Changes were documented relative to the temporary and specified road/stream crossings. The road locations were adjusted to minimize stream crossings. Some additional steep ground was added to the harvest units and a minimal increase of soil disturbance was anticipated. The amount of temporary road was decreased, thus, anticipated to contribute to less soil disturbance. The size of the sort yard was increased from five acres to eight acres to better accommodate log sorting, log storage and control surface water. The required clearing limits for the sort yard and the construction of access roads added additional area, so the disturbed area was increased to sixteen acres.

This monitoring utilized pilot National BMP monitoring forms. The national forms completed for this effort were the Best Management Practices Evaluation: Veg A Ground-based Skidding and Harvesting and Road B Completed Road and/or Water Body Crossing Construction or Reconstruction form.

The units and road monitored were located in T58S, 59, 60 R77E, 78, 79 Copper River Meridian on the Lindenburg Peninsula, Kupreanof Island. The project area is approximately 2 air miles west of Petersburg. These units and road are located in value comparison units (VCUs) 4370, 4390 and 4470. The road and units are in the Duncan Canal-Frontal watershed, HUC 19010210110 and Mitchell Slough, HUC 1901020101106.

*Tonka Stewardship Photo 1. Central-west portion of Tonka harvest unit 610 showing stream buffers on east and west.*

## Monitoring Results

### *Unit 610*

Unit 610 is a 6 acre unit comprised of three connected segments; two segments below the road and one segment above the road bound by stream channels. The unit was accessed by Forest Development Road (FDR) 6350. The unit has a low- mid gradient slope that averages 35 percent slope gradient. Originally the unit was 4 acres and included only the area below the road. The original configuration included the area adjacent to stream 1.8 in the Class IV and II reaches of the high gradient contained (HCO) channel. Due to the configuration of the streams and buffer requirements, and configuration of the terrain, the boundaries of the unit were changed during lay out.

The final unit configuration shown in the contract dropped the area adjacent to the Class II reach of stream 1.8 and added an area roughly 2 acres above the road. Below the unit, a Class I stream flows westward in a moderate gradient mixed control (MMS) channel that has a 120-foot buffer requirement. Stream 1.7 is buffered from the unit on the west boundary and flows downslope. Stream 1.7 flows in a high gradient contained channel (HCO- HCL) and is a tributary to stream 1; the confluence lies roughly 700 feet below the unit. Stream 1.9 flows in a channel buffered off the east boundary of the unit. This stream shows a lower gradient and flows in a moderate gradient mixed control (MMS) channel. The confluence to stream 1 lies roughly 250 feet below the unit. Stream 1.8 originates in the unit above the road then flows into the unit in a high gradient HC channel that is roughly 2 feet wide and shows stepped pools with minimal flow. Stream 1.8 transitions into a Class II stream that is roughly 2-3 feet wide and flows in a high gradient (HCO) channel for about 550 feet then the gradient decreases and the stream flows in a mixed gradient channel (MMO) that is roughly 3-5 feet wide for

*Tonka Stewardship Photo 2. Lower-east portion of Tonka harvest unit 610 showing stream buffers on east and west.*

about 550 feet to the confluence with stream 1. The MMO reach of stream 1.8 is a Class I stream.

*Tonka Stewardship Photo 3. Tonka harvest unit 610, stream 1.8; Class II stream reach showing stream channel*

Stream 1.8 was walked and inspected during the monitoring trip since this stream originated in the unit and showed a Class IV reach that transitioned to a Class II reach to a Class I reach within 1000 feet. Stream protection measures were implemented on the reaches of the channel; buffers implemented on the Class II and I reaches and tree debris was removed from the Class IV stream channel. The buffer was implemented on this stream and effective in preventing sediment transport from the harvest activities. This stream was a relatively small 1- 5 feet bank full width channel and flowed in a moderate gradient meandering channel with gravel substrate to a shallow gradient stream with cobble to gravel substrate with fines. The Class II reach of the unit required 100 feet buffer and the buffers measured showed 102 feet, 106 feet, and 112 feet, exceeding the minimum requirement. The Class I stream reach showed buffers that exceeded 120 feet; the shortest buffer measured 124 feet. In the Class IV stream reach within the unit, stream 1.8 was well cleaned out and showed no disturbance in the channel. The banks were moss covered. The stream bedload was primarily gravel with cobbles and fines.

The timber was shovel yarded from this unit to road 6350. The shovel yarding was completed with minor impact to the soils. Tree debris was used under the shovel yarder as puncheon. Partial suspension was implemented to meet soil quality standards. The unit showed no erosion within the unit and erosion control measures were implemented on the road. No supplemental erosion control was needed in the unit or on the road. Minor areas of detrimental disturbance were noted in less than 1 percent of the unit and supplemental erosion control through slashing a small area and fluffing was applied. The unit harvest and yarding completed meets the soil quality standards.

### *Unit 609*

Unit 609 is a 9 acre unit bound by stream channels on the north and south sides of the unit. The unit was accessed by FDR 6350. The unit has a low gradient slope that averages 2-5 percent slope gradient. Originally the unit was 8 acres with an irregular configuration that included some relatively flat and higher slope gradient area and crossed stream 2 through Class I and II stream reaches of high gradient and mixed gradient channel. Due to the configuration of the streams and buffer requirements, and configuration of the terrain, the boundaries of the unit were changed during lay out. The final unit configuration shown in the contract dropped the area that crossed stream 2 and provided a buffer adjacent to the Class I and II reaches of stream 2 and added an area roughly 2 acres above the road.

*Tonka Stewardship Photo 4. Tonka harvest unit 610, stream 1.8; Class IV stream reach showing stream channel*

*Tonka Stewardship Photo 5. Tonka harvest unit 609 showing stream buffers outside the north and south unit boundaries.*

North of the unit, stream 1 flows southwest along the border of the unit. This stream originates above the unit and flows in a high gradient contained (HCL) channel adjacent to the upper (eastern portion) of the unit and that transitions to a moderate gradient mixed control (MMS) channel roughly 500 feet from the road. This stream has a 100 feet buffer in the HCL reach and a 120 feet buffer requirement in the MMS reach. Stream 2 is a Class II stream that transitions to a Class I stream and borders the southern portion of the unit. This stream flows in a moderate to high gradient contained (HCO) channel in the upper Class II reach and a moderate gradient mixed control channel (MMO) in the lower Class I stream reach.

Stream 1 was walked and inspected during the monitoring trip since this stream is located in closest proximity to the unit and showed a Class II stream reach that transitioned to a Class I reach. Stream protection measures were implemented on the reaches of the channel; buffers implemented on the Class II and I reaches. The buffer was implemented on this stream and effective in preventing sediment transport from the harvest activities. This stream was a relatively small 2- 5 feet bank full wide channel and flowed in a moderate gradient meandering channel with gravel substrate to a shallow gradient stream with cobble to gravel substrate with fines. The Class II reach of the unit required a 100-foot buffer and the buffers measured showed 108 feet and 114 feet, exceeding the minimum requirement. The Class I stream reach showed buffers of 120 feet and 124 feet.

The timber was shovel yarded from this unit to road 6350. At the southwest edge of this unit a helicopter landing area was developed. The shovel yarding was completed with minor impact to the soils. There had been more shovel ruts shown in the unit than anticipated on the relatively flat ground; however, the ruts were slash-covered to prevent erosion. The detrimental soil conditions were shown in 1- 2 percent of the unit. Partial suspension was implemented to meet soil quality standards. The unit showed minimal erosion within the unit and erosion control measures were implemented on the road. No supplemental erosion control was needed in the unit or on the road. Supplemental erosion control through slashing and fluffing was applied. The unit harvest and yarding completed meets the soil quality standards.

*Tonka Stewardship Photo 6. Tonka harvest unit 609 showing stream buffers outside the north unit boundaries on stream 1.*

### *Road 6351*

*Tonka Stewardship Photo 7. Tonka harvest unit 609 showing stream 1; Class I stream reach.*

Road 6351 is accessed off FDR 6350, roughly 9 miles west of the Tonka Marine Access Facility (MAF)/ Log Transfer Facility (LTF). This road accesses the Mitchell Creek fishway and was left open to provide recreational and administrative access to the fishway. Although at one time access was needed to yard the timber harvest units, this road was planned as a 0.352 mile long specified road due to the public use. Road 6351 was designed and constructed as a road with minimal construction controls and requirements of culverts at all live stream crossings. The culvert was removed from the live stream and a driveable water bar was installed. This stream is a Class IV stream that flows to Mitchell Creek. The stream transports water from a beaver pond across the road. The road was constructed roughly 200 feet upslope of Mitchell Creek. The road had roadway reconditioning completed for road maintenance that included installation of a one foot deep lift of shot rock and (8 inches loose then 6 inches compacted) aggregate. The reconstruction included surfacing a 30 x 45 feet parking lot at the end of the road for the Mitchell Creek fishway. The construction specified the aggregate placed on the slopes of the drivable ford in a compacted layer. This maintenance completed is covered in the categorical exclusion for road maintenance that does not require a decision memo as defined in 36 CFR 220.6(d).

The road was constructed in 1982 with a road operational level of 2 for high clearance vehicle traffic with a Road Management Objective 2 (open- high clearance vehicles). The District had on file a hazardous communication/waste mitigation plan and the contract had a Spill Prevention Countermeasure and Control (SPCC) plan to address any petroleum spills. No spills were noted along the road or in the inspection file.

The segment monitored through the national BMP protocol was focused on a drivable water bar provides a Class IV stream crossing located approximately at MP 015. The road segment evaluated in the monitoring was roughly 0.4 mile long. The length of connected road surface approaches are 52 feet on the left and 41 feet on the right and the length of road in the aquatic management zone is roughly 100 feet. The connected road ditches measured at 131 feet on the left and 146 feet on the right. The dominant road grade to the right was 5 percent slope gradient and 10 percent slope gradient to the left.

*Tonka Stewardship Photo 8. Tonka recreation road 6351; showing road corridor.*

Implementation monitoring showed that the provisions to protect water, riparian, and aquatic resources were implemented in planning and contract development. The monitoring showed several provisions were implemented in road construction. Only reshaping of the drivable waterbar was needed to provide a more durable

*Tonka Stewardship Photo 9. Tonka recreation road 6351; showing drivable dip*

running surface. Corrective action noted as required to fully implement the BMPs include adding armor rock to the crossing and removal of the fines used to shape the surface contour of the drivable dip. To minimize further erosion of the running surface, the group recommends that the larger rock be added to the crossing to prevent ruts from vehicle traffic.

Effectiveness monitoring showed that the BMPs specific to the featured stream crossing were effective, overall. The lift of durable surface rock that included 6- 8 inches of loose rock and 6 inches of compacted surficial aggregate provided a hardened running surface on the road. There was one practice related to surface erosion that was not effective. Surface instability was indicated by ruts in the running surface of the drivable dip. There was traceable evidence in the water body and isolated turbidity and very minor changes in the substrate composition from the fines transported at the crossing. Minor bank cutting and puddling was noted on the road at the crossing. Sediment was transported less than 10 feet from the road surface to the stream at the crossing. The changes recommended by the group included adding armoring rock to the crossing and removing fines from the road surface in the dip. This minor modification should contribute to more effective implementation of the BMPs. No other erosion or sediment transport was noted on the road and the road surface was constructed to provide effective implementation of the BMPs.

## BMP Implementation

The implementation questions evaluate practices used to minimize water quality impacts. All applicable BMPs were implemented on the units and road. A review of the maintenance project files documented aquatic specialist review and recommendations. The trail was in need of maintenance because of runoff and erosion in and around Carlanna Creek. This section of units and road is not on Forest land.

### *Corrective Actions to Improve Implementation*

There were no corrective actions noted at the units and one minor corrective action recommended on road maintenance. The work was well implemented and well designed. The drivable dip on the road served to drain water from the beaver pond and with minor modification will provide a hardened travel surface.

*Tonka Stewardship Photo 10. Tonka sort yard; showing back wall in the distance*

*Tonka Stewardship Photo 11. Tonka sort yard; showing back wall raveling*

### *Adaptive Management Actions to Improve Implementation*

No adaptive management actions were noted for the units and road.

## BMP Effectiveness

The effectiveness questions evaluated evidence of potential or current impacts to water quality. No noted sediment transport or substantial erosion was noted in the units. Minor sediment transported was noted at the drivable water bar and will be remedied by minor road maintenance. Stream impacts were minimized by the changes in the unit configurations that included moving the boundaries outside of the stream buffers. Erosion and sediment transport was minimized through the implementation of buffers and applications of shovel logging. Soil disturbance was minimized through the use of puncheon and slash in the shovel units. The construction of the lift of durable rock on the running surface of the road minimized erosion potential.

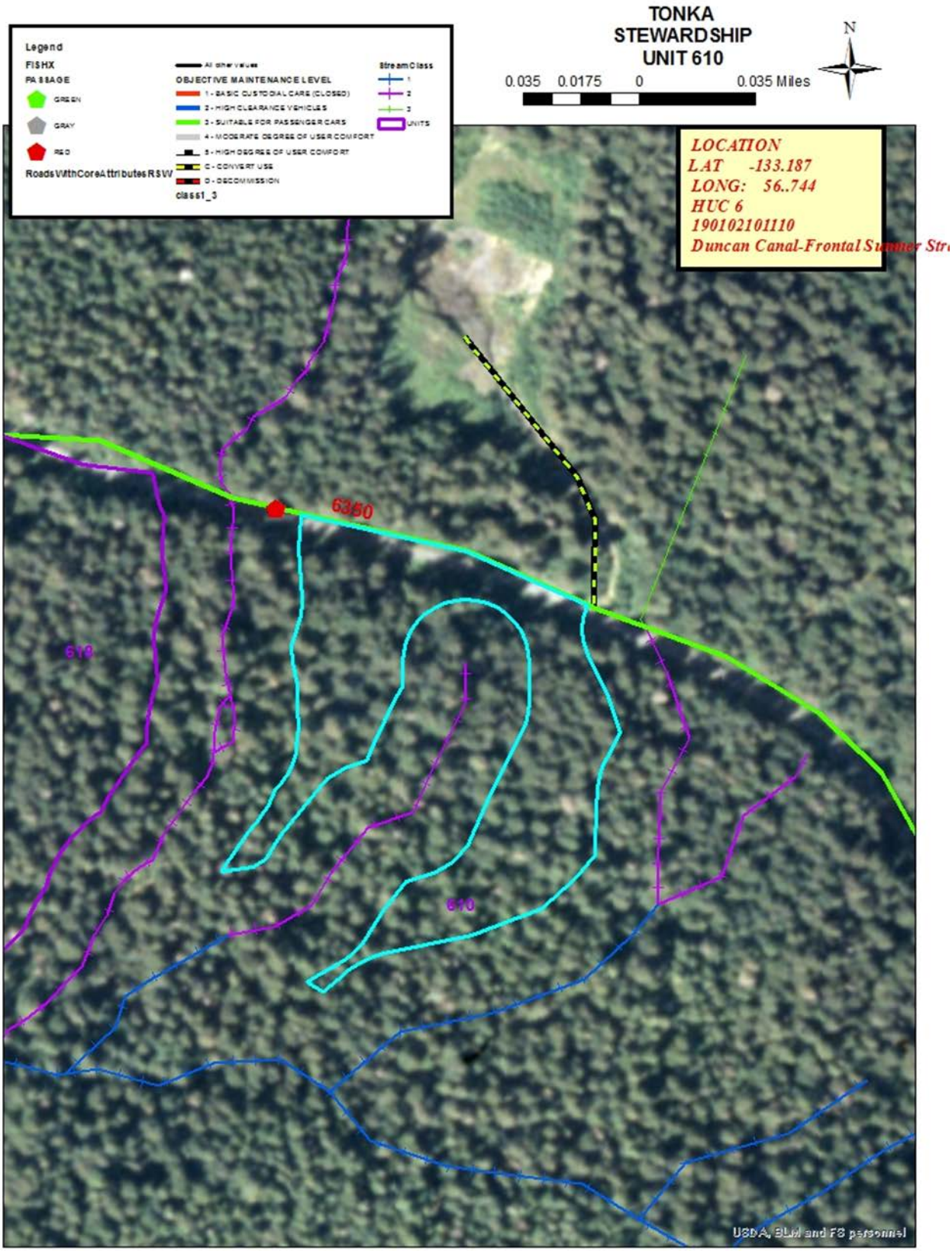
### *Corrective Actions to Improve Effectiveness*

No corrective actions were noted for the units. Using larger rock material in drivable dips through water crossings, as well as standard ford construction drawings was recommended on the road monitored.

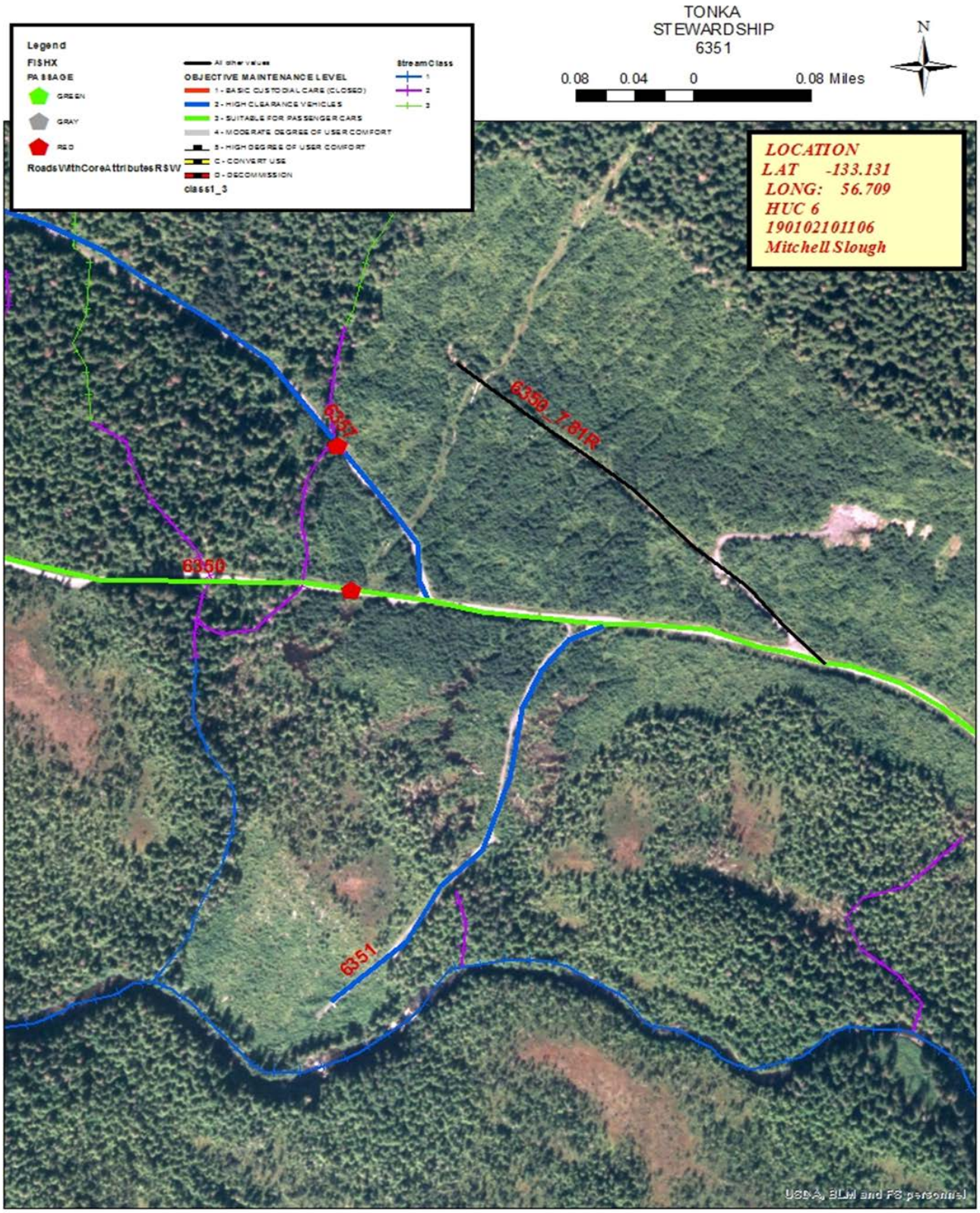
### *Adaptive Management Actions to Improve Effectiveness*

No adaptive management actions were noted for the units and road.

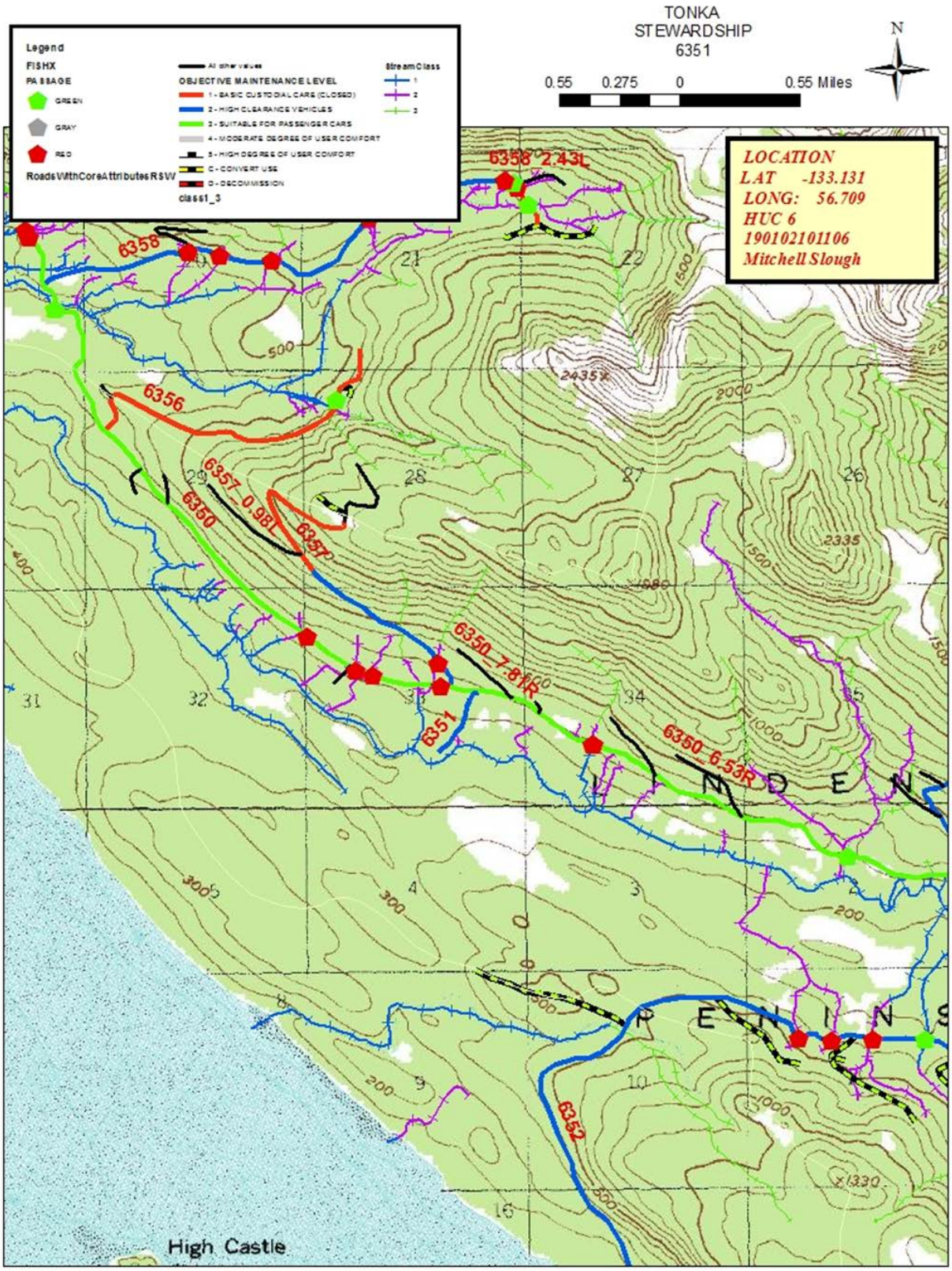
*Tonka Stewardship Photo 12. Tonka sort yard drainage and settling pond.*




**Tonka Stewardship Figure 1. Tonka unit 610**




**Tonka Stewardship Figure 2. Tonka road 6351**




**Tonka Stewardship Figure 3. Map showing Tonka road 6351**