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# Monitoring Guide

## For the Chugach National Forest Revised Land and Resource Management Plan

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# Monitoring Guide

## For the Chugach National Forest Revised Land and Resource Management Plan

R10-MB-733, September 2011

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# Acronyms

| | |
|---|---|
| ADF&G | Alaska Department of Fish and Game |
| AICC | Alaska Interagency Coordination Center |
| ANI | Artificial nest island |
| ANILCA | Alaska National Interest Lands Conservation Act |
| ARPA | Archaeological Resource Protection Act |
| BHIMS | Bear-Human Information Management System |
| BLM | Bureau of Land Management |
| BMP | Best management practices |
| BOR | Bureau of Reclamation |
| CE | Categorical exclusion |
| CEQ | Council on Environmental Quality |
| CFR | Code of Federal Regulations |
| CI | Confidence interval |
| CO | Carbon monoxide |
| DEIS | Draft environmental impact statement |
| DLP | Defense of life and property |
| EA | Environmental assessment |
| EIS | Environmental impact statement |
| EO | Executive Order |
| EPA | Environmental Protection Agency |
| ESA | Endangered Species Act |
| ESI | Environmental Sensitivity Index |
| EVOS | Exxon Valdez oil spill |
| FACTS | Forest Service Activity Tracking System |
| FEIS | Final environmental impact statement |
| FIA | Forest Inventory and Analysis |
| FOIA | Freedom of Information Act |
| FONSI | Finding of no significant impact |
| FMO | Fire management officer |
| FRCC | Fire regime condition class |
| FSH | Forest Service Handbook |
| FSM | Forest Service Manual |
| INFRA | Infrastructure Database |
| GIS | Geographical Information System |
| GPS | Global Positioning System |
| LANDFIRE | Landscape Fire Resource Management Planning Tools |
| LEI | Law enforcement investigation |
| LEIMARS | LEI Management Attainment Reporting System |
| MIS | Management indicator species |
| ML | Maintenance level |
| MEIT | Monitoring and evaluation interdisciplinary team |
| MODIS | Moderate Resolution Imaging Spectroradiometer |
| MOU | Memorandum of understanding |
| NAAQS | Nation Ambient Air Quality Standards |

| | |
|---|---|
| NDMI | Normalized difference moisture index |
| NDVI | Normalized difference vegetation index |
| NEPA | National Environmental Policy Act |
| NFMA | National Forest Management Act |
| NFS | National Forest System |
| NFSR | National Forest System road |
| NFST | National Forest System trail |
| NHD | National Hydrological Database |
| NOA | Notice of availability |
| NOAA | National Oceanic and Atmospheric Administration |
| NOI | Notice of intent |
| NPS | National Park Service |
| NRIS | Natural Resource Information System |
| NTU | Nephelometric turbidity units |
| O/G | Outfitter and guide |
| OHV | Off-highway Vehicle |
| OML | Operational maintenance level |
| OSV | Over-snow vehicle |
| OUD | Overnight-use developed recreation fee-site facilities |
| PALS | Planning, Appeals and Litigation System |
| PAOT | People at one time |
| PNW | Pacific Northwest Research Station |
| RLMP | Resource land management plan |
| RMRS | Rocky Mountain Research Station |
| RNA | Research natural area |
| ROD | Record of decision |
| ROS | Recreation opportunity spectrum |
| RV | Recreational vehicle |
| SE | Standard error |
| SIO | Scenic integrity objective |
| SOPA | Schedule of Proposed Actions |
| SUPE | Sample unit probability estimator |
| SUV | Sport utility vehicle |
| TES | Threatened and endangered species |
| UPGMA | Unweighted pair group method with arithmetic mean |
| U.S.C. | United States Code |
| USDA | United States Department of Agriculture |
| USFWS | United States Fish and Wildlife Service |
| USGS | United States Geological Survey |
| UTM | Universal Transverse Mercator |
| VQO | Visual quality objective |
| WSA | Wilderness study area |

# Executive Summary

The Chugach National Forest Revised Land and Resource Management Plan (Revised Forest Plan) identifies management direction for the Chugach National Forest through goals and objectives, desired conditions, standards and guidelines, and management area direction. This direction is based upon underlying assumptions about how the Revised Forest Plan will be implemented and what the results of the implementation will be. These assumptions lead to the development of a set of key questions that are identified in Chapter 5 of the Revised Forest Plan. Monitoring is the gathering and evaluation of information to address these questions.

The Monitoring and Evaluation Program for the Revised Forest Plan includes a number of elements: a monitoring and evaluation interdisciplinary team, a monitoring guide, an annual monitoring program of work, an annual monitoring and evaluation report, and a five-year monitoring and evaluation report. The monitoring guide is presented here.

The Revised Forest Plan and subsequent documents established 43 general monitoring questions for the Chugach National Forest. This includes three questions added after the Plan was published, including one left out inadvertently and two added as a result of appeal decisions.

A meeting with the Pacific Northwest Research Station, the Monitoring and Evaluation Interdisciplinary Team (MEIT), and the Chugach National Forest's Supervisor and Resources Staff Officer resulted in agreement that forest plan monitoring should focus on priority questions and be realistic in what it proposes to accomplish. This conclusion was largely driven by the fact that full implementation of the Monitoring and Evaluation Strategy in Chapter 5 of the Revised Forest Plan is not possible given current and projected funding levels. For these reasons, the forest leadership team approved a process, developed by the MEIT, for evaluating each monitoring item in the Monitoring and Evaluation Strategy.

The MEIT evaluated 46 monitoring items (evaluation included three monitoring items not documented in the Revised Forest Plan) using a set of merit criteria. Weighted averaging was used to score each item from 0 to 1, based on merit criteria. The 33 monitoring items with overall scores exceeding 0.50 were determined to be priority items suitable for protocol development. At this time, 24 monitoring protocols have been developed, approved, and are included in this monitoring guide. Of the remaining priority monitoring questions with overall scores exceeding 0.50, five have protocols still under development and others have either been combined with other questions or are being proposed to be dropped. As additional monitoring protocols are approved, they will be added to this guide.

The format for the monitoring protocols was developed by the MEIT with guidance from GTR-WO-72. The goal of the protocol descriptions is to provide sufficient (but not excessive) information so that a person other than the author can understand and implement the methods.

# Introduction

This document details the methodologies and protocols to be used to conduct monitoring and evaluation identified in Chapter 5 of the Revised Land and Resource Management Plan of the Chugach National Forest (Revised Forest Plan) (USDA Forest Service 2002a). The guide is designed to be flexible to accommodate new methodologies and techniques. As monitoring techniques are implemented they can be evaluated for their effectiveness and efficiency, and be revised as appropriate.

As indicated in the Revised Forest Plan (p. 5-4), the monitoring information collected should be consistent with national protocols where available. The data will be stored and maintained in standard national databases and Geographical Information System (GIS) layers (for example, Natural Resource Information System (NRIS) databases http://www.fs.fed.us/emc/nris/).

# Overview of the Monitoring and Evaluation Program

The record of decision (ROD) (USDA Forest Service 2002b; p. 36) of the Revised Forest Plan states, “Monitoring results will be used to evaluate progress toward achieving Revised Forest Plan goals, objectives, and desired conditions.” As described in Chapter 5 of the Revised Forest Plan, the elements to be included in the forest’s monitoring and evaluation program are described below.

## Monitoring and Evaluation Interdisciplinary Team

A Monitoring and Evaluation Interdisciplinary Team (MEIT) was established to facilitate implementation of a monitoring and evaluation program. Based on the Revised Forest Plan (p. 5-3), the MEIT is responsible for:

1) Leading the development and revision (as needed) of a monitoring guide
2) Coordinating implementation of monitoring activities
3) Providing quality control/quality assurance to ensure that national, regional, or forest protocols are followed
4) Ensuring that monitoring is completed and properly reported
5) Synthesizing and publishing annual and 5-year monitoring and evaluation reports
6) Proposing criteria to facilitate setting priorities for the annual forest plan monitoring program of work

A small cadre of specialists representing the range of monitoring activities identified in the Revised Forest Plan comprises the MEIT (formally established in December 2002, and renewed in 2003, 2008, and 2010). The team uses additional internal and external expertise as needed.

# Monitoring Guide

As specified in the Revised Forest Plan (p. 5-3), the monitoring guide identifies:

1) Specific methods for data collection
2) How the data will be stored
3) Responsibilities for managing monitoring information
4) Relationships of the data to national efforts
5) Timing of monitoring and evaluation activities
6) Cooperators and their roles

# Annual Program of Work

As stated on page 1-7 of the Revised Forest Plan, “Annual Forest budget proposals are based on the activities needed to achieve the goals and objectives of the Revised Forest Plan. These activities include the projects anticipated by the Revised Forest Plan, along with the implementation of the Monitoring and Evaluation Strategy. Monitoring results and actual costs of meeting Revised Forest Plan objectives consistent with the standards and guidelines provide the basis for each year’s budget proposals.” Further, page 5-3 of the Revised Forest Plan states that the extent to which the Monitoring and Evaluation Strategy is implemented will depend on funding. MEIT will assist forest management in developing criteria to facilitate setting priorities for the annual forest plan monitoring program of work.

# Annual Monitoring and Evaluation Report

Annually, the MEIT will synthesize and publish monitoring and evaluation reports. As stated on page 5-3 of the Revised Forest Plan, this report will “…briefly summarize the monitoring activities conducted, the evaluation of those items monitored annually or during that year, and recommendations for remedial action. It will describe actions taken in response to recommendations made in previous monitoring and evaluation reports, and will provide references for the public to obtain more detailed information. The Monitoring and Evaluation Report will also contain any annual monitoring accomplishments provided to the Regional Office. The Monitoring and Evaluation Report will be reviewed and approved by the Forest Supervisor within 6 months of the conclusion of the fiscal year.”

# Five-year Monitoring and Evaluation Report

Every 5 years, the MEIT will synthesize and publish a 5-year monitoring and evaluation report. As stated on page 1-9 of the Revised Forest Plan, “The Forest Supervisor is required to review conditions of the land at least every 5 years to determine if forest plan revision is necessary. If monitoring and evaluation indicate that immediate changes are needed, and these needed changes cannot be handled by amendment, then revision of the forest plan becomes necessary.” The Five-year Monitoring and Evaluation Report

replaces the Annual Monitoring and Evaluation Report in the fifth year. As stated on page 5-3 of the Revised Forest Plan, “This report is a complete evaluation of all monitoring items and is intended to provide more detailed rationale for any change in management direction identified in the five-year Revised Forest Plan review.”

## Process for Monitoring Guide Revision

As indicated on page 5-3 of the Revised Forest Plan, the Five-year Monitoring and Evaluation Report may update monitoring items and the monitoring guide (as necessary). Any proposed revisions to the guide are to be submitted to the chair of the MEIT. The chair will include the change proposal(s) on the MEIT agenda for review by the team. If the MEIT concurs with the proposed change (potentially following independent peer review), the MEIT chair will seek forest leadership team approval of the proposed change. The approved changes will then be incorporated into the revised guide. The revised guide will be posted on the Chugach Internet site

## Interpreting the Results of Monitoring

Monitoring and evaluation provides information to determine whether programs and projects are meeting forest plan direction (Forest Service Handbook (FSH) 1909.12, chapter 6). Evaluation of the monitoring data is used to determine the effectiveness of the forest plan and the need to change the plan through amendment. The intensity of the monitoring should be commensurate with the risks, costs, and values involved in meeting plan objectives (FSH 1909.12, 6.03).

Interpretation of monitoring data will focus on an objective evaluation of trends rather than strict statistical analysis. Evaluation of sample data will compare measurements against desired conditions. Crossing the threshold of any desired condition would trigger (1) the altering of management activities to restore desired conditions, (2) a more detailed exploration of potential needs to amend the forest plan, or (3) a description of why the observed change is beyond the control of the forest plan. The extent of this more detailed analysis would be determined on a case-by-case basis as directed by the forest leadership team.

Elzinga et al. (1998: 261) provide an example of interpreting results of monitoring. The four possible outcomes when comparing a sample estimate and confidence interval to a threshold level are illustrated in Figure 1 and discussed below:

1) The threshold level has not been crossed by either the sample estimate or the confidence interval (arrow A). No change in management activities or potential need to amend the plan has been triggered.

2) The threshold level has not been crossed by the sample estimate, but the upper bound (arrow B) or the lower bound (arrow C) of the confidence interval does exceed the threshold value. Potentially, a need to change management activities or amend the plan has been triggered. Further evaluation is warranted in this situation.

3) The threshold level has been crossed by both the sample estimate and the confidence interval (arrow D). Of the four examples, this represents the

strongest case that management activities need to be changed or a potential need to amend the plan has been triggered.

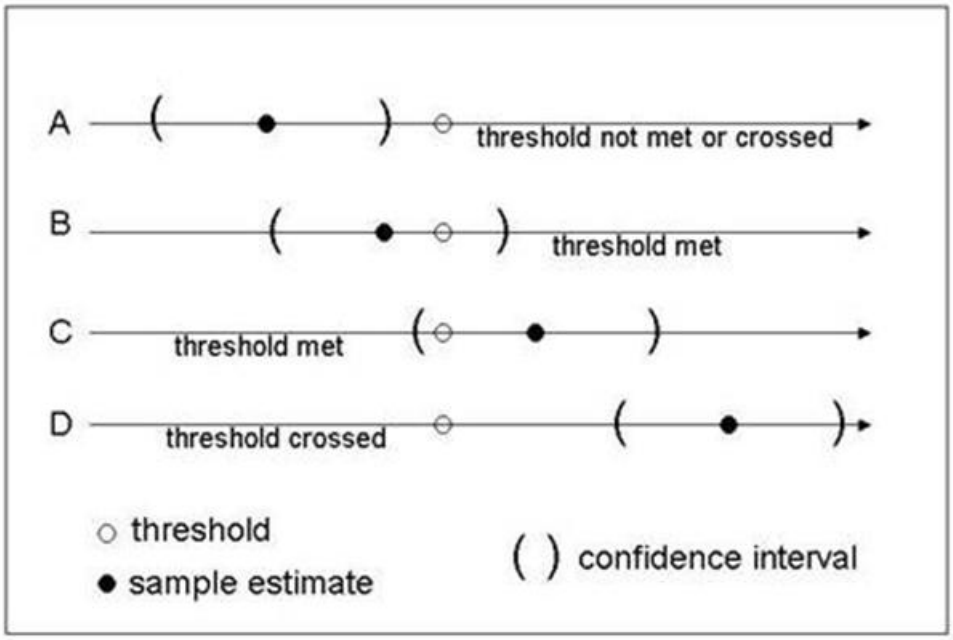


**Figure 1. Four possible outcomes when comparing a sample estimate and confidence interval to a threshold level (adapted from figure 11.22 in Elzinga et al. [1998])**

## Items to be Monitored

Concerns were raised during the development of this guide that some monitoring questions in the Monitoring and Evaluation Strategy (Chapter 5) may not clearly address the assumptions underlying objectives, standards, or guidelines of the Revised Forest Plan. These concerns were echoed in a meeting among the Pacific Northwest Research Station (PNW), the MEIT, and Chugach National Forest's Supervisor and Resources Staff Officers. The group agreed that forest plan monitoring should focus on priority questions and be realistic in what it proposes to accomplish. This conclusion was largely driven by the fact that full implementation of the Monitoring and Evaluation Strategy is not possible, given projected funding levels. For these reasons, the forest leadership team approved a process, developed by the MEIT, for evaluating each monitoring item in the Monitoring and Evaluation Strategy. A paper providing the details and results of this process is currently in preparation for publication (DeVelice et al. 2011). At the core of this evaluation are criteria identified through a collaborative effort between PNW, the Inventory and Monitoring Institute, and the MEIT. These criteria fall into two categories: (1) merit criteria; those that evaluate the monitoring item according to how well it addresses the Revised Forest Plan as well as regional and national information needs, and (2) design criteria; those that evaluate the statistical rigor of the sampling design and field protocols developed for the monitoring item in relation to the risk associated with the resource proposed for monitoring.

In general, the merit criteria assess the monitoring item according to:

1) How well it evaluates the Revised Forest Plan,

2) The ability of the Forest to influence the state of the resource proposed for monitoring,

3) The risks associated with that resource, and

4) The extent to which the monitoring item will meet priority needs beyond the Revised Forest Plan.

The design criteria assess the monitoring protocols according to:

1) The appropriateness of the statistical rigor in relation to risks associated with the monitoring item, and

2) Efficiencies such as the use of existing data and cost of the monitoring.

The MEIT evaluated the 46 monitoring items (refer to Table 1) according to the merit criteria (DeVelice et al. 2011). The MEIT used weighted averaging to score each item from 0 to 1, based on the criteria. Scores approaching 1 indicate the monitoring item fully meets the criteria, whereas those approaching 0 indicate the monitoring item does not meet the criteria. Design criteria were considered in developing the protocols included in the guide, but they were not directly quantified. The 33 monitoring items with overall scores exceeding 0.50 were those for which the development of protocols was planned. At this time, 24 monitoring protocols have been approved and have been included in this monitoring guide. Of the remaining monitoring questions with overall scores exceeding 0.50, five are still under development and others have either been combined with other questions or are being dropped.

## References

DeVelice, R.L., M.A. Friberg, G.M. Harris, M.I. Goldstein, P.C. Reed, and D.A. Boyce. 2011. Prioritizing land management plan monitoring questions. USDA Forest Service, Chugach National Forest. *Manuscript in preparation for publication*.

Elzinga, C.L., D.W. Salzer, and J.W. Willoughby. 1998. Measuring and monitoring plant populations. Bureau of Land Management Technical Reference 1730-1. Denver, Colorado. 477 pp. Website: http://www.blm.gov/nstc/library/pdf/MeasAndMon.pdf

USDA Forest Service. 2002a. *Revised Land and Resource Management Plan, Chugach National Forest*. USDA Forest Service, Chugach National Forest, R10-MB-480c.

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**Table 1. List of monitoring questions (shaded) from chapter 5 of the Revised Forest Plan (as interpreted by the Monitoring and Evaluation Interdisciplinary Team) for which protocols are included in this monitoring guide [1]**

| Monitoring Questions by General Category |
|---|
| **Compliance with Revised Forest Plan** |
| 1. Are projects being implemented consistent with the Forest Plan direction? |
| **Integrated Effectiveness/Validation Monitoring** |
| 2. Are management activities achieving their intended outcomes? |
| 3. Is Forest management influencing changes in ecosystem composition and structure outside the expected range of variability? |
| **Soil Resources** |
| 4. Is Forestwide soil quality decreasing over time due to ground-disturbing activities (e.g., OHV and snowmachine use, concentrated foot traffic, fuel reduction activities, road and trail construction)? |
| **Water Resources** |
| 5. Are Forest management actions contributing to changes in water quantity on the Forest that could have social or ecological impacts? |
| 6. Are Best Management Practices (including wetland management) effective in meeting water quality standards? |
| **Sensitive and Exotic Plant Species** |
| 7. Are Forest management activities contributing to changes in the abundance and distribution of sensitive plant populations? |
| 8. Are Forest management activities contributing to changes in the abundance and distribution of invasive plant populations? |
| **Management Indicator Species** |
| 9. Do changes in populations of MIS adequately indicate changes in other fish and wildlife populations or their habitat? |
| 10. Has the Revised Forest Plan direction prevented adverse interactions between bears and humans? |
| 11. Is Forest management of winter snow machining influencing winter den use by brown bears? |
| 12. What are the population trends for brown bear and the relationship to habitat change? |
| 13. What are the population trends for dusky Canada geese and the relationship to habitat change? |
| 14. What are the population trends for moose and the relationship to habitat change? |
| 15. What are the population trends for mountain goat and the relationship to habitat change? |
| 16. Is Forest management of winter snow machining influencing winter habitat use by ungulates? |
| 17. What are the population trends for black oystercatchers and the relationship to habitat change? |
| 18. What are the population trends for Dolly Varden char and the relationship to habitat change? |

**Table 1. List of monitoring questions (shaded) from chapter 5 of the Revised Forest Plan (as interpreted by the Monitoring and Evaluation Interdisciplinary Team) for which protocols are included in this monitoring guide [1]**

| |
|---|
| 19. What are the population trends for Coho salmon and the relationship to habitat change? |
| **Species of Special Interest** |
| 20. What are the population trends for gray wolves and the relationship to habitat change? |
| 21. What are the population trends for Kenai wolverines and the relationship to habitat change? |
| 22. What are the population trends for Townsend warblers and the relationship to habitat change? |
| 23. What are the population trends for northern goshawks and the relationship to habitat change? |
| 24. What are the population trends for Sitka black-tailed deer and the relationship to habitat change? |
| 25. What are the population trends for Montague Island marmot and the relationship to habitat change? |
| 26. What are the population trends for cutthroat trout and the relationship to habitat change? |
| **Sensitive Animal Species** |
| 27. What are the population trends for trumpeter swan and the relationship to habitat change? |
| **Forest Products** |
| 28. Are harvested forestlands restocked? |
| 29. Have lands once identified as unsuitable for timber production been examined to determine if they have become suitable? |
| 30. Have such lands been returned to timber production? |
| **Minerals** |
| 31. Are mining plans of operations consistent with Revised Forest Plan direction? |
| **Heritage Resources** |
| 32. Are National Register eligible heritage resources being adequately maintained and protected? |
| 33. Are heritage resource site surveys being conducted on all surface or subsurface activities disturbing more than one square meter of ground? (Implementation of the Heritage Resource Standard on page 3-34 of Revised Forest Plan). Note: this question has been combined with #32. |
| **Recreation Opportunities, Tourism, Access, and Facilities** |
| 34. Are Forest visitors satisfied with the quality of Forest recreation opportunities and is satisfaction changing over time? |
| 35. Is management area direction in the forest plan consistent with public demand for recreational opportunities over time? |
| 36. Is the Revised Forest Plan direction for motorized and nonmotorized access working? |
| 37. Are areas of the Forest being managed in accordance with the prescribed Recreation Opportunity Spectrum class in Forestwide standards and guidelines? |

**Table 1. List of monitoring questions (shaded) from chapter 5 of the Revised Forest Plan (as interpreted by the Monitoring and Evaluation Interdisciplinary Team) for which protocols are included in this monitoring guide [1]**

| |
|---|
| 38. What are the trends in the use of developed recreational facilities and how does it compare to capacity? |
| 39. What are the trends in commercial recreation services on the Forest and how does it compare to capacity? |
| **Scenic Quality** |
| 40. Are areas of the Forest being managed in accordance with the Scenery Integrity Objectives (SIO) in Forestwide standards and guidelines? |
| **Fire Protection and Fuels Management** |
| 41. Are human life, property, and facilities being protected from wildland fire hazards? |
| **Wilderness** |
| 42. Is the wilderness character of the Wilderness Study Area (WSA) and areas recommended for Wilderness being maintained? |
| **Research Natural Areas** |
| 43. Are proposed and established Research Natural Areas (RNA) being maintained in a manner consistent with the purposes for which the area was established? |
| **Community Effects** |
| 44. What are the trends in Forest management programs contribution to local communities and economies? |
| 45. What are the trends in the compatibility between Forest management programs/activities and the local community perceptions of quality of life? |
| **Air Resources** |
| 46. What is the potential that winter snowmachine use and its associated activities are causing violations of Alaska State air quality standards in areas of the Chugach National Forest where winter motorized use is the highest? |
| [1] The 24 questions (shaded) had merit scores exceeding 0.5 and are the questions for which protocols are included in this monitoring guide. |

# Monitoring Protocols

## Monitoring Protocol Description and Format

This section describes the format for monitoring protocols written for the Chugach National Forest. This format was developed by the Monitoring and Evaluation Interdisciplinary Team (MEIT) with guidance from GTR-WO-72 (Vesely et al. 2006). The goal of the protocol description and format is to provide sufficient (but not excessive) information so that a person other than the author can understand and implement the methods. When an established, peer-reviewed published protocol is being used, that protocol is referenced and a hyperlink to the protocol is inserted (full text from already established protocols is not included in the guide). For protocols not presently covered in peer-reviewed publications, the full text for the protocol is included. Data forms or other information pertinent to specific monitoring questions follow each question as "attachments." Monitoring protocols are written in the following format.

**A. Monitoring Item:** Classification of the item to be monitored as listed in table 5-1 of the Revised Forest Plan (e.g., Water Resources).

**B. General Monitoring Question:** The general monitoring question as listed under each monitoring item in table 5-1 of the Revised Forest Plan and as interpreted by the MEIT (e.g., Table 5-1: What is the distribution and abundance of exotic plants, particularly in areas affected by management activities? MEIT Interpretation: Are Forest management activities contributing to changes in the abundance and distribution of invasive plant populations?)

**C. Business Need and Rationale:** This section summarizes the need and rationale of the monitoring as it relates to the Revised Forest Plan desired conditions, goals, objectives, and standards and guidelines.

**D. Category:** The category of monitoring would be implementation monitoring, effectiveness monitoring, or validation monitoring. Note: the protocol must be appropriate for the category of monitoring for which it is developed (see chapter 5 of the Revised Forest Plan). Also note that there is no such thing as baseline forest plan monitoring. In most cases these should be implementation or effectiveness monitoring.

**E. Protocol Status, Source, and Re-evaluation Schedule:** Indicates whether the protocol documented here is a pilot or final. The year where the pilot data will be evaluated or when the final protocol will be re-evaluated is indicated. The relationship of the protocol to national efforts such as Core Data Standards and national technical guides is explained.

In addition, any existing protocols used in the monitoring are identified. A citation is provided as well as the protocol source (e.g., U. S. Fish and Wildlife Service (USFWS), Alaska Department of Fish and Game (ADF&G)), spatial scale for which it was developed (e.g., national, regional, local), and its status (pilot or final). The existing protocol is kept on file by the Chugach National Forest and its

location is indicated. The existing protocol is paraphrased throughout the monitoring question format to provide basic information required without repeating the entire document, and the page number where detailed information can be found in the original document is referenced.

**F. Objective Statement:** An explicit statement of the monitoring objectives that will inform the monitoring question; it covers all of the sub-elements below. This statement drives the entire design of the protocol.

**[F-1] Required by Law:** Indicates those monitoring questions that are explicitly required by law. The law is cited.

**[F-2] Statistical Rigor Rationale:** Statistical rigor is expressed as high, medium, low, or not applicable (for protocols based on censusing). Rationale for the statistical rigor designated is explained.

**[F-3] Data Precision, Reliability:** This is the precision and reliability of the data, as indicated in the forest plan monitoring strategy for each monitoring question. The classes are:

*Class A:* These methods are generally well accepted for modeling or measuring the resource. The methods produce repeatable results and are often statistically valid. Reliability, precision, and accuracy are very good. The cost of conducting these measurements is higher than other methods. These methods are often quantitative in nature.

*Class B:* These methods are valuable tools that are based on a variety of techniques. These tools include project records, communications, onsite ocular estimates, and less formal measurements like pace transects informal visitor surveys, air photo interpretation, and other similar types of assessments. Reliability, accuracy, and precision are good, but usually less than Class A. Class B methods are often qualitative in nature, but still provide valuable information on the status of resource conditions.

**[F-4] Confidence:** Indicates the desired level of confidence in the monitoring results. This may be based on several factors including: the desired level of statistical rigor, whether the monitoring is required by law, and the business needs and rationale for the monitoring. Confidence should be expressed as a confidence interval in the units of measure specified (e.g., 10 to 20 meters) and at a specified level of confidence (1-$\alpha$). Also see Vesely et al. 2006, pp. 2-1 and 3-1 and Schreuder et al. 2004.

**[F-5] Change Detection:** This is the desired statistical power to detect change. Change detection indicates how much sensitivity to change is necessary to determine whether the threshold has been crossed. Also base the desired power to detect change on an assessment of risk and the Forest's business needs. Also see Vesely et al. 2006, pp. 2-1 and 3-1.

**[F-6] Threshold:** A pre-determined level of change that triggers management action. This includes the source and/or methods for establishing the threshold values. Also see Vesely et al. 2006, pp. 2-1 and 3-1 to 3-2.

**[F-7] Scope of Inference:** "The spatial and temporal scales over which the monitoring results" are applicable. In most cases the spatial scope is the area from which the sample was taken. The temporal scope will be influenced by anticipated rates of change. For forest plan monitoring, the appropriate spatial scope of inference is most often the forest. The smallest appropriate spatial scope on the Chugach National Forest will be a geographic area as defined in the forest plan.

**G. Indicator and its Units of Measure:** The appropriate measured variable(s) that inform the monitoring question(s). Additional explanations are provided if the indicators used are proxies for monitoring questions. The units of measure for the indicator.

**H. Sampling Design:** A formal statement of how the sample will be selected so that the sample's attributes accurately represent the population. This should include a description of all the sub-elements below. Also see Vesely et al. 2006, pp. 2-4 and 3-9 to 3-16 and Schreuder et al. 2004 p. 7.

**[H-1] Target Population:** All elements (household) representing the parameter of interest (average household income) within some defined area and time period. See Schreuder et al. 2004, p. 6 for this example.

**[H-2] Sampling Frame:** A complete list of the sample units (landowners – following the example above) that can potentially be selected from the target population and from which inferences can be made. The sampling frame is expressed both in time and space and represents the target population. See Vesely et al. 2006, 2.1.3 and Schreuder et al. 2004, p. 6.

**[H-3] Sample Selection Methods:** The methods for selecting sample units. Some examples are simple random, stratified random, systematic, cluster, and adaptive cluster. See Vesely et al. 2006, pp. 3-10 to 3-13 and Schreuder et al. 2004, chapters V-VIII.

**[H-4] Sample Unit Description:** A description of the sample on which observations or measurements are performed. Examples include plots, transects, or individual organisms. Quoted from Vesely et al. 2006.

**[H-5] Detection and Observer Bias Controls:** An acknowledgement of sources of bias and methods used to control them.

**[H-6] Sample Size Estimate and Estimation Methods:** An estimate of the sample size needed to meet the objective of the monitoring and the estimation methods used. See Schreuder et al. 2004, p. 42 and Vesely et al. 2006, p. 2-6.

**[H-7] Temporal Details of Sampling:** Describes the temporal aspects of the sampling design. For example, the Forest Inventory and Analysis

(FIA) program visits one-tenth of their total number of plots annually (sampling frequency). Therefore, it takes them 10 years to survey all plots in their sample (cycle length). In addition, they only conduct the P2 survey in Alaska during the months of June, July, and August within any given year (seasonal limits). Their resample cycle is as long as their cycle length (10 years). See Vesely et al. 2006, pp. 3-15 to 3-16.

**I. Data Collection:** A description of the methods of data collection that is made up of the three sub-elements below.

**[I-1] Methods for Locating Sample Units:** Field methods for locating sampling units. Also see Vesely et al. 2006, pp. 2-6 to 2-7.

**[I-2] Methods for Layout and Marking:** Describes the dimensions of plots, transects, or other sampling units.

**[I-3] "Field" Sampling Methods**: A complete description of the field methods used for sampling. Refer to Vesely et al. 2006, p. 2-7, for required details.

**J. Quality Control and Assurance:** Describes the procedures that will be used to minimize the likelihood of errors occurring as a result of the data collection tasks that are most vulnerable to error. Also see Vesely et al. 2006, p. 2-8.

**K. Data Form:** Title and list of all forms used for data collection. These forms are provided as attachments or links. Also see Vesely et al. 2006, p. 2-9, for required details.

**L. Data Storage:** A description of data storage that includes the two sub-elements below.

**[L-1] Data Cleaning Methods:** Describes the methods for reviewing the collected data for errors and completeness.

**[L-2] Data Storage:** Describes where the data collected from monitoring can be found. Data should be stored in corporate databases whenever possible.

**M. Data Analysis:** This describes the general approach to data analysis and the specific statistical tests that will be used. The rationale for selecting a specific statistical test should be provided and be based on the data type and distribution and any underlying assumptions. Note whether statistical analysis is appropriate (will depend on the objective of the monitoring).

**N. Assumptions and Limitations:** The assumptions used in the data collection, analysis, and interpretations of the monitoring data are discussed, as are the limitations of the data and methods of analysis.

**O. Reporting Frequency:** The reporting frequency is as indicated in table 5-1 of the Revised Forest Plan for each general monitoring question. The reporting frequency (in years) should not be confused with the monitoring frequency described in the sample design. When scheduled for reporting, all Revised

Forest Plan monitoring and evaluation will be reported in the annual monitoring and evaluation report.

**P. Responsibility:** This describes who will do the monitoring and who will be responsible for managing the monitoring information. This includes United States Department of Agriculture (USDA) Forest Service personnel, other agencies, and opportunities for private citizens.

**Q. List of Preparers:** This is a list of the contributing authors, their titles and positions, and their Forest Service unit or other place of work.

**R. 10-Year Cost Forecast:** The cost of implementing this monitoring by year and over a 10-year period (FY 2012 to 2021). The annual cost estimated in the Revised Forest Plan is referenced.

**S. Literature Cited:** Includes citations for all literature cited in the protocol.

Schreuder, Hans T., Richard Ernst, and Hugo Ramirez-Maldonado. 2004. *Statistical techniques for sampling and monitoring natural resources***.** Gen. Tech. Rep. RMRS-GTR-126. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 111 p.

Vesely, David, Brenda C. McComb, Christina D. Vojta, Lowell H. Suring, Jurai Halaj, Richard S. Holthausen, Benjamin Zuckerberg, and Patricia M. Manley. 2006. *Development of protocols to inventory or monitor wildlife, fish, or rare plants*. Gen. Tech. Rep. WO-72. Washington, DC: U.S. Department of Agriculture, Forest Service. 100 p.

# Specific Monitoring Protocols

Specific monitoring protocols for the questions from Table 1 that met merit analysis criteria follow.

## *Compliance with Revised Forest Plan*

### *1. Are projects being implemented consistent with Forest Plan direction?*

**A. Monitoring Item:** ***Compliance with Forest Plan Direction***

**B. MEIT Interpretation of General Monitoring Question:** Interpreted as stated.

**C. Business Need and Rationale:** The record of decision (ROD) for the Revised Forest Plan states that

> "Both Forestwide and Management Area Prescription standards and guidelines are applied to the planning and implementation of site-specific projects or other activities that occur on the Chugach National Forest. These standards and guidelines are written to meet, at a minimum, all requirements of applicable laws, regulations, and state standards…" and
>
> "Most standards and guidelines serve as mitigation measures to reduce or eliminate adverse effects. Singularly and collectively, they avoid, rectify, reduce, or eliminate the potential negative environmental impacts of forest management activities." (Revised Forest Plan ROD p. 5)

In addition, the agency is obligated under the National Forest Management Act to: (1) implement project specific mitigation measures identified in National Environmental Policy Act (NEPA) decision documents; and (2) to ensure that project-level decisions are consistent with the applicable forest plan (see 36 CFR 219.8(e) and 40 CFR 1503.3).

Although the application of these laws, regulations, standards, and mitigation measures is reviewed at the project level, monitoring is needed to determine their application at the forestwide scale.

**D. Category:** Implementation monitoring

**E. Protocol Status, Source, and Re-evaluation Schedule:** This is a pilot protocol developed by the Chugach National Forest. This protocol will be piloted in the first year, re-evaluated, and finalized for implementation in year 2. Once final, this protocol will be re-evaluated every 5 years.

**F. Objective Statement:** Determine to what extent Chugach National Forest NEPA decision documents are being implemented consistent with relevant forestwide and management area-specific standards and guidelines and project-specified mitigation measures.

**[F-1] Required by Law:** There is no explicit statutory requirement for this monitoring. However, NEPA decision documents that are not implemented consistent with relevant forestwide and management area-specific standards and guidelines and project-specified mitigation measure violations can result in violations of the National Forest Management Act (36 CFR 219.8(e)).

**[F-2] Statistical Rigor Rationale:** Only very basic statistics will be used for data analysis. Because of the potential for undesired environmental impacts (significant or non-significant) that can be caused by not implementing decisions consistent with the forest plan or project-specified mitigation measures (significant or non-significant); all projects for which an environmental impact statement (EIS) or environmental assessment (EA) will be monitored under this protocol. Projects completed under a documented categorical exclusion (CE) will be sampled. The sample will be small in relationship to the number of documented CEs published by the Chugach National Forest. However, all documented CEs and their implementation receive review. In addition, projects completed under a documented CE are “routine administrative, maintenance, and other actions [that] normally do not individually or cumulatively have a significant effect on the quality of the human environment” (FSH 1909.15 chapters 30 and 31.12). Therefore, a lower level of statistical rigor has been deemed acceptable.

**[F-3] Data Precision, Reliability:** Class B

**[F-4] Confidence:** We expect to have a high degree of confidence in the results from this monitoring protocol. All EISs and EAs will be monitored and, although the sample of documented CEs is small relative to the total number of documented CEs signed by the forest, we expect the variability in compliance with forest plan direction to be low. In addition, controls will be used to minimize detection and observer bias.

**[F-5] Change Detection:** The objective of this protocol is not to measure change. Although observations of change in the level of compliance with applicable forest plan direction may be made with this protocol, and may be of interest over time, no attempts will be made to measure change using statistics.

**[F-6] Threshold:** The threshold is surpassed when the following occurs within a rolling 5-year period:

- Three or more projects do not fully implement all the relevant forest plan direction and mitigation measures.

Surpassing this threshold will trigger a management review by the forest leadership team. Note that this protocol does not determine whether project-level monitoring is occurring consistent with the NEPA decision. However, any project monitored under this protocol for which the applicable forest plan direction and mitigation measures are not fully

implemented will be referred to the appropriate staff officer for corrective action.

**[F-7] Scope of Inference:** Chugach National Forest and district(s).

**G. Indicator and its Units of Measure:** Whether the project fully implemented the applicable forest plan direction and mitigation measures prescribed by the associated NEPA decision. Note that full implementation is defined in the resource-specific protocols in the monitoring guide. See the following protocols:

- Question #4 – Soils
- Question #6 – Best management practices
- Question #7 – Sensitive plants
- Question #8 – Invasive plants
- Question #33 – Heritage
- Question #40 – Scenic integrity objectives

**H. Sampling Design:**

**[H-1] Target Population:** The target population includes all projects conducted under an EIS, EA, or CE on the Chugach National Forest.

**[H-2] Sampling Frame:** For logistical reasons, only a portion of the Chugach National Forest will be surveyed in a given year. The Seward Ranger District will be surveyed the first year, Seward and Glacier the next, and Cordova the next. Therefore the sampling frame will move from district to district annually. Within a district, the annual sampling frame includes all projects under an EA, EIS, or documented CE that require a decision memo as listed in FSH 1909.15 chapter 31.2. Only projects for which implementation was complete in the last 2 years or that are ongoing (those conducted under special-use permits and mining plans of operation) are included in the sampling frame. In addition, each year newly completed projects will be added to the sampling frame and projects that are older than 2 years or that have already been monitored as part of this protocol will drop out of the sampling frame.

**[H-3] Sample Selection Methods:** All projects completed under an EA or EIS that are in the annual district sampling frame will be selected for monitoring. The Chugach National Forest issues hundreds of documented CEs; therefore, these projects will be sampled. Projects under a CE will be weighted based on their type and then selected at random. Projects under a CE with more potential for ground-disturbing activity will receive a higher weight. Project type weights are as follows:

  - Building infrastructure – 4
  - Hazardous fuel reduction – 4

- Mining – 4
- Roads – 4
- Streams – 4
- Trails – 3
- Fish habitat – 2
- Recreation special use permits – 1
- Wildlife habitat – 1

In addition, projects adjacent to water (streams, rivers, lakes, wetlands, estuaries, and salt water) and projects likely to be in sight of a high-use areas (trails, recreation sites, highways, lakes, streams and/or the ocean) will be weighted three times higher than those that are not. Projects with the potential (or are known) to contain a heritage site will also be weighted three times higher. If available, the heritage site predictive model will be used for this purpose.

**[H-4] Sample Unit Description:** Sampling units will be the individual projects completed within the last 2 years or that are ongoing for which a NEPA decision was made, excluding undocumented CEs.

**[H-5] Detection and Observer Bias Controls:** The majority of monitoring conducted under this protocol will be objective (e.g., whether stream buffers are 1,500 feet from project activities, as required by the decision). However, some subjective elements can result in detection or observer bias (e.g., whether helicopters exiting from the Girdwood Airstrip will stay at very low levels in Glacier Creek Gorge). A dedicated team of specialists will conduct the monitoring each year to control detection and observer bias.

**[H-6] Sample Size Estimate and Estimation Methods:** Approximately five sample units will be visited per year. Note that the sample sizes will likely vary among years and districts. The Seward Ranger District generates the largest number of NEPA documents; therefore, sampling will be more intense on the Seward Ranger District.

**[H-7] Temporal Details of Sampling:** Sampling will occur annually and on a 3-year cycle. To gain logistical efficiencies, sites on the Seward Ranger District will be monitored one year, Seward and Glacier Ranger District the next, and Cordova Ranger District the next year. The cycle will then repeat itself. Refer to the resource-specific resources protocols to determine whether they impose any seasonal constraints for onsite visits to projects.

## I. Data Collection:

**[I-1] Methods for Locating Sample Units:** NEPA Documents: The Planning, Appeals, and Litigation System (PALS) is a database that can provide a list of NEPA decisions that have been signed. However, the PALS database does not keep track of implementation or report when or if a project has been completed. The PALS does provide contact information for the "primary project manager" and "secondary project manager," which can be used to determine whether the project has been implemented or not. These project managers must be contacted to determine whether the projects are complete and can be included in the sample.

Locate each project by consulting with the project manager, the project implementation record, and the NEPA decision document.

**[I-2] Methods for Layout and Marking:** Not applicable. See the resource-specific protocols (see list above) for details of the onsite implementation monitoring.

**[I-3] "Field" Sampling Methods:** The data form in Attachment Q1-1 will be used to collect the following data for each resource and project:

1. All the applicable forest plan directions and whether they were implemented on the project.

2. Project-specific mitigations and whether they were implemented on the project.

All documentation of the relevant forest plan direction and mitigations will be recorded PRIOR TO determining their implementation.

Steps in collecting these data follow:

1. Each subject matter expert on the review team will review each NEPA document and decision in the sample to determine the significant issues or meaningful environmental consequences identified and how the decision responded to those issues or consequences.

2. The following sections of the forest plan should then be consulted to determine the applicable forest plan direction for each resource:

    a. Forestwide standards and guidelines (Revised Forest Plan, pp. 3-22 through 3-49)

    b. Management area-specific standards and guidelines (Revised Forest Plan, pp. 4-7 through 4-88)

    c. Management area-specific activities tables (Revised Forest Plan, pp. 4-7 through 4-88)

In addition, subject matter experts should review the NEPA decision to determine the mitigation measures prescribed for their resource.

3. Determine whether the decision was implemented, or is being implemented, consistent with forest plan direction and project-specific mitigation. This should start with a review of the implementation record. Note that additional applicable forest plan direction and project mitigation may be identified in the implementation record. These should also be recorded on the data form PRIOR TO visiting the project in the field.

4. A field visit will be conducted to determine whether the decision was implemented (yes or no), or is being implemented, consistent with the forest plan direction and mitigation recorded on the data form. Additional relevant forest plan direction and mitigations may be identified during this stage of the monitoring, as well, and should be recorded. Examples of compliance and non-compliance will be photographed to assist with reporting results.

   Note that field visits will not be made to projects under a special use permit. Instead, the team of specialists will review the most recent performance appraisal.

**J. Quality Control and Assurance:** A standardized form will be used for collecting the data, and training will be provided in data collection methods.

**K. Data Form:** See Attachment Q1-1.

**L. Data Storage:**

**[L-1] Data Cleaning Methods:** The specialists and the Chugach National Forest Environmental Coordinator will review all data forms for completeness. The specialists will also review data entered into the database for obvious errors.

**[L-2] Data Storage:** The Chugach National Forest Environmental Coordinator will maintain a database of the results in the forest supervisor's office. In addition, each specialist will maintain electronic copies of their resource-specific data collected as part of this protocol.

**M. Data Analysis:** All the resource-specific data for each project monitored will be gathered together and a determination will be made whether the project was implemented consistent with all relevant forest plan direction and all prescribed mitigation measures (yes or no). Then, at a minimum, the following will be calculated annually and for each rolling 5-year period:

The number and percentage of projects that did, and did not, correctly implement all the identified forest plan direction and mitigation measures.

As data are accumulated over the years, it may become fruitful to calculate the compliance rate of individual direction in the forest plan.

**N. Assumptions and Limitations:** Assumption is that we are getting a representative sample of projects forestwide.

**O. Reporting Frequency:** Once every 5 years, with non-compliances reported to the appropriate staff officer immediately after they are discovered. In addition, passing a threshold will be reported in the Annual Monitoring and Evaluation Monitoring Report and brought to the forest leadership team soon thereafter.

**P. Responsibility:** Chugach National Forest Supervisor's Planning Staff Officer.

**Q. List of Preparers:**

Joshua Milligan, Environmental Coordinator, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

**R. 10-Year Cost Forecast:** The cost for field visits by the resource specialists and their individual analyses associated with this protocol are covered under the individual resource protocols in this monitoring guide. Costs reported here cover the forest environmental coordinator and project manager field visits and data analysis.

| | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| People | $3,939 | $4,985 | $4,179 | $4,305 | $4,434 | $4,567 | $4,797 | $4,941 | $5,089 | $5,241 |
| Travel | $788 | $2,319 | $836 | $861 | $2534 | $913 | $941 | $2,688 | $998 | $1,028 |
| Other | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **TOTAL** | **$4,727** | **$7,303** | **$5,015** | **$5,165** | **$6,968** | **$5,480** | **$5,738** | **$7,629** | **$6,087** | **$6,269** |

Cost in Inflated dollars ($)

The 10-year cost forecast is$60,381. The annual cost estimate in the Revised Forest Plan is $5,000.

**S. Literature Cited:**

USDA Forest Service. 2002. *Revised Land and Resource Management Plan, Chugach National Forest*. USDA Forest Service, Chugach National Forest, R10-MB-480c.

***Attachment Q1-1. Form for Resource-Specific Data Collection for Plan Implementation Monitoring (Question 1)***

NEPA Decision Document Name:

Date Implementation Completed:

Type of NEPA Decision Document (CE, EA, or EIS):

Resource Type (e.g., fisheries, hydrology, soils):

| **Applicable forest plan Direction*. (Brief description and forest plan pg. #.)** | **Identified in the NEPA Document? (Yes or No. If Yes include pg #)** | **Identified in the Implementation Record? (Yes or No. If Yes include pg #)** | **Implemented on the Project? (Yes or No)**** | **Remarks Including Evidence Used to Make Determination and Dissenting Opinions.** |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| **Project Specific Mitigation Measures** (Brief description and pg. #.) | **Identified in the NEPA Document?** (Yes or No. If Yes include pg #) | **Identified in the Implementation Document?** (Yes or No. If Yes include pg #) | **Implemented on the Project?** (Yes or No)** | **Remarks Including Evidence Used to Make Determination and Dissenting Opinions.** |
| | | | | |
| | | | | |
| | | | | |

* The applicable forest plan direction may or may not have been included in the NEPA or Implementing documents. The intent for this data column is to list all applicable forest plan direction regardless of whether it was included in these documents.

** The method for determining whether forest plan direction or mitigation measures are implemented will vary by resource. See the resource specific protocol.

NEPA Document Reviewer Name, Title, and Duty Location:

Implementation Document Reviewer Name, Title, and Duty Location:

On-site Monitoring Team Member Name, Title, and Duty Locations:

Date Review Complete:

## *Integrated Effectiveness/Validation Monitoring*

### *2. Are management activities achieving their intended outcomes?*

**A. Monitoring Item: *Integrated Effectiveness Monitoring***

**B. General Monitoring Question:** Are management activities achieving their intended outcomes? (Forest Plan, Table 5-1). MEIT interpretation: Are management activities achieving their intended outcomes?

**C. Business Need and Rationale:** Management activities on the Chugach National Forest respond to forest plan desired conditions, goals, or objectives. As the success of individual management activities is germane to achieving these desired conditions, goals, or objectives, it is important to determine whether individual management activities are achieving their intended outcomes.

**D. Category:** Effectiveness monitoring

**E. Protocol Status, Source, and Re-evaluation**: This is a pilot protocol. This protocol will be piloted the first year, re-evaluated, and finalized in the second year.

**F. Objective Statement:** The objective of this monitoring protocol will be to determine whether management activities proposed and analyzed under National Environmental Protection Act (NEPA) procedures are achieving their intended outcomes. Every NEPA analysis contains a description of the purpose and need of the project and a description of intended outcomes of the proposed action. This monitoring protocol will compare the intended outcome and the actual outcome, and the results will be used to maintain or make adjustments to management activities to better meet forest plan goals and objectives.

**[F-1] Required by Law:** There is no explicit statutory requirement for this monitoring question.

**[F-2] Statistical Rigor Rationale:** The percentage of projects that meet, partially meet, or do not meet their intended outcomes will be used to determine overall success.

**[F-3] Data Precision, Reliability:** Class B.

**[F-4] Confidence:** There is expected to be a high degree in confidence for projects documented under an environmental impact statement (EIS) or environmental assessment (EA) because the sample size will be close to 100 percent. There is a lower degree of confidence for projects documented under a categorical exclusion (CE) because the sample size will be small relative to the total number of CEs completed.

**[F-5] Change Detection:** This protocol will not measure change. However, information from this protocol may be used to evaluate project design and implementation or forest plan direction.

**[F-6] Threshold:** The following thresholds are untested and will be evaluated during the pilot phase of this protocol. A threshold is surpassed when any of the following conditions occur within a 3-year time span or less:

- **One or more projects does not achieve <u>any</u> intended outcomes; or**
- **<u>Two or more projects</u> only partially achieve intended outcomes; or**
- **<u>Five or more</u> intended outcomes are not achieved.**

Surpassing a threshold will trigger a forest leadership team management review.

**[F-7] Scope of Inference:** Management activities occurring on the Chugach National Forest or districts.

**G. Indicator and Units of Measure:** The indicators will be performance measures developed for the intended outcomes from the NEPA document and decision, and the project as viewed or measured in the field. The units of measure for each intended outcome will be: (1) fully achieved, (2) partially achieved, or (3) did not achieve.

**H. Sampling Design:** Sampling designs are estimated.

**[H-1] Target Population:** All projects that require NEPA documentation on the Chugach National Forest.

**[H-2] Sampling Frame:** For logistical reasons, only a portion of the Forest will be surveyed in a given year. The Seward Ranger District will be surveyed in the first year, Glacier Ranger District in year 2, and Cordova in year 3.

Within a district, the annual sampling frame will include all projects documented under an EIS or EA, or documented CE (FSH 1909.15 Ch. 31.2). Only projects for which implementation was complete in the last 3 years or that are ongoing (e.g., special use permits or mining plans of operation) are included in the sampling frame. Each year, newly completed projects will be added to the sampling frame. Projects that are older than 3 years or that have already been monitored will be removed from the sampling frame.

**[H-3] Sampling Selection Methods:** The team will monitor five projects. The team will select all projects that require an EIS or an EA because these projects may have significant environmental effects under NEPA. It is not expected that more than one or two EISs or EAs will be available for monitoring.

In order to complete the sample size, projects requiring a documented CE will also be sampled; however, the sample size for projects documented with a CE will be small compared to the number of CEs in the sampling frame because these projects do not have significant environmental impacts under NEPA. The sample of CEs should include those that involve ground-disturbing activities as opposed to those that do not (e.g., Forest Orders). See protocol #1 for specific sample selection methods for CEs.

The team leader will select completed or almost-completed projects; such that outcomes have been determined or are being determined and can be measured.

**[H-4] Sample Unit Description:** The sample units are projects documented under an EIS, EA, or CE. Project area size will vary by project and project type. Should projects include multiple or large areas, a sample of the project areas will be selected for field review.

**[H-5] Detection and Observer Bias Controls:** To reduce bias, the evaluation team should not be the same as the team that proposed or implemented the project.

**[H-6] Sample Size Estimate and Estimation Methods:** Target sample size is five projects.

**[H-7] Temporal Details of Sampling:** For logistical reasons, only a portion of the Forest will be surveyed in a given year. The Seward Ranger District will be surveyed in the first year, Glacier Ranger District in year 2, and Cordova in year 3.

**I. Data Collection:**

**[I-1] Methods for Locating Sample Units**: Projects will be selected from the Chugach National Forest Schedule of Proposed Actions (SOPA). District project managers or NEPA coordinators will be contacted to determine whether implementation has occurred or is ongoing.

**[I-2] Methods for Layout and Marking:** Not applicable.

**[I-3] "Field" Sampling Methods:** Not applicable. There are no field sampling methods. Intended outcomes of selected projects are being evaluated.

**Pre-Work:** Identify intended outcomes and performance measures for selected projects.[1]

**Intended Outcomes:** Intended outcomes are typically described in the NEPA document under the heading "purpose and need."

**Performance Measures:** As each site-specific project is unique in issues and outcomes, uniform or model performance measures cannot be used. However, certain projects are common on the Chugach National Forest; such as, fuel reduction, trail and other recreation infrastructure maintenance and construction, mining plans of operations, and special uses. Over time, the team will be able to identify similar performance measures for projects that are common to the Chugach National Forest. As these performance measures are developed, they will be documented for use in evaluating intended outcomes for similar future projects.

The team must develop performance measures for intended outcomes, which may necessitate contacting knowledgeable resource specialists.

[1] Some NEPA decisions explicitly provide for project monitoring. For these types of NEPA decisions, the project manager should be contacted to acquire documentation of project monitoring. This information may provide the team with monitoring related to intended outcomes or identify performance measures.

Although, performance measures will likely be unique for each outcome, some examples of projects that commonly occur on the Chugach National Forest include:

- Fuel Reduction (reduction in wildfire risk to at-risk communities):
  - Number of acres treated in the wildland urban interface
  - Number of piles of downed material burned without harm to soils
- Stream Restoration
  - Number of miles of degraded stream restored
  - Acres of fish and riparian habitat improved
- Trail Maintenance
  - Percent of reconstructed or relocated trail that meets trail condition class

**Coordinate a Field Visit:** A determination will be made for each project on whether a field visit is required to measure accomplishment of its intended outcomes.

**Measure the Performance Levels:** There are three levels of performance: (1) fully achieved, (2) partially achieved, or (3) not achieved. Identifying the performance measure for an intended outcome will be a somewhat subjective exercise, but it should be based on the NEPA documentation for the project and done in consultation with knowledgeable resource specialists.

**J. Quality Control and Assurance:** Intended outcomes monitoring will be conducted by an interdisciplinary team with the appropriate knowledge to be able to measure the performance level of the intended outcomes. Where applicable, performance measures for similar outcomes will become standardized.

**K. Data Form:** See Attachment Q2-1.

**L. Data Storage and Cleaning:** The Chugach Environmental Coordinator will review forms for completeness. Once finalized, the Chugach Environmental Coordinator will maintain a database of the results from this monitoring protocol.

**M. Data Analysis:**

Every three years, the following will be calculated:

The cumulative number of intended outcomes and the number by year and district that are:

- Fully Achieved
- Partially Achieved

- Not Achieved

**N. Assumptions and Limitations**

**Assumptions**

- Performance measures are accurately identified
- A representative sample of projects is selected.
- The intended outcomes of the projects are in accordance with Forest Plan goals and objectives or desired conditions**.**

**Limitations:** None

**O. Reporting Frequency:** Annual.

**P. Responsibility:** Forest Planner or Environmental Coordinator, and applicable resource specialists on the Forest or districts.

**Q. List of Preparers:**

Mary Friberg, Inventory and Monitoring Coordinator, USDA Forest Service, Alaska Regional Office, Juneau, Alaska.

Connie Hubbard, Chugach National Forest, Anchorage, Alaska.

Joshua Milligan, Environmental Coordinator, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

**R. Ten-Year Cost Forecast**

| | FY 12 | FY 13 | FY 14 | FY 15 | FY 16 | FY 17 | FY 18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| **People** | 6,489 | 6,683 | 6,884 | 7,090 | 7,303 | 7,522 | 7,748 | 7,980 | 8,126 | 8,370 |
| **Travel** | 1,545 | 3,600 | 1,591 | 1,639 | 3,708 | 1,688 | 1,739 | 3,820 | 1,791 | 1,845 |
| **Other** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **8,034** | **10,283** | **8,475** | **8,729** | **11,011** | **9,210** | **9,478** | **11,800** | **9,917** | **10,215** |

The 1-year cost forecast is $97,152. The annual cost estimate in the Revised Forest Plan is $25,000.

***Attachment Q2-1. Data input form for monitoring question 2 – Are management activities achieving their intended outcomes?***

**Date:**

**Evaluator(s):**

**Project Name:**

**Location and District:**

**Intended Outcomes and Performance Measures**: *[Describe what the intended outcome(s) are for the project and what criteria will be used to measure whether the project is achieving the outcome(s).]*

Intended Outcome 1:

Performance Measure for Outcome 1:

Intended Outcome 2:

Performance Measure for Outcome 2:

Intended Outcome 3:

Performance Measure for Outcome 3:

**Evaluation:** [*Describe what evidence from the record or field visit was considered to determine whether the project is achieving its intended outcome(s).]*

Evaluation of Intended Outcome 1:

Evaluation of Intended Outcome 2:

Evaluation of Intended Outcome 3:

**Results:** *[Make a determination on whether the project achieves, partially achieves, or does not achieve for each intended outcome evaluated.] The following format is recommended for recording determinations:*

| [Project Name] | Achieves | Partially Achieves | Does not Achieve |
|---|---|---|---|
| Intended outcome 1 | | | |
| Intended outcome 2 | | | |
| Intended outcome 3 | | | |

**Remarks**: *[Use this section to describe any other relevant observations]*

## *3. Is Forest management influencing changes in ecosystem composition and structure outside the expected range of variability?*

**A. Monitoring Item: *Integrated Effectiveness Monitoring***

**B. General Monitoring Question:** Table 5-1 – To what extent are ecosystem composition and structure changing and has forest management influenced these changes? How do these changes compare to the expected range? MEIT Interpretation – Is Forest Management influencing changes in ecosystem composition and structure outside the expected range of variability?

**C. Business Need and Rationale:** Section 219.26 of The National Forest Management Act of 1982[2] states that "Forest planning shall provide for diversity of plant and animal communities …" and that "Such diversity shall be considered throughout the planning process. Inventories shall include quantitative data making possible the evaluation of diversity in terms of its prior and present condition." In addition, section 219.27(g) states that "Management prescriptions, where appropriate and to the extent practicable, shall preserve and enhance the diversity of plant and animal communities…."

Under forestwide desired conditions, the Revised Forest Plan (p. 3-13) specifies that predominately the vegetation on the forest will be that resulting from natural processes. In selected locations, management treatments will be used to restore degraded conditions or provide benefits to wildlife. A goal of the Revised Forest Plan (p. 3-3) states, "Maintain a full range of naturally occurring ecological processes and flora native to South-central Alaska including a variety of vegetation types, patterns and structural components." Two objectives listed under this goal are to (1) "Develop a baseline estimate of current vegetation types, patterns and structural components on the Chugach National Forest. Monitor changes to these components to determine how well the plan is maintaining desired landscape conditions," and (2) "Restore vegetation on landscapes affected by activities, natural events or processes to meet desired conditions."

**D. Category:** Effectiveness

**E. Protocol Status, Source, and Re-evaluation Schedule:** This is a pilot protocol. The pilot will be evaluated in FY2012 after all methodologies have been implemented. Based on this evaluation the protocol will be finalized. Once final, the protocol will be re-evaluated every 5 years. Three methodologies will be used:

1. Forest Inventory and Analysis (FIA) grid inventory: *Status* – nationally established and approved protocol[3] samples overstory tree species along with percent cover of dominant understory species to quantify the extent and condition of forest resources and analyze how these resources are changing over time. *Source* – FIA National Office and PNW Research. The FIA data will provide an overall estimate of forest plant and community occurrence for forestwide and geographic area interpretations.

[2] http://www.fs.fed.us/emc/nfma/includes/nfmareg.html
[3] home page - http://fia.fs.fed.us/; protocols - http://fia.fs.fed.us/library/field-guides-methods-proc/; http://www.fs.fed.us/pnw/fia/publications/fieldmanuals.shtml

2. Analysis of MODIS (Moderate Resolution Imaging Spectroradiometer)[4] satellite imagery. *Status* – there is no Forest Service nationally approved protocol for change detection using multi-temporal satellite imagery, but Collins and Woodcock (1996) described and evaluated methods for use in operational monitoring of forest mortality by the Forest Service. *Source* – Werstak et al. (2009). Vegetation indices based on the wavelength data will be used as surrogates for land cover features and changes in the index values between image dates will be summarized for forestwide, geographic area, and management area interpretations.

3. Analysis of LANDFIRE (Landscape Fire and Resource Management Planning Tools Project)[5] data. *Status* – nationally established and approved protocol for producing consistent and comprehensive maps and data describing vegetation, wildland fuel, and fire regimes across the United States. *Source* – Rollins and Frame (2006). Department of Interior and USDA Forest Service wildland fire management programs and the Wildland Fire Leadership Council. The composition of existing vegetation types will be compared between image dates for forestwide, geographic area, and management area interpretations.

**F. Objective Statement:** Summarize trends in ecosystem composition and structural attributes (as indexed by FIA vegetation data, vegetation indices applied to satellite imagery, and existing vegetation types) across the Forest, by geographic area, and by management area prescription to identify if and where changes are of sufficient magnitude to be of concern to management.

**[F-1] Required by Law:** Yes. The National Forest Management Act states that "Inventories shall include quantitative data making possible the evaluation of diversity in terms of its prior and present condition."

**[F-2] Statistical Rigor Rationale:**

*Monitoring method 1:* The statistical rigor of FIA data collection is high because the samples are from a systematic grid and are permanently marked (exact) locations.

*Monitoring methods 2 and 3:* The MODIS and LANDFIRE data will be collected across 100 percent of the forest (basically a "census").

**[F-3] Data Precision, Reliability:** Class A or B.

**[F-4] Confidence:** The null hypothesis is that there is no change in ecosystem composition and structure between monitoring dates. In this monitoring, it is desirable to detect if the difference between dates exceeds 20 percent with a confidence level of 80 percent.

[4] http://modis.gsfc.nasa.gov/
[5] http://www.landfire.gov/

**[F-5] Change Detection:** For this monitoring, the probability of rejecting a false null hypothesis is set to 80 percent (statistical power = 1-*ß*).[6]

**[F-6] Threshold:**

*Monitoring method 1:* In the FIA data analyses, results having the greatest concern to management are those where the calculated P value from the significance test used is less than 0.20. This threshold represents a standard yet conservative level of significance used to detect changes in vegetation composition in monitoring situations (Elzinga et al. 1998). Index of similarity values less than 80 percent between sampling dates would trigger more detailed investigation as to the actual or potential cause for such a change (and to determine if management action may be warranted). Cases exceeding the threshold will be brought to the forest leadership team as appropriate following interpretation of possible causes for such change.

*Monitoring method 2:* In the MODIS analyses, contiguous areas larger than 2,000 hectares that have differences in index values exceeding 20 percent will be evaluated more closely to interpret potential causes for the change. This interpretation may involve use of higher resolution data such as aerial photography and plot data. As appropriate, reports to the forest leadership team will be delivered for their review and possible action.

*Monitoring method 3:* In the LANDFIRE analyses, cases where index of similarity values are less than 80 percent between sampling dates would be brought to the forest leadership team, as appropriate, following interpretation of possible causes for such change.

**[F-7] Scope of Inference:**

The spatial scope includes forestwide, by geographic area (i.e., Copper River Delta, Prince William Sound, and Kenai Peninsula, as described in the Revised Forest Plan), and, in the case of the satellite image methodologies (2 and 3), by management area. The temporal scale is annual to decadal.

**G. Indicator and its Units of Measure:**

*Monitoring method 1:* For the FIA data analysis, the specific variables to be analyzed are abundance measures by species, growth form, ground cover characteristic, and vegetation community type.

*Monitoring method 2:* For the MODIS work, the normalized difference vegetation index (NDVI) and normalized difference moisture index (NDMI) will be calculated (Wilson and Sader 2002 and Werstak et al. 2009).[7]

[6] Where *ß* = the probability of Type II error (the failure to detect a difference when in truth there is one).

[7] NDVI is typically used as an estimator of such vegetation attributes as leaf area index, biomass, chlorophyll concentration in leaves, plant productivity, and fractional vegetation cover. NDMI is typically used as an estimator of forest structure, forest damage, leaf and canopy water content, and water stress.

*Monitoring method 3:* For the LANDFIRE analysis, the specific variable to be analyzed is acreage by existing vegetation type.

**H. Sampling Design:**

Sampling designs for FIA, MODIS, and LANDFIRE are documented at the respective websites listed on page 34.

**[H-1] Target Population**:

*Monitoring method 1:* FIA targets forest vegetation.

*Monitoring method 2:* MODIS data collection targets radiation reflectance values (indicators of land cover attributes).

*Monitoring method 3:* LANDFIRE data collection targets existing vegetation types.

**[H-2] Sampling Frame:**

*Monitoring method 1*: The FIA sample consists of all surveyed plots on the FIA grid within the Chugach National Forest boundaries.

*Monitoring method 2:* The MODIS data set consists of all portions of MODIS scenes within the boundaries of the Chugach National Forest.

*Monitoring method 3:* The LANDFIRE data set is derived from LANDSAT[8] imagery and, as such, consists of all portions of LANDSAT scenes within the boundaries of the Chugach National Forest.

**[H-3] Sample Selection Methods:**

*Monitoring method 1*: All sample plots for FIA are distributed systematically on a 4.8-km grid.

*Monitoring methods 2 and 3:* The satellite image data used in the MODIS and LANDFIRE analyses is a 100-percent sample.

**[H-4] Sample Unit Description:**

*Monitoring method 1:* Individual FIA grid points are a cluster of four sampling plots each of 7.3-meter radius.

*Monitoring method 2:* The MODIS data used is collected in 500-meter and 250-meter pixels.

*Monitoring method 3:* The LANDSAT data used by LANDFIRE is collected in 30-meter pixels.

[8] http://landsat.usgs.gov/

**[H-5] Detection and Observer Bias Controls:**

*Monitoring method 1*: There is potential for large variations in cover estimation among observers in FIA data collection. This bias can be controlled by calibrating cover estimation among observers prior to initiating field work.

*Monitoring methods 2 and 3:* Satellite imagery is collected by automated sensors. Detection parameters are as defined in the respective sensor specifications. Accuracy assessment associated with LANDFIRE vegetation classes will indicate robustness of the classification. This assessment will be considered when evaluating change values for vegetation classes.

**[H-6] Sample Size Estimate and Estimation Methods:**

*Monitoring method 1:* Sample size is already established for the FIA plots based on the 4.8-km grid. The adequacy of the number of plots so derived will be evaluated based on post hoc power and minimum detectable change analysis (pp. 262–264 of Elzinga et al. 1998). If this analysis shows low confidence in the results due to low power and high minimum detectable change size, it may be desirable to make changes in the monitoring design to increase power (e.g., increase sample size). In addition, the necessary sample size for detecting differences between two means when using the paired sampling units will be estimated using the method described on pp. 354 through 357 of Elzinga et al. (1998).

*Monitoring methods 2 and 3:* The satellite image data is a 100-percent sample.

**[H-7] Temporal Details of Sampling:**

*Monitoring method 1*: Ten percent of the FIA plots are sampled annually in a 10-year rotation.

*Monitoring method 2:* Forestwide acquisition of MODIS satellite imagery will occur annually between July 1 and August 31, with analysis and interpretation every 5 years to document trends.

*Monitoring method 3:* The refreshment cycle of the LANDFIRE mapping is anticipated on a 5- to 10-year time step.

**I. Data Collection:**

*Monitoring method 1*: FIA data collection methods are described in field guides posted on the Internet (see links on p. 33).

*Monitoring method 2 and 3:* The satellite image data collection methods are those of the respective image collection operation (i.e., see MODIS link on p. 34 and LANDSAT link on p. 36).

**[I-1] Methods for Locating Sample Units:**

*Monitoring method 1:* The FIA sample is on a predetermined systematic 4.8-km grid.

*Monitoring method 2:* MODIS imagery to be used in this work is collected in 250-meter and 500-meter pixels in a 2,330-km by 10-km swath.

*Monitoring method 3*: LANDSAT imagery used in LANDFIRE is collected in 30-meter pixels in 170-km by 185-km scenes.

**[I-2] Methods for Layout and Marking:**

*Monitoring method 1:* Layout and marking of FIA plots are as described in the field guides. Individual FIA grid points consist of a cluster of four systematically located sample plots each of 7.3-meter radius.

*Monitoring methods 2 and 3:* Layout and marking does not apply to the satellite image data.

**[I-3] "Field" Sampling Methods:**

*Monitoring method 1:* In each FIA plot, overstory tree species and percent cover (by ocular estimation) of dominant understory species are recorded.

*Monitoring method 2:* MODIS data is acquired by space-borne imaging instruments. Satellite image data needs to be collected during the same period each year (July 1 through August 31) and the shared cloud-free portion of image pairs must exceed 90 percent.

*Monitoring method 3:* LANDFIRE methods are as described on the websites listed on p. 34.

**J. Quality Control and Assurance:**

*Monitoring method 1:* The aspects of FIA data collection most vulnerable to error are species identification and cover estimation. These errors will be controlled by calibrating cover estimation among observers prior to field work (and periodically during the field season) and collecting voucher specimens when species identity is in question.

*Monitoring methods 2 and 3:* Quality control of the satellite imagery is as provided by the respective image acquisition corporation. LANDFIRE classification of imagery will have an established accuracy assessment associated with classified vegetation types.

**K. Data Form:**

*Monitoring method 1:* Pacific Northwest Research Station (PNW) crews will collect the FIA data using their own forms.

*Monitoring method 2:* No form is needed for the satellite image data collection.

**L. Data Storage:**

**Data Cleaning Methods:**

*Monitoring method 1*: The PNW will process the FIA data following their standardized protocols.

*Monitoring method 2*: Prior to being used in this work, the satellite image data will be radiometrically and geometrically corrected.

*Monitoring method 3:* The LANDFIRE Project will process the LANDFIRE data following their standardized protocols.

**Data Storage:**

*Monitoring method 1:* The FIA data will be stored in the FIA database.

*Monitoring method 2:* The MODIS data will be stored in the Chugach National Forest GIS database.

*Monitoring method 3:* The LANDFIRE data will be stored in the LANDFIRE database.

**M. Data Analysis:**

*Monitoring method 1*: When comparing FIA data collected at the different sampling intervals, the following variables will be summarized forestwide and by geographic area: number of plant species present, Jaccard's Index of Similarity,[9] overall sum cover, sum cover by species, sum cover by growth form, and sum cover by ground cover class.

The format to be used for summarizing and interpreting the results of the statistical analyses of the FIA data is as shown in Table Q3-1 (modified from figure 11.24 of Elzinga et al. 1998). For all variables in the FIA data analysis, the statistical test to be used is a paired *t* test (pp. 78–79 of Steele and Torrie 1960). This test is appropriate because it is expected that data from the pairs of sampling units are highly correlated (repeat measurements from the same locations).

If significant changes are determined in the above analyses, further evaluation of the data will be conducted. To determine if observed compositional changes in species cover within the FIA data are of a sufficient magnitude to result in a change in a vegetation classification, the program CLUSTR, supplied in the PC-ORD computer package (McCune and Mefford 1999), will be used. Within CLUSTR, the run options selected will be the Sorensen (Bray-Curtis) distance measure (Beals 1984) and the group linkage method is the unweighted pair group method with arithmetic mean (UPGMA; Lance and Williams 1967).

[9] $IS_J=(c/a+b+c) \times 100$ where ***c*** is the number of species in common between the two dates, ***a*** is the number of species unique to the first date, and ***b*** is the number unique to the second date.

**Table Q3-1. Example format to be used for summarizing and interpreting the results of the statistical analyses of the FIA data**

| Significance threshold = 0.10. Change threshold = 30%. Desired statistical power = 0.90[10]. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sample Size** | **Sample Statistics** | | | | **Observed Change** | **Results of Statistical Test (P)** | **Calculated Power (1-ß) to Detect a 30% Change** | **Minimum Detectable Change Size with a Power of 0.9** |
| | **Year 1** | | **Year 2** | | | | | |
| | **mean** | **sd** | **mean** | **sd** | | | | |
| 50 | 3.12 | 11.16 | 1.30 | 2.92 | 1.82 (58 %) | 0.85 | 0.13 | 4.82 (155 %) |
| INTERPRETATION: In this example, it cannot be concluded that a change took place (cannot reject the null hypothesis). There is low confidence in the results due to low power and high minimum detectable change size. It may be desirable to take action as a precautionary step and make changes in the monitoring design to increase power. | | | | | | | | |

*Monitoring method 2:* For the specifics of the methodology used in the MODIS satellite image work, see Werstak et al. (2009). The basic steps are to (1) derive vegetation indices (NDVI and NDMI) from MODIS imagery; (2) use image algebra to calculate the direction and magnitude of change in the index values between dates; (3) group the continuous data values resulting from the differenced images into classes using a 1-standard deviation scheme; and (4) summarize the change data forestwide, by geographic area, and by management area.

*Monitoring method 3:* In the LANDFIRE analyses, pair-wise comparisons of similarities in existing vegetation composition will be made between dates forestwide, by geographic area, and by management area. Specifically, for each year, the relative values of acreage by existing vegetation type will be calculated such that they total 100. The percentage value of those existing vegetation types common between the two dates will be summed in the calculation of percent similarity. Table Q3-2 provides an example of this calculation.

**Table Q3-2. Example calculation of the percentage similarity in existing vegetation type composition between two dates using LANDFIRE data**

| Existing Vegetation Type | Year 1 acres | Year 2 acres | Year 1 (in percent) | Year 2 (in percent) | Percent Similarity |
|---|---|---|---|---|---|
| A | 123 | 160 | 17.5 | 25.2 | 17.5 |
| B | 550 | 450 | 78.5 | 70.9 | 70.9 |
| C | 28 | 25 | 4.0 | 3.9 | 3.9 |
| Sum | 701 | 635 | 100 | 100 | **92.3** |

In this example, the percent similarity exceeds 80 percent (i.e., 92.3) which is a level of change below the threshold for alerting the forest leadership team.

[10] In the actual monitoring, these values will be set to: Significance threshold = 0.20, change threshold = 20 percent, and desired statistical power = 0.80.

**N. Assumptions and Limitations:**

*Monitoring method 1:* The FIA plots are primarily drawn from forested locations and will not represent plant species and plant community occurrences in shrubland and herbaceous vegetation. Also, FIA plots are not being sampled within the 796,720-hectare wilderness study area, which encompasses 36 percent of the land area of the Chugach National Forest.

*Monitoring method 2:* Major limitations of satellite data collection in south-central Alaska are the rarity of cloud-free days and the short growing season. There may be less than 10 days per year where cloud-free or nearly cloud-free images may be obtained during mid growing season. It is assumed that the satellite image reflectance bands and the derived vegetation indices are relevant metrics of land cover states.

*Monitoring method 3:* It is assumed that the LANDFIRE data quality is sufficient for these landscape-scale analyses.

**O. Reporting Frequency:** Reports with interpretations will be generated every 5 years (FY12 and FY17).

**P. Responsibility:** Chugach National Forest Ecologist in coordination with district ecologists.

**Q. List of Preparers:**

R.L. DeVelice, Ph.D., Forest Ecologist, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

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**R. 10-Year Cost Forecast:**

*Monitoring method 1:* Summarization of FIA data will occur annually. The cost of FIA data collection and entry into the FIA database is funded by PNW. The cost for interpreting the FIA data to answer this forest plan monitoring question would be funded by the Forest (these interpretations would occur once every 5 years).

*Monitoring method 2:* The forestwide collection of MODIS scenes would be obtained annually at no charge. Image analysis and reporting will be funded by the forest plan monitoring dollars and will occur in FY12 and FY17.

*Monitoring method 3:* The cost of LANDFIRE data products is covered under a national multi-partner, multi-agency partnership, and would not be funded by the Forest. The Forest would fund the cost for interpreting the LANDFIRE data to answer this forest plan monitoring question (these interpretations are anticipated to occur once every 5 to 10 years, depending on the LANDFIRE refreshment schedule).

| | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| People | $39,393 | $2,608 | $2,687 | $2,767 | $2,850 | $45,667 | $3,024 | $3,114 | $3,208 | $3,304 |
| Travel | $2,814 | $0 | $0 | $0 | $0 | $3,262 | $0 | $0 | $0 | $0 |
| Other | $2,814 | $0 | $0 | $0 | $0 | $3,262 | $0 | $0 | $0 | $0 |
| **TOTAL** | **$45,020** | **$2,608** | **$2,687** | **$2,767** | **$2,850** | **$52,191** | **$3,024** | **$3,114** | **$3,208** | **$3,304** |

Total 10-year estimated cost: $120,773

Estimated annual cost in forest plan (p. 5-6): $35,000

**S. Literature Cited:**

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## *Water Resources*

### *6. Are Best Management Practices (including wetland management) effective in meeting water quality standards?*

**A. Monitoring Item: *Water Resources***

**B. MEIT Interpretation of General Monitoring Question:** Interpreted as stated.

**C. Business Need and Rationale**: The forest plan standards and guidelines for soils (USDA Forest Service, Chugach National Forest 2002) require the implementation of best management practices (BMP) specified in the Soil and Water Conservation Handbook (USDA Forest Service, Alaska Region 2006). BMPs are recognized as the primary control mechanisms for nonpoint sources of pollution on National Forest System lands. The Forest Service is required to apply BMPs to comply with Alaska State water quality standards that are specified by the Alaska Department of Environmental Conservation (Alaska Department of Environmental Conservation 2009). Site-specific application of these BMPs is designed to protect and maintain soil, water, and water-related beneficial uses, and to prevent or reduce nonpoint source pollution.

Monitoring is the first step of a feedback mechanism and an essential part of the BMP process. Monitoring of BMPs is intended to call attention to areas in which management activities are not following BMPs and/or are contributing to nonpoint sources of pollution that may lead to State water quality standards not being met. Management activities that are subject to BMP monitoring include the following, as outlined in the Region 10 Soil and Water Conservation Handbook (USDA Forest Service, Alaska Region 2006):

- Watershed Management (chapter 12)
- Timber Management (chapter 13)
- Transportation and Other Facilities Management (chapter 14)
- Pesticide Use Management (chapter 15)
- Recreation Management (chapter 16)
- Minerals Management (chapter 17)
- Fish and Wildlife Habitat Management (chapter 18)
- Fire Suppression and Fuels Management (chapter 19)

This monitoring item contributes to management understanding of the following goals and objectives stated in the Chugach National Forest Revised Forest Plan (USDA Forest Service, Chugach National Forest 2002):

**Goal:** Maintain and restore water quality.

**Objective:** Meet State standards for nonpoint source water quality.

This monitoring item also contributes to management understanding of the following goals and objectives of the Forest Service Region 10 Strategic Business Plan (USDA Forest Service, Alaska Region 2005):

**Goal 5:** Improve watershed condition.

**Objective:** Monitor water quality impacts of activities on National Forest System lands.

**Performance Measure:** Percentage of projects on National Forest System lands fully implementing BMPs.

**Short-term Performance Measure:** Percentage of roads in compliance with BMPs.

**Output Measure:** Percentage of projects on National Forest System lands fully implementing BMPs (the FY12 target is 90 percent).

**D. Category**: Monitoring of BMPs includes both implementation and effectiveness monitoring. Implementation monitoring determines whether the necessary BMPs, mitigations, constraints, and decisions were actually applied to an activity as planned. Implementation monitoring is the emphasis of this monitoring program. Effectiveness monitoring determines the success of BMPs in protecting water quality and beneficial uses. Effectiveness monitoring will be conducted on streams or rivers adjacent to the selected monitoring sites.

**E. Protocol Status, Source, and Re-evaluation Schedule:** This is a pilot protocol. Guidance for this pilot protocol was taken from the BMP monitoring methodology, used on the Chugach National Forest between 1993 and 1998 (Blanchet 1993), and developed by the Alaska Region BMP Monitoring Working Group. Additional guidance was provided by the Region 10 Soil and Water Conservation Handbook (USDA Forest Service, Alaska Region 2006). To gain efficiencies, this protocol will be conducted in conjunction with other forest plan implementation monitoring protocols, based on the sampling design described in Monitoring Question #1 (Are projects being implemented consistent with the Forest Plan direction?).

The Forest Service has been involved in a 10-year process of developing a national BMP program to standardize BMPs, monitoring protocols, practices, data storage, and reporting. The set of national core BMPs will tier to the existing Region 10 BMPs, but will not change the substance of the regional BMPs. The national BMP Handbook will also include a BMP monitoring technical guide that will utilize information from existing BMP monitoring programs, scientific review, field testing, and other comments. The technical guide will provide protocols for both implementation and effectiveness monitoring. The national core BMP monitoring protocols are scheduled to be ready for internal management review in June 2012.

This pilot protocol will be re-evaluated following the completion of the national core BMP monitoring protocols. At that time, the national technical guide will be adopted to the extent required and appropriate.

**F. Objective Statement**: The objective of this monitoring protocol is to cost-effectively and scientifically assess the level at which BMPs are being implemented and their effectiveness in protecting water quality on the Chugach National Forest.

**[F-1] Required by Law:** This effort is guided by requirements of the Clean Water Act and Alaska State water quality standards, which define the level where water

quality is to be maintained and protected. In the Alaska Region, the Forest Service has been delegated the authority to implement and monitor activities potentially impacting water quality. This process relies on the use of BMPs to provide an adequate level of water quality protection, and this protocol provides the guidance to measure success.

**[F-2] Statistical Rigor Rationale:** See F-3.

**[F-3] Data Precision, Reliability:** BMP monitoring will incorporate both professional judgment and quantitative measures. Implementation monitoring will quantify the number of sites where BMPs were successfully implemented, providing Class B data (data that are mainly qualitative in nature). Effectiveness monitoring will analyze water quality data and reference it to State standards, providing Class A data (data that have well accepted quantitative methods).

**[F-4] Confidence:** Data collected using this protocol will allow managers to confidently determine the status of BMP implementation on forest projects. Collection of water quality data for effectiveness monitoring will follow standard collection methods (Alaska Department of Environmental Conservation 2009), providing an adequate level of confidence in subsequent comparisons to State standards. Details of the detection, accuracy, and precision of the monitoring program are discussed in the Sampling Design section.

**[F-5] Change Detection:** Results of BMP implementation monitoring will be expressed in terms of the percentage of projects on the forest fully implementing the applicable BMPs, as defined in the Indicator and Its Unit of Measure section. The Region 10 target is for 90 percent of projects on National Forest System lands to fully implement BMPs annually (USDA Forest Service, Alaska Region 2005). BMP effectiveness monitoring will be conducted to determine the success of BMPs in protecting water quality and beneficial uses.

The threshold for BMP implementation monitoring is surpassed when, within any 5-year window, three or more projects do not achieve full implementation of BMPs. Likewise, the threshold for effectiveness monitoring is surpassed when, within any 5-year window, three or more projects result in State water quality standards not being met as a result of the project implementation. Surpassing either of these thresholds will trigger a review by the forest leadership team.

Although this protocol is not intended to be used as project-level monitoring, any project monitored on the Chugach National Forest that does not achieve full implementation of BMPs will be referred to the deciding official and the appropriate staff officer for corrective actions.

Similarly, any project in which water quality data and professional judgment suggest that Alaska State water quality standards are not being met as a result of the management activity will trigger additional review, including management review, and if necessary, consultation with Alaska Department of Environmental Conservation and additional water quality monitoring. If this review indicates that management activity is the cause of the water quality impairment, then the deciding official will be notified and corrective actions will be taken to protect water quality.

**[F-6] Threshold:** See F-5.

**[F-7] Scope of Inference:** The spatial scope of inference is forestwide and at the district scale. The temporal scope of inference is the construction season in which the sampling is conducted.

**G. Indicator and its Units of Measure:**

**BMP Implementation Monitoring:** Qualitative ratings are used to characterize the extent to which BMPs have been applied at each management activity site. For each site, implementation of each applicable BMP is qualitatively rated on a scale of 0 to 4 (see Data Collection). The implementation ratings for all applicable BMPs are averaged for each site. Full implementation is defined as an average BMP implementation score of 3.5 or higher. The percentage of sites fully implementing BMPs will then be calculated.

**BMP Effectiveness Monitoring:** For those sites where management activities are adjacent to or crossed by perennial streams or rivers, the following two water quality parameters will be measured upstream and downstream of the site:

**Turbidity (NTU):** Turbidity is a measure of suspended sediment and other particles in the water. High turbidity can be the result of surface erosion from management activities. Under the Antidegradation Policy within the Alaska State water quality standards, water quality will be protected at its highest potential use level. The applicable Alaska State water quality standard for turbidity dictates the following for fresh water uses (Alaska Department of Environmental Conservation 2009):

- Turbidity may not exceed 5 nephelometric turbidity units (NTU) above natural conditions when the natural turbidity is 50 NTU or less.
- Turbidity may not have more than a 10-percent increase over natural conditions when the natural turbidity is more than 50 NTU.
- Turbidity may not exceed a maximum increase of 25 NTU over natural conditions.

**Stream Temperature (degrees C):** Stream temperature can indicate the effectiveness of riparian vegetation in moderating water temperature, which can be important for fish and aquatic species. Increased stream temperatures can be the result of the effects of management activities on riparian vegetation and channel morphology. The applicable Alaska State water quality standard for temperature dictates the following for fresh water uses (Alaska Department of Environmental Conservation 2009):

- All waters: May not exceed 15 degrees C at any time.
- Fish migration routes: May not exceed 15 degrees C.
- Spawning areas: May not exceed 13 degrees C.
- Rearing areas: May not exceed 15 degrees C.
- Egg and fry incubation areas: May not exceed 13 degrees C.

**H. Sampling Design:** General sampling design for BMP monitoring will be determined using the protocol for Monitoring Question #1 (Are projects being implemented consistent with the Forest Plan direction?).

**[H-1] Target Population:** The target population is all of the ground-disturbing activities occurring on the Chugach National Forest in a given fiscal year. BMPs should be built into the implementation of all ground-disturbing projects on the Chugach National Forest. These BMPs fall under the following categories in the Soil and Water Conservation Handbook (USDA Forest Service, Alaska Region 2006):

- Watershed Management
- Timber Management
- Transportation and Other Facilities Management
- Pesticide Use Management
- Recreation Management
- Minerals Management
- Fish and Wildlife Habitat Management
- Fire Suppression and Fuels Management

**[H-2] Sampling Frame:** See H-1.

**[H-3] Sample Selection Methods:** Samples will be selected using the protocol for Monitoring Question #1. Sites will be selected that are adjacent to perennial streams, cross perennial streams, or otherwise directly affect perennial streams. Both BMP implementation and BMP effectiveness monitoring will be conducted at the selected sites.

**[H-4] Sample Unit Description:** Sample units will be determined using the protocol for Monitoring Question #1.

**[H-5] Detection and Observer Bias Controls:** Qualitative sampling strategies, such as those used for BMP implementation monitoring, are inherently biased because of individual interpretations of the same observation. This bias will be minimized through the use of adequate training and instruction, and the use of photo documentation of field conditions observed while assessing a site. The quantitative data collection in BMP effectiveness monitoring will incorporate much less bias because, in addition to adequate instruction and training, sampling instruments have known detection and precision characteristics when properly calibrated and maintained.

**[H-6] Sample Size Estimate and Estimation Methods:** Sample sizes for BMP monitoring will be determined using the protocol for Monitoring Question #1.

**[H-7] Temporal Details of Sampling:** The timing of sampling will vary according to the type of activity occurring at each site. To gain logistical efficiencies, monitoring will be coordinated with the interdisciplinary team for Monitoring

Question #1. Monitoring will generally occur during between June and October, following implementation of a project.

**I. Data Collection:**

**[I-1] Methods for Locating Sample Units:**

The interdisciplinary team identified for Monitoring Question #1 will visit each of the chosen sites following project completion. See I-3 for more information.

**[I-2] Methods for Layout and Marking:** See I-3

**[I-3] "Field" Sampling Methods:**

BMP Implementation Monitoring will be conducted at each of the chosen sites.

For each site, the monitoring personnel will record the following site descriptors on the BMP implementation monitoring form (see Attachment Q6-1):

- Date of sampling
- Samplers
- Activity site ID#: Assign a unique ID number to each site.
- Site name
- Ranger district
- Watershed: Record the name of the 5th- or 6th-level HUC, if known.
- Site location description: Provide details on how to locate the site. This can include physical descriptions, GPS coordinates, or Township and Range coordinates.
- Start and end description: Provide details on the boundaries of the site.
- Name of adjacent stream: Provide the name, if available, of any adjacent stream(s), or any stream(s) that crosses the site.
- Recent and current weather: Describe the current and recent weather conditions.
- Site narrative: Provide a short narrative describing the management activity performed at the site, the completion date, the road maintenance level or trail class if applicable, and any other factors pertinent to the monitoring.

For each site, a list of applicable BMPs will be developed using the Region 10 Soil and Water Conservation Handbook (USDA Forest Service, Alaska Region 2006). The BMPs selected for monitoring will be based on the type of activity occurring and professional judgment of the hydrologist and/or soil scientist. Each applicable BMP will be rated using a scale of 0 to 4 to determine if the BMP was fully, partially, or not implemented at the site as a whole. Decimal ratings can also be given. Ratings will be evaluated based on the language provided in the BMP. Ratings will be assigned through consensus of the team. Numerical rating definitions follow:

**4** – BMP fully implemented (100 percent implementation)

**3** – Intent of BMP is met, but BMP is not fully implemented

**2** – Intent of BMP is partially met, mitigation may be necessary

**1** – An attempt was made to implement the BMP, but the intent is not met, mitigation is necessary

**0** – BMP was disregarded (no attempt was made to implement the BMP)

With the exception of activities involving ongoing mining, projects will be monitored after they are completed. In addition to field visits to project sites, monitoring personnel may need to examine NEPA documents, project daily diaries, and other project records. Monitoring personnel will indicate the phase or phases in which the problem occurred, as follows:

**EA:** Environmental Analysis Phase

**CO:** Construction (Implementation) Phase

**PI:** Post-Implementation Phase

A short narrative will be written for each BMP evaluated, providing rationale for the rating, physical characteristics related to the specific BMP, and any observed evidence of surface erosion. As an example, for BMP 14.9 (Drainage Control to Minimize Erosion and Sedimentation), the narrative may include a discussion of the total number of culverts, the number of culverts that are non-functional, reasons for blocked culverts, and evidence of erosion related to drainage at these culverts.

BMP effectiveness monitoring will be conducted on each site chosen for implementation monitoring. Two water quality parameters will be measured upstream and downstream of each site. The sampling team will choose at a minimum one site upstream of the site and one site downstream of the site. These water quality measurement sites will be on the same stream or river segment. The “upstream” and “downstream” sites must have similar stream characteristics to minimize the influence of other variables on water quality parameters, and any tributaries that enter between the upstream and downstream sites will be noted. Samples will always be taken in flowing water to avoid sampling the effects of water stagnation. The samplers will assign a sample ID number to each site and record the time of the sample on the BMP effectiveness monitoring form (see Attachment Q6-2). The samplers will then measure and record the following variables:

**Turbidity:** Turbidity will be sampled using a portable turbidimeter. Water will be sampled from a flowing, well-mixed area of the channel that is representative of the general site conditions. Waters with natural glacial turbidity should be noted.

**Stream Temperature:** Stream water temperature will be measured using a simple field thermometer. Water temperature will be measured in a

flowing, well-mixed area of the channel that is representative of the general site conditions. Samples from stagnant areas of water should be avoided unless they represent the general site conditions.

A short narrative will be written describing any visible sources of water quality impairment. Sources of turbidity may include surface erosion, glacial silt, or high flows. Stream temperature can be influenced by impaired riparian vegetation, channel widening, or weather.

**J. Quality Control and Assurance:** BMP monitoring will be conducted by an interdisciplinary team, of which one member is a qualified hydrologist or soil scientist. Training of additional sampling personnel will be conducted by a qualified hydrologist or soil scientist. Sampling personnel should have a working knowledge of the BMPs in the Region 10 Soil and Water Conservation Handbook (USDA Forest Service, Alaska Region 2006), this pilot protocol, and the water quality sampling techniques necessary for this level of monitoring. Calibration of the turbidimeter should be conducted as specified by the manufacturer.

**K. Data Form:** BMP implementation monitoring data will be collected on the Chugach National Forest BMP Implementation Monitoring Form (Attachment Q6-1). BMP effectiveness monitoring data will be collected on the Chugach National Forest BMP Effectiveness Monitoring Form (Attachment Q6-2).

**L. Data Storage:** Currently, no Forest Service system exists for storing BMP monitoring data and information. Data will be stored in annual reports, both in paper and electronic format.

**[L-1] Data Cleaning Methods:** Not applicable

**[L-2] Data Storage:** Currently, no Forest Service database exists for storing BMP monitoring data and information. Data will be stored in annual reports, both in paper and electronic form.

**M. Data Analysis:** The following data analysis steps will be taken. Statistical analysis of these data will not be conducted. A BMP monitoring report will be compiled by the end of the fiscal year of the monitoring by a qualified hydrologist or soil scientist. This report will be made available to the appropriate line officer(s) for review and will include the following components:

1) A list of sites monitored during the fiscal year will be created, including the location of each site, the type of activity conducted, and the date on which the activity occurred. A description of each site will include the aerial extent, the management history of each site, and photos, if available.

2) An average BMP implementation score will be developed for each site by averaging the BMP implementation scores for all applicable BMPs. The average BMP implementation scores for each site will then be summarized in the BMP monitoring report. The percentage of projects monitored that fully implemented BMPs will be calculated. For this purpose, sites that receive an average BMP implementation score of 3.5 or greater will be considered to have “full implementation” of BMPs.

3) For effectiveness monitoring, water quality measurements will be summarized for each site. Water quality data will be compared to the Alaska State standards for water quality (Alaska Department of Environmental Conservation 2009). Water quality data from upstream and downstream of each site will be analyzed to determine whether the management activity may be influencing water quality.

4) Professional judgment will be used to analyze any linkages between management activities and physical measurements of water quality. Measured water quality parameters will be linked to any visible sources of water quality impairment. BMP implementation scores will be compared to the water quality data of the BMP effectiveness monitoring, and these comparisons will be summarized (Table Q6-1).

5) BMP implementation and effectiveness monitoring results will be compiled and summarized with results from previous years. If three or more projects in any 5-year window do not achieve full implementation of BMPs, or three or more projects in any 5-year window do not meet State water quality standards as a result of project implementation, the forest leadership team will conduct a review.

**Table Q6-1. Recommended actions based on results of BMP implementation and effectiveness monitoring**

| | Category | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| Monitoring Results | **Implementation Monitoring:** BMPs are fully implemented for the site (average score of 3.5 or greater) | Yes | No | Yes | Yes | No | No |
| | **Effectiveness Monitoring:** Measured water quality data meet State water quality standards | Yes | Yes | No | No | No | No |
| | If water quality standards are exceeded, professional judgment suggests that it is the result of the management activity | - | - | Yes | No | Yes | No |
| Recommended Action(s) | No action needed | X | | | | | |
| | Management review for corrective actions to implement applicable BMPs | | X | | | X | X |
| | Further investigate the source of the water quality impairment | | | | X | | X |
| | Management review for corrective actions to protect water quality. If necessary, consult with Alaska Department of Environmental Conservation and conduct additional water quality monitoring | | | X | | X | |

**N. Assumptions and Limitations:** This protocol has the following assumption:

- Sites sampled are representative of the types and locations of ground-disturbing activities occurring on the Chugach National Forest.

This protocol has the following limitations:

- BMP implementation ratings can be subjective. Ratings can be influenced by observer bias, seasonal differences, and weather conditions.

- Water quality parameters are affected by numerous environmental and human-influenced factors. Differences in water quality parameters measured upstream and downstream of a management site may not always be the result of the management activity.

- The magnitude of the effects of management activities on water quality parameters depends on the flow in the stream or river. High flows will generally moderate any human-related water quality effects.

The forest hydrologist or soil scientist will use sound professional judgment to determine the level to which these limitations may be influencing the results of the monitoring.

**O. Reporting Frequency:** A BMP monitoring report will be developed following each season of BMP monitoring.

**P. Responsibility:** The Chugach National Forest Supervisor's Resources Staff Officer is responsible for this protocol. The forest hydrologist or soil scientist will be responsible for coordinating BMP monitoring and reporting. Monitoring will be conducted by the interdisciplinary team identified for Monitoring Question #1, which will include at least one qualified hydrologist or soil scientist.

**Q. List of Preparers:**

*Prepared by:*

Bill MacFarlane, Forest Hydrologist, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

*Reviewed by:*

Mary Friberg, Inventory and Monitoring Coordinator, USDA Forest Service, Regional Office, Juneau, Alaska.

Dave Mott, Watershed and Air Program Manager, USDA Forest Service, Regional Office, Juneau, Alaska.

Mike Novy, Resources Staff Officer, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

**R. 10-Year Cost Forecast:** The anticipated FY12 annual cost of BMP monitoring, including personnel time and analysis, is $11,300. The following table shows anticipated annual costs through FY21, based on an annual inflation rate of 3 percent. The total 10-year cost of annual BMP monitoring would be $134,000. These estimates are based on two specialists monitoring between 5 and 10 projects per year. The number of projects monitored would be determined under Monitoring Question #1. Monitoring costs would be expected to increase or decrease depending on the number, location, size, and complexity of the projects occurring on Chugach National Forest in a given year. The estimated annual cost in the Revised Forest Plan is $10,000. Additional costs for travel to the Cordova Ranger District would occur every third year.

| | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| People | $11,300 | $11,600 | $12,000 | $12,400 | $12,700 | $13,100 | $13,500 | $13,900 | $14,300 | $14,700 |
| Travel | $0 | $1500 | $0 | $0 | $1500 | $0 | $0 | $1500 | $0 | $0 |
| Other | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **TOTAL** | **$11,300** | **$13,100** | **$12,000** | **$12,400** | **$14,200** | **$13,100** | **$13,500** | **$15,400** | **$14,300** | **$14,700** |

## S. Literature Cited:

Alaska Department of Environmental Conservation. 2009. 18 AAC 70 Water Quality Standards, amended as of September 19, 2009.

Blanchet, D. 1993. *BMP Implementation Monitoring Report for Selected Roads on the Chugach National Forest*. Chugach National Forest, Anchorage, Alaska.

USDA Forest Service, Alaska Region. 2005. *USDA Forest Service Alaska Region Strategic Business Plan for Fiscal Years 2006-08*. USDA Forest Service. Version 2.1, May 2005.

USDA Forest Service, Alaska Region. 2006. *Soil and Water Conservation Handbook* (FSH 2509.22). USDA Forest Service, Alaska Region (available at http://fsweb.r10.fs.fed.us/directives/fsh/2509.22/.)

USDA Forest Service, Chugach National Forest. 2002. *Revised Land and Resource Management Plan, Chugach National Forest.* USDA Forest Service, R10-MB-480c.

## *Attachment Q6-1. Chugach National Forest BMP implementation monitoring form*

**Chugach National Forest** **BMP IMPLEMENTATION MONITORING FORM** *6-27-07 version*

| | |
|---|---|
| Date | |
| Sampler(s) | |
| Activity Site ID# | |
| Site Name | |
| Ranger District | |
| Watershed | |
| Site Location Description | |
| Start/End description | |
| Name of adjacent stream | |
| Recent and current weather | |
| Site Narrative | |

| BMP Number and Title | BMP Rating | Prob. Phase | Comments |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
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## *Attachment Q6-2: Chugach National Forest water quality BMP effectiveness monitoring form*

**Chugach National Forest** **BMP EFFECTIVENESS MONITORING FORM - WATER QUALITY** *6-27-07 version*

| | |
|---|---|
| Date | |
| Sampler(s) | |
| Activity Site ID# | |
| Site Name | |
| Ranger District | |
| Watershed | |
| Site Location Description | |
| Start/End description | |
| Name of monitored stream | |
| Recent and Current Weather | |
| Site narrative | |

| Sample ID# | Sample Time | Sample Location Description | Turbidity (NTU) | Stream Temp (deg C) | Comments |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

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## *Sensitive and Exotic Plant Species*

### *7. Are Forest management activities contributing to changes in the abundance and distribution of sensitive plant populations?*

**A. Monitoring Item: *Sensitive Plant Species***

**B. General Monitoring Question:** Table 5-1 – What is the distribution and abundance of sensitive plants in areas affected by management activities? MEIT Interpretation – Are Forest management activities contributing to changes in the abundance and distribution of sensitive plant populations?

**C. Business Need and Rationale:** The National Forest Management Act of 1976 requires providing "for diversity of plant and animal communities."

Forest Service Manual ((FSM) 2670.5) defines sensitive species as those plant and animal species identified by a regional forester for which population viability is a concern, as evidenced by:

a. Significant current or predicted downward trends in population numbers or density.

b. Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

FSM 2670.45 directs forest supervisors to "Determine distribution, status, and trends of … sensitive species and their habitats on forest lands." This direction is consistent with the Alaska Region FSM issuance 2672.41.

The record of decision for the Revised Forest Plan documents the determination of the biological evaluation for plants that, although individuals may be affected, these effects will not likely contribute to the loss of viability of populations, the species, or to the Federal listing of any sensitive species.

The Revised Forest Plan includes the following:

- A desired condition (p. 3-13) stating that "the abundance and distribution of sensitive plants will be stable."
- A goal (p. 3-4) to "conserve rare plant species."
- A standard (p. 3-27) that states "Collecting or disturbing any threatened, endangered, or sensitive plant is prohibited unless authorized. In cases of legitimate scientific or educational use, a permit may be issued authorizing collection of sensitive plants or plant parts. Such collections must not adversely affect the continued existence or vigor of a sensitive plant population."
- A guideline (p. 3-27) to "Avoid, minimize, or mitigate the effects of human activities in areas containing sensitive plant populations."

Since completion of the Revised Forest Plan, the sensitive plant list has been revised and may receive future revisions. This protocol applies to the sensitive plant list in effect at the time of analysis.

Monitoring is needed to determine how effectively the Forest is meeting sensitive plant desired conditions, goals, standards, and guidelines specified in the Revised Forest Plan. Since intensive management only occurs on about 4 percent of the Chugach National Forest (prescription categories 3, 4, and 5 of the Revised Forest Plan; pp. 4-3 to 4-4), the likelihood is low that forest management is contributing to deleterious changes in sensitive plant populations.

**D. Category:** Implementation and effectiveness as listed under section E.

**E. Protocol Status, Source, and Re-evaluation Schedule:** This is a pilot protocol. Reevaluation of this protocol will occur after the first year of implementation. Based on this evaluation, the protocol will be finalized and thereafter reviewed every 5 years. One implementation and one effectiveness monitoring method will be used:

*Implementation monitoring* – Follows the protocol for Monitoring Question #1 (i.e., Are projects being implemented consistent with the Forest Plan?) of this guide. Specifically, projects where sensitive plants have been found will be reviewed to determine if they are in compliance with Revised Forest Plan standards and guidelines; and to determine if mitigation measures from biological evaluations and other botanical input are carried into environmental assessments, decisions and permits, and ultimately implemented.

*Effectiveness monitoring* – Monitor the condition of populations in areas of active management activity.[11] The source of the plant occurrence data will be records in Forest Service NEPA and project files, the Forest Service corporate database (NRIS TESP), the Alaska Natural Heritage Program database, and herbarium records.

**F. Objective Statement:** This monitoring evaluates the likelihood that forest management activities are contributing to a downward trend in sensitive plant populations, specifically:

*Implementation monitoring* – Determine the extent to which mitigation measures from biological evaluations and other botanical input are carried into NEPA documents, incorporated into decisions and permits, and finally, implemented.

*Effectiveness monitoring* – Determine whether sensitive plant population abundance or distribution is changing in areas where management activities are occurring.[12]

> **[F-1] Required by Law**: Inferred. The National Forest Management Act directive to “provide for diversity of plant and animal communities” infers the need to monitor and document attainment of that directive. USDA Forest Service policy under FSM 2670 calls for developing and implementing management objectives for the conservation of populations and/or habitat of sensitive species.

[11] In the context of this monitoring an “active management activity” is a management action that could potentially affect sensitive plant individuals and populations.
[12] Presently there are fewer than five known instances of overlap of sensitive plant populations with active management activities.

**[F-2] Statistical Rigor Rationale:**

*Implementation monitoring* – Moderate.

*Effectiveness monitoring* – High, given sufficient sample size. However, there are a limited number of known co-occurrences of sensitive plants with management activity on the forest, so statistical rigor as applied to the currently available data is probably low to moderate.

**[F-3] Data Precision, Reliability:**

*Implementation monitoring* – Class B.

*Effectiveness monitoring* – Class A.

**[F-4] Confidence:**

*Implementation monitoring* – A high degree of confidence in the results is expected.

*Effectiveness monitoring* – It is desirable that the confidence level exceed 80 percent in testing the null hypothesis that there is no change in sensitive species cover or area of occurrence between monitoring dates. However, the sample size for the sensitive plant population monitoring dataset is likely insufficient at present to achieve such levels of confidence.

**[F-5] Change Detection:**

*Implementation monitoring* – The lack of mitigation measures incorporated into projects and/or lack of mitigation implementation for any project must be detected.

*Effectiveness monitoring* – The probability of rejecting a false null hypothesis is set to 80 percent (statistical power = 1-*ß*).[13] However, the sample size for the sensitive plant population monitoring dataset is likely insufficient at present to achieve such statistical power.

**[F-6] Threshold:**

*Implementation monitoring* – If mitigation measures have not been implemented in projects where sensitive plants have been found, the proponent would be notified. If such measures are not implemented in a timely manner then management action may be invoked.

*Effectiveness monitoring* – Results having the greatest concern to management are those where the calculated *P* value from the significance test used is less than 0.20. This threshold represents a standard yet conservative level of significance used to detect changes in plant abundance in monitoring situations (Elzinga et al. 1998). However, the sample size is presently insufficient for significance testing.

[13] Where *ß* = the probability of Type II error (the failure to detect a difference when in truth there is one).

**[F-7] Scope of Inference:** The spatial scope is forestwide and the temporal scale is annual to decadal.

**G. Indicator and its Units of Measure:**

*Implementation monitoring* – Mitigation measures. During document review, mitigation measures for each sample unit will be tracked through documents from biological evaluations through environmental documents and to final project plans, and finally to project implementation.

*Effectiveness monitoring* – Sensitive plant species presence, percent cover, stem count, and area of occurrence (hectares). Sensitive plant species are those designated by the regional forester.[14]

**H. Sampling Design:** Sampling design for project implementation monitoring is described under the protocol for Monitoring Question #1 in this guide and is not repeated here (sensitive plant specific details are included below).

**[H-1] Target Population**: Threatened, endangered, and sensitive plants.

**[H-2] Sampling Frame:**

*Implementation monitoring* – All projects on the Chugach National Forest conducted under an EIS, EA, or CE where sensitive plants have been found and all permits involving collection of sensitive plants.

*Effectiveness monitoring* – Areas of active management activity where sensitive plants have been found.

**[H-3] Sample Selection Methods:**

Implementation monitoring – The pool of projects sampled will be all those with known populations of sensitive plants.

*Effectiveness monitoring* – The sensitive plant population samples are a randomly selected subset of sites with known populations of sensitive plants in areas of active management activity. For each species, the sample size is arbitrarily set at five populations or 10 percent of the populations, whichever is larger. The sensitive plant population monitoring sample is currently small, but may increase in the future if more sensitive plant populations are discovered.

**[H-4] Sample Unit Description:**

*Implementation monitoring* – Projects on the Chugach National Forest conducted under an EIS, EA, or CE where sensitive plants have been found and all permits involving collection of sensitive plants.

*Effectiveness monitoring* – Samples are polygons extending around individual populations of sensitive plants.

14 http://fsweb.r10.fs.fed.us/staffs/wfew/wfew_documents/2009_revised_r10_sensitive_species_list.doc

**[H-5] Detection and Observer Bias Controls:**

*Implementation monitoring* – In monitoring on-the-ground mitigation, the observer needs to be trained in detecting mitigation measures.

*Effectiveness monitoring* – Intensive training in finding and correctly identifying sensitive plant species will be necessary for all observers. Large variations in cover estimation can occur among observers. This bias will be controlled by calibrating cover estimation among observers prior to initiating field work. To reduce variation in recorded species cover over the full growing season, field data collection will occur from early July to late August. Mid-season data collection will also reduce variation in species detection probability resulting from phenologic differences.

**[H-6] Sample Size Estimate and Estimation Methods:**

*Implementation monitoring* – Up to five projects conducted under an EIS, EA, or CE where sensitive plants have been found will be sampled annually on the Forest. All permits involving collection of sensitive plants will also be monitored.

*Effectiveness monitoring* – Initially, the sample size will equal the number of projects intersecting sensitive plant populations. Additional sites will be added as more management activities take place and more sensitive plants are found and documented. The adequacy of the number of plots so derived will be evaluated based on post hoc power and minimum detectable change analysis (pp. 262–264 of Elzinga et al. 1998). If this analysis shows low confidence in the results due to low power and high minimum detectable change size it may be desirable to make changes in the monitoring design to increase power (e.g., increase sample size).

**[H-7] Temporal Details of Sampling:**

*Implementation monitoring* – Document review will occur annually. To gain logistical efficiencies, field visits for project implementation monitoring will be coordinated with the interdisciplinary team for Monitoring Question #1.

*Effectiveness monitoring* – All field sampling is done during June, July, and August. The monitoring sites are read annually over a 5-year period with year 0 being prior to initiation of the disturbance activity.

**I. Data Collection:** Data collection methods for project implementation monitoring are described under the protocol for Monitoring Question #1 in this guide and are not repeated here (sensitive plant specific details are included below).

**[I-1] Methods for Locating Sample Units:**

*Implementation monitoring* – NEPA documents and permits for collecting sensitive plants. Locate each project by consulting with the project manager, the project implementation record, and the NEPA decision document.

*Effectiveness monitoring* – Monitoring will take place within known populations of sensitive plants in areas of active management activity.

**[I-2] Methods for Layout and Marking:**

*Implementation monitoring* – Not applicable.

*Effectiveness monitoring* – The center and the boundary of the population will be digitally documented as a polygon using a mapping-grade GPS. No on-the-ground permanent marking is necessary because location data obtained using a mapping-grade GPS receiver is sufficiently accurate.

**[I-3] "Field" Sampling Methods:**

*Implementation monitoring* – The presence of and type of mitigation at the project site will be documented.

*Effectiveness monitoring* – The surveyor will conduct a timed meander (Goff et al. 1982) to locate sensitive plants and complete an Alaska Region TES Plant Survey Field Form.[15] If plants are found, the population boundaries will be mapped (as above) and Alaska Region threatened and endangered species (TES) Plant Element Occurrence Field Forms[16] will be completed.

**J. Quality Control and Assurance:** The data collection most vulnerable to error is species identification and cover estimation. These errors will be controlled by calibrating cover estimation among observers prior to field work and collecting voucher specimens when species identity is in doubt. Collection will be done judiciously to preclude extirpation of the population.

**K. Data Form:**

*Implementation monitoring* – The form is included with the protocol for Monitoring Question #1 in this guide.

*Effectiveness monitoring* – Alaska Region TES Plant Survey and TES Plant Element Occurrence field forms referred to above.

**L. Data Storage:**

**[L-1] Data Cleaning Methods:**

*Implementation monitoring* – Described under protocol for Monitoring Question #1 and not repeated here.

*Effectiveness monitoring* – The data will be checked for consistency with NRIS requirements prior to entry into NRIS-TESP.

**[L-2] Data Storage:**

*Implementation monitor*ing – Described under protocol for Monitoring Question #1 and not repeated here.

[15] http://fsweb.r10.fs.fed.us/staffs/wfew/botany/botany-docs/sensitive_plant_survey_form_0812.doc
[16] http://fsweb.r10.fs.fed.us/staffs/wfew/botany/botany-docs/sensitive_plant_EO_form_R10_0812.doc

*Effectiveness monitoring* – NRIS TESP.[17]

**M. Data Analysis:**

*Implementation monitoring* – Described under protocol for Monitoring Question #1 and not repeated here.

*Effectiveness monitoring* – The following variables will be summarized forestwide and, if the sample size is adequate, by geographic area: percentage of samples with occurrences, sum cover by species, total area by species.

The format to be used for summarizing and interpreting the results of the sensitive plant population monitoring statistical analyses is as shown in Table Q7-1 (modified from figure 11.24 of Elzinga et al. 1998). **All cases where a statistically significant (i.e., *P* is less than 0.20) DECREASE in an evaluation variable is calculated will be subjectively assessed to determine if forest management activities may be contributing to the decrease in sensitive species occurrence.**

**Table Q7-1. Format to use for summarizing and interpreting results of sensitive plant population monitoring statistical analyses**

| Significance threshold = 0.10. Change threshold = 30%. Desired statistical power = 0.90[18]. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Sample Size | Sample Statistics | | | | Observed Change | Results of Statistical Test (P) | Calculated Power (1-ß) to Detect a 30% Change | Minimum Detectable Change Size with a Power of 0.9 |
| | Year 1 | | Year 2 | | | | | |
| | mean | sd | mean | sd | | | | |
| 50 | 3.12 | 11.16 | 1.30 | 2.92 | 1.82 (58 %) | 0.85 | 0.13 | 4.82 (155 %) |
| INTERPRETATION: In this example, it cannot be concluded that a change took place (cannot reject the null hypothesis). There is low confidence in the results due to low power and high minimum detectable change size. It may be desirable to take action as a precautionary step and make changes in the monitoring design to increase power. | | | | | | | | |

For the "percent of samples with occurrence" variable, the statistical test to be used is McNemar's test (pp. 246–248 of Elzinga et al. 1998). This is appropriate to test for a difference in proportion between years when the same sampling units are measured each year. The test will be applied in pair-wise comparisons, e.g., 2008 vs. 2009; 2008 vs. 2010, etc.

For the "sum cover by species" and the "total area by species" variables, the statistical test to be used is a paired *t* test (pp. 78–79 of Steele and Torrie 1960). This test is appropriate because it is expected that data from the pairs of sampling units are highly correlated (repeat measurements from the same locations).

[17] http://fsweb.nris.fs.fed.us/products/TESP/index.shtml

[18] In the actual monitoring these values will be set to: Significance threshold = 0.20, change threshold = 20 percent, desired statistical power = 0.80.

**N. Assumptions and Limitations:**

*Implementation monitoring* – Assumes that we are getting a representative sample of projects forestwide.

*Effectiveness monitoring* – Presently, the number of sites of co-occurrence of sensitive plants and active management activity is likely insufficient for statistical analysis. There may be occurrences of sensitive plants in areas of management activity that we are unaware of. When implemented, it is assumed that the monitoring will provide repeatable measures of sensitive plant population responses to management across the Forest.

**O. Reporting Frequency:**

*Implementation monitoring* – Described under protocol for Monitoring Question #1 and not repeated here.

*Effectiveness monitoring* – Data will be entered into NRIS annually and reports with interpretations will be generated every 5 years.

**P. Responsibility:** Chugach National Forest Ecologist (Botanist) in coordination with district ecologists (botanists).

**Q. List of Preparers:**

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**R. 10-Year Cost Forecast:**

Implementation monitoring will occur annually with reports completed every 5 years. Once there are at least five populations available for sampling (see “Sample Size Estimates and Estimation Methods”), annual effectiveness monitoring will begin with reports completed in the fifth year. See the following table for estimated annual costs.

| | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| People | $3,095 | $1,478 | $1,522 | $1,568 | $1,615 | $3,588 | $1,713 | $1,765 | $1,818 | $1,872 |
| Travel | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Other | $563 | $0 | $0 | $0 | $0 | $652 | $0 | $0 | $0 | $0 |
| **TOTAL** | **$3,658** | **$1,478** | **$1,522** | **$1,568** | **$1,615** | **$4,241** | **$1,713** | **$1,765** | **$1,818** | **$1,872** |

Total 10-year estimated cost: $21,250

Estimated annual cost in Revised Forest Plan (p. 5-8): $15,000 (i.e., $150,000 total over 10 years).

**S. Literature Cited:**

Elzinga, C.L., D.W. Salzer, and J.W. Willoughby. 1998. *Measuring and monitoring plant populations*. Bureau of Land Management Technical Reference 1730-1. Denver, Colorado. 477 p. Website: http://www.blm.gov/nstc/library/pdf/MeasAndMon.pdf

Goff, F.G., G.A. Dawson, and J.J. Rochow. 1982. Site examination for threatened and endangered plant species. *Environmental Management* 6(4):307–316.

Steele, R.G.D. and J.H. Torrie. 1960. *Principles and procedures of statistics: with special reference to the biological sciences*. McGraw-Hill Book Company, Inc., New York. 481 p.

## *8. Are Forest management activities contributing to changes in the abundance and distribution of invasive plant populations?*

**A. Monitoring Item: *Exotic Plant Species***

**B. General Monitoring Question:** Table 5-1 – What is the distribution and abundance of exotic plants, particularly in areas affected by management activities? MEIT Interpretation – Is Forest management contributing to changes in the abundance and distribution of invasive plant populations?

**C. Business Need and Rationale:** Agency direction includes the Forest Service Manual (FSM) 2080; the Forest Service Strategy for Noxious and Nonnative Invasive Plant Management,[19] and the Forest Service National Strategy and Implementation Plan for Invasive Species Management.[20] Invasive plant species are also identified by the former Chief of the Forest Service (2003) as one of the four major threats to environmental sustainability on the national forests.[21] The Chief calls for finding the means and mechanisms to prevent the spread of invasives, and applying an aggressive program to treat areas already infested. The Chief's views are echoed in the national strategy which has as a number one goal to "Reduce, minimize, or eliminate the potential introduction, establishment, spread, and impact of invasive species across all landscapes and ownerships."

A forestwide desired condition specified in the Revised Forest Plan (p. 3-13) is that exotic plant infestations will be decreasing in size. A forestwide goal (p. 3-4) is to prevent the introduction and spread of exotic plants and reduce areas of current infestation. Two objectives listed under this goal are to (1) identify infestations of exotic plant species and maintain infestation data in a standard database, and (2) treat infestations with a high potential to spread.

Monitoring of nonnative invasive plants (an aggressive subset of exotic plants) on the Chugach National Forest is consistent with all of these strategies and with the Forest's Invasive Plant Management Plan.[22] As stated in this plan, "Existing surveys on the Chugach National Forest found that most areas of invasive plant occurrence on the Forest are presently in areas of intensive human-caused disturbance such as road edges, visitor facilities, trailheads, and trails. Invasive plants are presently rare within natural communities on the Forest." Because of the association of invasive plant occurrences with human-caused disturbances, data collection under this protocol focuses on monitoring sites of such disturbance under the management purview of the Forest (i.e., National Forest System roads, trails, developed sites, and site-disturbing projects) and in the context of the broader landscape.

**D. Categories:** Effectiveness and Implementation as listed under E.

**E. Protocol Status, Source, and Re-evaluation Schedule:** This is a pilot protocol. The pilot will be evaluated in FY12, after all methodologies have been implemented. Based

[19] http://www.fs.fed.us/r6/weeds/efs_strat_doc.pdf
[20] http://www.fs.fed.us/invasivespecies/documents/Final_National_Strategy_100804.pdf
[21] http://www.fs.fed.us/news/2003/speeches/09/change-debate.shtml
[22] http://fsweb.chugach.r10.fs.fed.us/staff/res/weed_plan/chugach_invasive_plant_plan_012705.pdf

on this evaluation, the protocol will be finalized. Once final, the protocol will be re-evaluated every 5 years. Five effectiveness monitoring methods (#1 through #5 below) and one implementation monitoring method (#6 below) will be used:

1. Forest Inventory and Analysis (FIA) grid inventory: *Status* – nationally established and approved protocol[23] samples overstory tree species along with percent cover of dominant understory species and a "watch for" list of invasive plants for the Alaska Region. *Source* – FIA National Office and PNW. The FIA data will provide an overall estimate of invasive plant occurrence across the entire Chugach National Forest (which is about 99 percent roadless with relatively rare occurrences of invasive plants in the roadless portions to date).
2. A comprehensive 1-mile road survey method will be used across that portion of the Chugach National Forest that has been found to have the greatest diversity and concentrations of invasive plants. *Status* – adaptation of regionally established protocol originally used on road systems across the Alaska Region. *Source* – State and Private Forestry, Anchorage (unpublished methodology). These road survey data will provide repeatable measures of invasive plant occurrences at both a broad and local scale. The ROADS data theme (Road System line coverage) of the Chugach National Forest GIS will be used to draw samples for this monitoring.
3. A modification of the trail survey methodology previously implemented on the Chugach National Forest will be used on recreational trails. *Status* – adaptation of Chugach National Forest established protocol originally used on trail systems across the forest. *Source* – DeVelice (2003). This trail survey data will provide repeatable measures of invasive plant occurrences at both a broad and local scale. The TRAILS data theme (Recreation and Other Forest Trails line coverage) of the Chugach National Forest GIS will be used to draw samples for this monitoring.
4. A random sample of 10 percent of developed sites (including administrative sites and facilities, recreation sites, mines, and gravel pits) will be monitored for invasive plant distribution and abundance. *Status* – adaptation of Chugach National Forest established protocol originally used on trail systems across the forest. *Source* – DeVelice (2003). Fixed area plots will be established at the developed sites and visual estimates of invasive plant species cover will be recorded. Chugach National Forest GIS data themes to be used to draw the samples for this monitoring include:
    a. FACIL_POLY (Facilities Polygon Features coverage)
    b. FACIL_PT (Facilities Point Features coverage)
    c. MINE_CLAIMS (Active Mining Claims polygon coverage)
    d. MINES (Shafts, Tunnels, Tailings, or Prospects point coverage)
    e. REC_SITE_PL (Recreation Polygon Features polygon coverage)
    f. REC_SITE_PT (Recreation Point Features point coverage)
    g. REPEATERS (Radio Repeaters point coverage)
5. Summarize invasive plant control and eradication project monitoring to assess eradication effectiveness. *Status* – nationally established and approved NRIS

[23] **home page** - http://fia.fs.fed.us/; **protocols** - http://fia.fs.fed.us/library/field-guides-methods-proc/; http://www.fs.fed.us/pnw/fia/publications/fieldmanuals.shtml

TESP-Invasive Species[24] and Forest Service Activity Tracking System (FACTS) database[25] protocols. *Source* – Washington Office. Boundaries of invasive plant infestations are established using GPS equipment and percent cover is recorded. Following treatment, the site is later revisited and changes in the infestation boundary and percent cover are recorded. Monitoring data are stored in NRIS TESP-Invasive Species and FACTS applications, with basic data queries providing the basis for this effectiveness monitoring. Following FACTS application guidelines, a minimum of 50 percent of treatments are monitored in a given year. Annual reports on invasive plant treatment effectiveness documented in FACTS will be summarized.

6. Project implementation monitoring will use the protocol for Monitoring Question #1. *Status* – pilot protocol developed by the Chugach National Forest. *Source* – this monitoring guide. Determines to what extent Chugach National Forest NEPA decision documents are being implemented consistent with relevant forestwide and management area-specific standards and guidelines and project-specified mitigation measures.

**F. Objective Statement:** The effectiveness monitoring is to determine the contribution of human-caused disturbance associated with forest management on the distribution and abundance of invasive plants on the Chugach National Forest. The implementation monitoring is to determine if projects are being implemented consistent with invasive plant standards and guidelines specified in the Revised Forest Plan and in project-specified mitigation measures.

**[F-1] Required by Law:** Yes. This monitoring is driven by legal direction for invasive plant management including the Federal Noxious Weed Act of 1974, Plant Protection Act of 2000, and Executive Order 13112. Further, Section 2(2)(iii) of Executive Order 13112 specifically requires Federal agencies to "monitor invasive species populations accurately and reliably."

**[F-2] Statistical Rigor Rationale:**

*Monitoring methods 1-3:* Systematic samples are used. The statistical rigor of method 1 (FIA) is high because the samples are from permanently marked (exact) locations, while statistical rigor of methods 2 and 3 (roadside and trail surveys, respectively) is moderate since repeat measurements are from GPS locations without on-the-ground markers (not exact).

*Monitoring method 4:* The developed site monitoring involves a random sample of 10 percent[26] of developed sites on the Chugach National Forest and has moderate statistical rigor.

*Monitoring methods 5 and 6:* Summaries of invasive plant control project and project implementation methods, respectively, are moderate.

[24] http://fsweb.nris.fs.fed.us/products/TESP_Invasive_Species/index.shtml
[25] http://fsweb.ftcol.wo.fs.fed.us/frs/facts/index.shtml
[26] The 10-percent sample size was set arbitrarily. See the "Sample Size Estimate and Estimation Methods" section for further elaboration.

**[F-3] Data Precision, Reliability:**

*Monitoring methods 1-3:* Class A for of the FIA, roadside, and trail survey methods.

*Monitoring methods 4-6:* Class B for the developed site, invasive plant control project, and project implementation methods.

**[F-4] Confidence:**

*Monitoring methods 1-5:* The null hypotheses are that there is no change in invasive species cover or infested area between monitoring dates. In this monitoring, it is desirable to detect if the difference between dates exceeds 20 percent with a confidence level of 80 percent.

*Monitoring method 6:* A high degree of confidence in the results is expected. All environmental impact statements and environmental assessments will be monitored and variability in compliance with forest plan direction among the sample of categorical exclusions is expected to be low.

**[F-5] Change Detection:**

*Monitoring methods 1-5:* The probability of rejecting a false null hypothesis is set to 80 percent (statistical power = 1-*ß*).[27]

*Monitoring method 6:* Change is not measured with this method.

**[F-6] Threshold:**

*Monitoring methods 1-5:* Results having the greatest concern to management are those where the calculated *P* value for an increase in cover or infested area from the significance test used is less than 0.20. This threshold represents a standard yet conservative level of significance used to detect changes in plant cover in monitoring situations (Elzinga et al. 1998). Species with higher invasiveness rank (70 or greater based on the Alaska Natural Heritage Program ranking system[28]) will be regarded as being more deleterious to ecological sustainability than species with a lower rank. There would be a greater concern to management when cover or infested area of a high-ranked species exceeds the *P* value threshold than when a low-ranked species exceeds the threshold. When change in a high-ranked species exceeds the threshold, results will be brought to the forest leadership team for review and action will be proposed.

*Monitoring method 6:* Management review by the forest leadership team is triggered if three or more projects do not fully implement invasive plant standards and guidelines specified in the Revised Forest Plan or project-specific invasive plant mitigation measures.

[27] Where *ß* = the probability of Type II error (the failure to detect a difference when in truth there is one).
[28] http://akweeds.uaa.alaska.edu/akweeds_ranking_page.htm

**[F-7] Scope of Inference:** The spatial scope is geographic area (i.e., Copper River Delta, Prince William Sound, and Kenai Peninsula as described in the Revised Forest Plan) to forestwide and the temporal scale is annual to decadal.

**G. Indicator and its Units of Measure:**

*Monitoring methods 1-4:* Invasive plant species presence and percent cover.

*Monitoring method 5:* Invasive plant species presence, percent cover, and area of infestation (hectares).

*Monitoring method 6:* Whether or not the project fully implements invasive plant standards and guidelines specified in the Revised Forest Plan and project-specific invasive plant mitigation measures. Specifically, forest plan guidelines call for incorporating exotic plant prevention and control into project planning and design (p. 3-25), using native plant species in revegetation or restoration projects when natural revegetation conditions are not favorable (p.3-25), and applying treatment measures on exotic plants to minimize their impacts on ecological processes (p. 4-10, repeated on other pages).

**H. Sampling Design:** Each monitoring method will have an associated sampling design:

1. FIA sampling design is described in field guides posted on the Internet (see links on page 33).
2. Road survey sampling is described following the Literature Cited section.
3. Trail surveys are described in DeVelice (2003). Invasive plants on trails will be inventoried at 1-km intervals, centering a 2.5-meter x 20-meter plot on the trail with the long axis parallel to the trail, invasive plants will be identified and plant cover estimated.
4. Developed site surveys are described in DeVelice (2003) where 7.07-meter x 7.07-meter plots are established at concentrations of invasive species.
5. Samples will be drawn from monitored invasive plant-control projects documented in the FACTS database for the Chugach National Forest.
6. The sampling design for project implementation monitoring is described under the protocol for Monitoring Question #1 in this guide and is not repeated here. To gain logistical efficiencies, project implementation monitoring will be coordinated with the interdisciplinary team for Monitoring Question #1.

**[H-1] Target Population:** The target population is invasive plants.

**[H-2] Sampling Frame:** The sampling frame for the five effectiveness methodologies are:

1. The FIA sample consists of all surveyed plots on the FIA grid within the Chugach National Forest boundaries.
2. The road survey sample is from all roads within the Chugach National Forest boundaries as documented in the forest GIS database.

3. Samples will be drawn from recreational trails within the Chugach National Forest boundaries as documented in the forest GIS database.

4. Samples will be drawn from developed sites (including administrative sites and facilities, recreation sites, mines, and gravel pits) within the Chugach National Forest boundaries as documented in the forest GIS database.

5. Monitored invasive plant treatment projects on the forest (and documented in the FACTS database) are the basis for treatment monitoring.

**[H-3] Sample Selection Methods:** The sample selection methods for the five effectiveness methodologies are:

1. All sample plots for FIA are distributed systematically on a 4.8-km grid.

2. Road survey plots are distributed systematically at 1-mile increments along roads.

3. Trail survey plots are spaced at 1-km increments along trails.

4. Developed site samples will be selected as a random sample of 10 percent of the sites stratified by geographic area and site type (i.e., administrative site or facility, recreation site, mine, gravel pit).

5. Data will be summarized for all invasive plant treatments for which the effectiveness is being monitored (documented in FACTS).

**[H-4] Sample Unit Description:**

1. Individual FIA grid points are a cluster of four sampling plots each of 7.3-meter radius.

2. Road survey plots are 50 meters long on both sides of the road and extend to the edge of the cleared right-of-way or 10 meters, whichever is less.

3. Trail survey plots are 2.5 meters x 20 meters, centered on the trail, with the long axis parallel to the trail.

4. Developed site plots are 7.07 meters x 7.07 meters, centered on locations of highest concentration of invasive species.

5. Sample units included in the summary of project effectiveness monitoring are the boundary polygons of the individual invasive species infestations (varying with infestation extent).

**[H-5] Detection and Observer Bias Controls:** Large variations in cover estimation can occur among observers. This bias will be controlled by calibrating cover estimation among observers prior to initiating field work. Additionally, except for permanently monumented plots (FIA), original plot center will not be located precisely even with the aid of mapping-grade GPS units (about 1-meter accuracy).

**[H-6] Sample Size Estimate and Estimation Methods:**

1. Sample size is already established for the FIA plots based on the 4.8-km grid.
2. Existing road survey plots are based on 0.25-mile spacing along roads, but will be monitored on a 1-mile interval.
3. Trail survey plots are based on 1-km spacing along trails.
4. Developed site monitoring will include 10 percent of the population of developed sites.
5. Data for all invasive plant control projects for which effectiveness is being monitored (documented in FACTS) will be summarized.

The adequacy of the number of plots so derived will be evaluated based on post hoc power and minimum detectable change analysis (pp. 262–264 of Elzinga et al. 1998). If this analysis shows low confidence in the results due to low power and high minimum detectable change size, it may be desirable to make changes in the monitoring design to increase power (e.g., increase sample size). In addition, the necessary sample size for detecting differences between two means when using the paired sampling units will be estimated using the method described on pages 354 through 357 of Elzinga et al. (1998).

**[H-7] Temporal Details of Sampling:** All sampling is done during June, July, and August.

*Monitoring method 1:* Ten percent of the FIA plots are sampled annually in a 10-year rotation.

*Monitoring methods 2-5:* Road, trail, and developed site monitoring will occur at a 5-year time step.

**I. Data Collection:**

1. FIA data collection methods are described in field guides posted on the Internet (see links on p. 33).
2. Road survey methods are described following the Literature Cited section.
3. Trail surveys methods are described in DeVelice (2003).
4. Developed site survey methods are described in DeVelice (2003).
5. Summary of invasive plant control project effectiveness monitoring follows NRIS TESP-Invasive Species and FACTS data protocols (see links on page 69).
6. Data collection methods for project implementation monitoring are described under the protocol for Monitoring Question #1 in this guide and are not repeated here.

**[I-1] Methods for Locating Sample Units:**

1. The FIA sample is on a predetermined systematic 4.8-km grid.

2. Road survey plots are distributed at 0.25-mile increments along roads and will be monitored at 1-mile increments. Initial starting point for survey will be randomly determined with systematic samples established thereafter.

3. Trail survey plots are spaced systematically at 1-km increments along trails start from the trailhead.

4. Developed site monitoring will be established based on subjective location of highest concentration of the invasive plant population. Sample plot will be located within center of this population boundary.

5. Summaries of invasive plant control project monitoring will consist of examining already-collected data residing in the FACTS data application. Sample units consist of all invasive plant control projects where invasive plants are being monitored.

Geographic locations for all samples will be loaded to a mapping grade GPS and plotted on field maps. Both the GPS and the field maps will be used to navigate to the sample locations.

**[I-2] Methods for Layout and Marking:**

1. Layout and marking of FIA plots are as described in the field guides. Individual FIA grid points consist of a cluster of four systematically located sample plots each of 7.3-meter radius.

2. Road survey plots are established at the center of the road, extending 25 meters in each direction along the length of road and extending to the edge of the right-of-way. Distance to the edge of the right-of-way is recorded to estimate area surveyed.

3. Trail survey consists of 2.5-meter x 20-meter plots centered on the trail, with the long axis parallel to the trail.

4. Developed site plots will be digitally documented with a mapping grade GPS (no permanent marking will be used). The developed site plots are 7.07 meters x 7.07 meters centered on locations of highest concentration of invasive species.

5. Sample units included in the summary of project effectiveness monitoring are the boundary polygons of the individual invasive species infestations.

**[I-3] "Field" Sampling Methods**: For all methods, the presence and percent cover (by ocular estimation) of each invasive plant species is recorded in each plot. In addition, invasive plant control monitoring (method 5) includes documenting the boundary of the infestation using GPS (to quantify infestation acreage).

**J. Quality Control and Assurance:**

*Monitoring methods 1-5*: For all of the effectiveness methods, the data collection most vulnerable to error is species identification and cover estimation. These errors will be controlled by calibrating cover estimation among observers prior to field work (and

periodically during the field season) and collecting voucher specimens when species identity is in doubt.

*Monitoring method 6:* A standardized form is used (included with the protocol for Monitoring Question #1 in this guide).

**K. Data Form:**

*Monitoring method 1*: PNW crews will collect the FIA data using their own forms.

*Monitoring methods 2-5*: The road survey, trail survey, developed site, and project monitoring use the NRIS TESP-Invasive Species Survey and Inventory Field Form.[29]

*Monitoring method 6*: The form is included with the protocol for Monitoring Question #1 in this guide.

**L. Data Storage:**

**[L-1] Data Cleaning Methods:**

*Monitoring method 1:* The PNW will process the FIA data following their standardized protocols.

*Monitoring methods 2-5*: The road survey, trail survey, developed site, and project monitoring data will be initially stored in electronic field data recorders, which will check for errors in data entry (e.g., out of bounds errors not allowed; illogical answers flagged as possible errors). These cleaned data will be uploaded upon return from the field.

*Monitoring method 6*: Data cleaning methods for project implementation monitoring are described under the protocol for Monitoring Question #1 in this guide and are not repeated here.

**[L-2] Data Storage:**

*Monitoring method 1*: The FIA data will be stored in the FIA database.

*Monitoring methods 2-5*: The road survey, trail survey, and developed site data will be stored in the NRIS TESP-Invasive Species database (see link below). All data will include both tabular and geospatial components. Data storage for the summary of invasive plant control project monitoring will be stored in FACTS (see link on p. 69).

*Monitoring method 6*: Data storage for project implementation monitoring is described under the protocol for Monitoring Question #1 in this guide and is not repeated here.

**M. Data Analysis:** The objectives of all monitoring methodologies outlined to date are to evaluate the contribution of a variety of forest management activities to the distribution and abundance of invasive plants on the Forest.

[29] http://fsweb.nris.fs.fed.us/products/TESP_Invasive_Species/documentation.shtml

All five effectiveness monitoring datasets (methods 1-5) will be analyzed separately, but using the same overall method as follows. Data from pairs of years will be compared by geographic area and forestwide. Five variables will be assessed: total number of invasive plant species, similarity index, percent of samples containing invasive plants, overall sum cover of invasive plants, and, in the case of method 5, overall infested area. These variables will be examined for two species groupings, all non-native plants and highly invasive plant species (rank greater than or equal to 70). Table Q8-1 summarizes data analysis components. Analysis of monitoring data will result in a total of 168 separate analyses per complete paired-year comparison, i.e., (a) 5 data sets x 4 variables (not including overall infested area) x 2 species groups x 4 geographic delineations, plus (b) 1 data set x 1 variable (overall infested area) x 2 species groups x 4 geographic delineations.

For all variables except the “Percent of Samples with Occurrence,” the statistical test to be used is a paired *t* test (pp. 78–79 of Steele and Torrie 1960). This test is appropriate because it is expected that data from the pairs of sampling units are highly correlated (repeat measurements from the same locations).

For the “Percent of Samples with Occurrence” variable, the statistical test to be used is McNemar’s test (pp. 246–248 of Elzinga et al. 1998). This is appropriate to test for a difference in proportion between years when the same sampling units are measured each year.

The format to be used for summarizing and interpreting the results of the statistical analyses is as shown in Table Q8-2 (modified from figure 11.24 of Elzinga et al. 1998). **All cases where a statistically significant (i.e., *P* is less than 0.20) INCREASE in an evaluation variable is calculated will trigger a review by the forest leadership team, with suggested recommendations for increasing control of invasive plant populations.**

Data analysis methods for project implementation monitoring (method 6) are described under the protocol for Monitoring Question #1 in this guide and are not repeated here.

**N. Assumptions and Limitations:**

*Monitoring method 1*: The FIA plots are primarily drawn from forested locations and will likely not provide a representative sample of invasive plant occurrences in shrubland and herbaceous vegetation. Also, FIA plots are not being sampled within the 796,720-hectare Wilderness Study Area, which encompasses 36 percent of the land area of the Chugach National Forest.

*Monitoring methods 2–4*: The road survey and trail survey data will not represent invasive plant occurrences at other sites directly modified by human disturbance. To meet this limitation, developed site monitoring is included to provide a 10-percent sample of developed sites across the Chugach National Forest.

*Monitoring method 5*: The project monitoring assumes a representative sample forestwide and by geographic area.

*Monitoring method 6*: Assumes that we are getting a representative sample of projects forestwide.

**O. Reporting Frequency:** Effectiveness monitoring data will be entered into FIA, NRIS TESP-Invasive Species, and FACTS annually, and reports with interpretations will be generated every 5 years. Reporting frequency for project implementation monitoring is described under the protocol for Monitoring Question #1 in this guide and is not repeated here.

**P. Responsibility:** Chugach National Forest Ecologist in coordination with district ecologists.

**Q. List of Preparers:**

R.L. DeVelice, Ph.D., Forest Ecologist, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

B.A. Schrader, Ph.D., Regional Ecologist, USDA Forest Service, Regional Office, Juneau, Alaska.

**R. 10-Year Cost Forecast:**

FIA data collection will occur annually. The road survey, trail survey, and developed site data collection will occur in the year prior to reporting (i.e., data collection in FY11 and FY16; reporting in FY12 and FY17). The cost of FIA data collection and entry into the FIA database is funded by PNW. The cost for interpreting the FIA data to answer this Chugach Forest Plan monitoring question would be funded by the Forest (these interpretations would occur once every 5 years) (see the following table). The road survey data collection and interpretation would be funded by the Forest (perhaps supplemented with funding from State and private forestry). The trail survey and developed site monitoring data collection and interpretation would be funded by the Forest. Invasive plant control project effectiveness monitoring will be funded by the respective project (not forest plan monitoring dollars) and will take place annually. The cost of interpreting the project effectiveness monitoring data to answer this Chugach National Forest Plan monitoring question and for covering expenses incurred under project implementation Monitoring Question #1 would be funded by the forest plan monitoring dollars. To reduce costs, it may be necessary to reduce the sample density of the road and trail surveys (accepting that this will affect statistical power).

| | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| People | $7,316 | $1,478 | $1,522 | $1,568 | $50,671 | $8,481 | $1,713 | $1,765 | $1,818 | $58,742 |
| Travel | $0 | $0 | $0 | $0 | $8,867 | $0 | $0 | $0 | $0 | $10,279 |
| Other | $675 | $0 | $0 | $0 | $760 | $783 | $0 | $0 | $0 | $881 |
| **TOTAL** | **$7,991** | **$1,478** | **$1,522** | **$1,568** | **$60,298** | **$9,264** | **$1,713** | **$1,765** | **$1,818** | **$69,902** |

Total 10-year estimated cost: $157,319

Estimated annual cost in Revised Forest Plan (p. 5-17): $10,000

**S. Literature Cited:** Includes citations for all literature cited in the protocol.

DeVelice, R.L. 2003. *Non-native plant inventory: Kenai Trails*. USDA Forest Service, Chugach National Forest, R10-TP-124. Anchorage, Alaska. 24 p. Website: http://www.uaf.edu/ces/cnipm/docs/KenaiTrails.pdf

Elzinga, C.L., D.W. Salzer, and J.W. Willoughby. 1998. *Measuring and monitoring plant populations*. Bureau of Land Management Technical Reference 1730-1. Denver, Colorado. 477 p. Website: http://www.blm.gov/nstc/library/pdf/MeasAndMon.pdf

Steele, R.G.D. and J.H. Torrie. 1960. *Principles and procedures of statistics: with special reference to the biological sciences*. McGraw-Hill Book Company, Inc., New York. 481 p.

**Table Q8-1. Effectiveness monitoring data analysis components**

| | Species Group | |
|---|---|---|
| Variable | All Non-Natives | Invasiveness Rank[30] ≥ 70 |
| Number of Species Present | √ | √ |
| Jaccard's Index of Similarity[31] | √ | √ |
| Percent of Samples with Invasive Plant Occurrence | √ | √ |
| Overall Sum Cover | √ | √ |
| Overall Infested Area | | |

**Table Q8-2. Example of the format used to summarize results of the effectiveness monitoring analyses**

| Significance threshold = 0.10. Change threshold =30 %. Desired statistical power = 0.90[32.] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sample Size** | **Sample Statistics** | | | | **Observed Change** | **Results of Statistical Test (P)** | **Calculated Power (1-ß) to Detect a 30% Change** | **Minimum Detectable Change Size with a Power of 0.9** |
| | **Year 1** | | **Year 2** | | | | | |
| | **mean** | **sd** | **mean** | **sd** | | | | |
| 50 | 3.12 | 11.16 | 1.30 | 2.92 | 1.82 (58 %) | 0.85 | 0.13 | 4.82 (155 %) |
| INTERPRETATION: In this example, it cannot be concluded that a change took place (cannot reject the null hypothesis). There is low confidence in the results due to low power and high minimum detectable change size. It may be desirable to take action as a precautionary step and make changes in the monitoring design to increase power. | | | | | | | | |

[30] http://akweeds.uaa.alaska.edu/akweeds_ranking_page.htm (note: in this protocol a few occurrences of a high-ranked invasive species is considered to constitute a bigger potential threat to sustainability than many occurrences of a low-ranked invasive).
[31] $IS_J=(c/a+b+c)$ x 100 where ***c*** is the number of species in common between the two dates, ***a*** is the number of species unique to the first date, and ***b*** is the number unique to the second date.
[32] In the actual monitoring, these values will be set to: Significance threshold = 0.20, change threshold = 20 percent, desired statistical power = 0.80.

## Road Survey Methodology[33]

DEFINITIONS

Non-native plant: A plant species that has been introduced to a location beyond its known historical range; a plant species considered “exotic” to Alaska.

Infestation: A population of one nonnative plant species, at one location, where individual plants are within approximately 50 meters of each other.

Right-of Way: The area within 50 feet of the center of the roadway or to the edge of the cleared area, whichever is greater.

Description of Work – GENERAL

1. Data shall be collected in road rights-of-way.
2. When an infestation extends beyond the right-of-way, an ocular estimate will be made of the extent of that infestation.
3. Information collected will describe the location, abundance, cover and habitat of each non-native plant infestation in the project area for the points surveyed. The information shall be collected using data collection standards found in the NRIS TESP-Invasive Species Data Recording Protocols for Invasive Species Management using the Invasive Species Survey and Inventory Field Form.[34]
4. Documentation shall be provided for each non-native plant infestation, at each point surveyed as described in the NRIS TESP-Invasive Species Data Recording Protocols for Invasive Species Management. All Forest Service, State, and local maintained roads shall be surveyed unless otherwise specified. Reports shall be completed regardless of whether invasive plant species are found, since “No Occurrence” data is valuable for determining the health of native Alaskan ecosystems. (See detailed description of documentation in NRIS TESP-Invasive Species Data Recording Protocols for Invasive Species Management.)
5. Walking surveys on closed roads will be required for a minimum of 0.25 mile and a maximum of 8 miles.

SPECIFIC TASKS

Field Work

1. Field work shall be conducted between July 1 and August 31. All data points shall be entered into the NRIS TESP-Invasive Species database and a final summary report completed by December 15.

[33] Paraphrased from USDA Forest Service, Chugach National Forest, Nonnative Plant Inventory on Chugach National Forest, contract solicitation from 2007. All reference to the Alaska Exotic Plant Information Clearinghouse (AKEPIC) has been replaced with references to the NRIS TESP-Invasive Species database and products.

[34] http://fsweb.nris.fs.fed.us/products/TESP_Invasive_Species/documentation.shtml

2. Surveys shall be made by driving, biking, or walking on both sides of the road. Ocular estimates will be used to determine the extent of infestations that are beyond the road right-of-way, on all surveyed roads.

3. Survey points will be every 0.25 mile along the roads. At each survey point, both sides of the road shall be surveyed for 25 meters each direction recording all non-native plant species encountered. In addition, the area around each bridge abutment, road intersection, recreation site, pullout, and parking area shall be surveyed in a similar fashion. Infestations that extend outside of the right-of-way shall be measured by ocular estimate and documented. All points shall be surveyed in accordance with NRIS TESP-Invasive Species Data Recording Protocols for Invasive Species Management (see link on p. 79).

4. Each survey point, including high-priority plant infestations, will be clearly marked at plot center with biodegradable flagging and the location will be spatially documented using a mapping grade GPS. The flagging should be attached so it is readily visible from the road (example: tied to a birch tree). The survey point ID, including date and location, shall be printed on the flagging using a Sharpie or Sharpie-type pen. For high-priority plant infestations, the appropriate USDA plant code name will also be printed on the flagging.

5. When a scheduled stop occurs within 25 meters of a pullout, use the pullout as plot center. This is for safety purposes.

6. When an infestation extends beyond the right-of-way, record “extends beyond right-of-way” in field notes and within the NRIS TESP-Invasive Species database. Provide an ocular estimate of infestation size.

7. Two or more entries into portions of the survey area may be required to identify non-native plant species during their flowering period.

8. Follow the work plan set forth by the Alaska Department of Transportation for work along the shoulders of the Alaska State Highways, and ensure employees are provided with safety equipment.

9. Obtain a valid lane-closure permit for work along State highways. An application for a no-cost permit from the Alaska Department of Transportation can be found at http://www.dot.state.ak.us.

Documentation

1. Complete a survey form for each survey site, regardless of whether an invasive plant species is found.

2. Label survey forms in the following fashion: District initials-road number-plot number. For example, the first survey point (plot) on State Route 1 on Seward Ranger District would be labeled SRD-SR1-001.

3. Keep original copies of survey forms until all data are entered and accepted into the NRIS TESP-Invasive Species database. After data are accepted into the NRIS TESP-Invasive Species database, file all original survey forms with final documentation by December 15.

4. Include in the final report a general description of the survey area, a description of the survey methods, and results of the inventory including the number of invasive plant infestations found, listed by species, and maps showing their general distribution within the inventory area. See an example of an acceptable summary report at the following website http://akweeds.uaa.alaska.edu/pdfs/literature/Arghngelsky_PrinceWalesIs_final_report.pdf.

Voucher Specimen Collection

1. First-time encounters of plant species may require collection of plant material for accurate identification. No collection shall be made in populations of less than 20, unless the species is a known invasive exotic plant. Avoid collecting rare or sensitive native plant species.[35]

2. Voucher specimens should comply with State herbarium voucher specimen standards that preserve the morphology of the plant for professional presentation and archival storage. Information about voucher specimen standards can be found at http://www.flmnh.ufl.edu/herbarium/voucher.htm

3. Include the following information with all pressed and dried voucher specimens:

    a. Family
    b. Genus
    c. Species
    d. Subspecies or variety
    e. Date
    f. Collector's name
    g. Lat/Long (GPS coordinates)
    h. Plot number where plant was collected
    i. Jurisdiction (e.g., Chugach National Forest)
    j. General location (e.g., Seward Highway)
    k. Specific location (e.g., mile post 10)
    l. Elevation
    m. Habitat
    n. Brief description of plant
    o. Plant frequency (e.g., abundant, common, uncommon, or rare)

35 http://fsweb.r10.fs.fed.us/staffs/wfew/wfew_documents/2009_revised_r10_sensitive_species_list.doc

# *Management Indicator Species*

## *10. Has the Revised Forest Plan direction prevented adverse interactions between bears and humans?*

**A. Monitoring Item: *Management Indicator Species***

**B. MEIT Interpretation of General Monitoring Question:** Has the Revised Forest Plan been effective in reducing adverse interactions between (brown) bears and humans?

This question speaks to numbers and trends in defense of life and property (DLP) bear mortalities. It also concerns adverse incidents of bear and human encounters, causing death or severe injuries to humans, herein termed “adverse encounter.” From an inventory and monitoring standpoint, this question regards only bear and human encounters that result in DLP or adverse encounters.

In accordance with Forest Service direction from the Regional Office, this protocol is not intended to investigate causes of DLPs and adverse encounters between people and bears, or examine likely reasons underlying the trends. For example, rising numbers of DLP incidents could stem from increases in brown bear numbers, or increases in human use of the forest.

The protocol herein focuses on absolute numbers and trends of DLPs and adverse encounters. If or when the DLP and adverse encounter threshold is surpassed, it will invoke future protocols to examine cause and effect.

**C. Business Need and Rationale:** The Chugach National Forest aims to manage the human and brown bear interface with a strategy of coexistence. This means reducing the likelihood of an adverse interaction between people and bears, which otherwise could result in human and/or bear injury and death. Our approach is collaborative, between neighboring land management agencies (National Park Service (NPS), USFWS) and the Alaska Department of Fish and Game (ADF&G).

***Background.*** Increases in human development and access to bear habitat raise the likelihood of an encounter between humans and brown bears. This tends to increase chances of human harm and bear mortalities from DLP incidents (Herrero 1985, McLellan et al. 1999, and Suring and Del Frate 2002).

The issue of DLP incidents is forestwide, and therefore, this protocol is intended to be forestwide. The forest plan, however, focuses DLP issues on the Kenai Peninsula, where brown bears and humans tend to come into most contact.

On the Kenai Peninsula, DLP incidents resulting in bear mortalities have doubled during the last decade, with the majority (70 percent) in rural areas (Suring and Del Frate 2002). DLP mortalities on the Kenai Peninsula were closely associated with the density of roads and trails (Suring and Del Frate 2002). The cumulative impacts of brown bear mortalities due to DLP incidents pose a significant risk to the Kenai brown bear population (Interagency Brown Bear Study Team 2001), and are a major concern to the Chugach National Forest. The Revised Forest Plan states:

***Desired Condition***: Brown bear-human confrontations will be minimal in important seasonal feeding areas and travel corridors, resulting in limited risks to brown bears through DLP mortality (p. 3-13).

*Kenai Peninsula Geographic Area:*

> Brown bear populations on the Kenai Peninsula will be stable, with minimal confrontations between bears and humans that result in DLP mortality to bears (p. 3-14).
>
> Brown Bear Core Area Management Areas are designed to manage selected landscapes and their associated habitats to meet population objectives for brown bears and to reduce dangerous encounters between humans and brown bears (p. 4-54).
>
> Brown Bear Core Area Management Areas will have a priority for minimizing bear-human interactions (p. 4-54).

*Minerals Guidelines:*

> Mineral exploration activities will include terms and conditions controlling operating methods and times to prevent or control adverse impacts on brown bear habitat and to prevent negative bear-human interactions (p. 4-57).
>
> Conserve brown bear habitat using prescriptions that provide adequate habitat and minimize bear-human confrontations in important seasonal feeding areas and travel corridors. Manage human use within bear habitat to minimize the risk of DLP mortality to brown bears (p. A-2).

*In the Record of Decision:* The Brown Bear Core prescription emphasizes reducing human-bear conflicts and protecting brown bear habitat. It is therefore used where high levels of human use occur in important brown bear concentration areas (p. 8).

*Situation Statement 2 – Habitat for Fish and Wildlife:*

> On the Kenai Peninsula, the Brown Bear Core prescription is designated to provide for brown bear and public use, with the intent to minimize bear-human interactions (p. 22).
>
> The largest potential for impact to brown bears from forest management and permitted activities is on the Kenai Peninsula. The revised forest plan allocates the second largest number of acres to the Brown Bear Core Management Area among the alternatives. That prescription, which specifically limits human-bear interactions by prescribing a 750-foot buffer to provide cover for brown bears while feeding on key anadromous fish streams, combined with the forestwide standard to limit the attractiveness of garbage and food to bears will help maintain brown bear viability on the Chugach National Forest under the revised forest plan. The revised forest plan is consistent with the recommendations of the Interagency Brown Bear Study Team conservation assessment (p. 39).

**D. Category:** Effectiveness

**E. Protocol Status, Source, and Re-evaluation Schedule**: This will be a final protocol developed by the Chugach National Forest. Formal reevaluation of the protocol will occur every 5 years.

**F**. **Objective Statement**: This monitoring documents and evaluates trends in brown bear DLP and adverse encounters between humans and brown bear resulting in severe human harm.

**[F-1] Required by Law:** No

**[F-2] Statistical Rigor Rationale:** Our goal is to determine if trends in numbers of DLP incidents or adverse encounters are significant. Our approach relies on comparing the number of DLPs or adverse encounters between years, by using regression analyses. Any value of significance can be employed, though 95 percent is the standard, and is the value selected here. This exercise will inform managers on the direction of the trend (increasing or decreasing).

Equally important are the absolute numbers of DLP or adverse encounters per year. These values are compared to the suggested thresholds, to evaluate if these thresholds are exceeded.

**[F-3] Data Precision, Reliability:** By law, all DLP incidents need reporting, though compliance is uncertain. Adverse encounters are more often reported than not.

**[F-4] Confidence:** Medium. All DLP incidents are not documented. The proportion undocumented is likely to remain constant. Therefore, the trend should remain valid.

**[F-5] Change Detection:** Our approach evaluates trends and absolute numbers. We plan to monitor changes in trends at the 95-percent confidence level.

**[F-6] Threshold:** Thresholds exist for DLPs and adverse encounters causing severe human harm. These mirror the monitoring plan and are based on biology, socio-political concerns and location.

***Human Thresholds.*** Any time a human is seriously injured or killed by a bear (adverse encounter), the threshold is reached.

***Brown Bear Thresholds.***

*Biological Threshold* – Only one biological threshold exists across the Chugach National Forest, and this is for the Kenai Peninsula geographical area. Brown bears on the Kenai Peninsula are geographically restricted from mainland populations, and maintaining a viable population of brown bears is a high priority for the Forest, USFWS, NPS, and ADF&G. Presently, an excess of 20 brown bear mortalities per year, regardless of cause or location, curtails the season's hunt on the Kenai Peninsula.

Our goal is to minimize DLPs and adverse encounters. The risk for a DLP or adverse encounter to occur will always be real whenever bears and

humans share the landscape. When they occur, the Chugach National Forest should learn from them to reduce the likelihood of others. Therefore, our threshold errs conservatively. When DLP incidents on National Forest System lands meet or exceed three per year within a sample unit (see below), the information will be brought to the forest leadership team for review.

*Socio-political Threshold and the Role of Location* – The Chugach National Forest, along with many individual and group organizations, aims to minimize DLP incidents. Whether or not management action should immediately stem from these occurrences depends on a number of factors. One consideration is frequency of occurrence. We suggest that if two or more DLP incidents occur in the same geographical location (such as on a trail or campground), the incident should be investigated to gain insight toward reducing the likelihood of another (information gained from the Bear-Human Information Management System (BHIMS), see below).

Socio-politically, when DLP incidents occur on remote trails, the public appears more tolerant than were a DLP to happen in a hardened campsite. Within such heavily used areas, the public has an expectation of increased safety from bears. Unfortunately, this often stems from a false sense of security based on safety in numbers, or human infrastructure reducing the sense of wilderness. In any event, DLPs occurring in areas with greater human use are generally less tolerated by the public than DLPs elsewhere. Therefore, in a heavily used area (e.g., hardened campsites, Russian River), the threshold is one. In less used locations, the threshold is two.

**[F-7] Scope of Inference:** Forestwide and geographic areas, especially the Kenai Peninsula.

**G. Indicator and its Units of Measure:** The indicators are DLP incidents, plus brown bear and adverse encounters between humans and brown bears resulting in severe human injury. The DLP or adverse encounters are the units of measure.

**H. Sampling Design:** Sampling will not occur under this protocol. Rather, we are analyzing data reported to ADF&G or reported within the BHIMS (Wilder et al., in review). BHIMS is designed as a statewide program for tracking the human and brown bear interface. BHIMS interfaces with a larger ArcGIS-based system to analyze geographic locations of DLP and adverse encounters.

**[H-1] Target Population:** Humans and brown bears on the Chugach National Forest.

**[H-2] Sampling Frame:** ADF&G DLP reports; reports of brown bear DLP and adverse encounters as reported in the BHIMS. A program with the NPS, ADF&G, and U. S. Geological Survey (USGS). These are comprehensive reports describing DLP and bear encounters. These data should include ADF&G data.

**[H-3] Sample Selection Methods:** Not applicable

**[H-4] Sample Unit Description:** DLP incident or an adverse encounter between a person(s) and a bear, resulting in human injury that occurred on the Chugach National Forest.

**[H-5] Detection and Observer Bias Controls:** Not all DLPs may be reported. Generally, we anticipate all adverse encounters being reported.

**[H-6] Sample Size Estimate and Estimation Methods:** All reported DLP incidents and adverse encounters will be incorporated.

**[H-7] Temporal Details of Sampling:** Year-round, with emphasis on April through October.

**I. Data Collection:** From ADF&G and BHIMS

**[I-1] Methods for Locating Sample Units:** Jeff Selinger, ADF&G Biologist, is the ADF&G contact. Karin Preston from Chugach National Forest is the BHIMS contact.

**[I-2] Methods for Layout and Marking:** Not applicable

**[I-3] "Field" Sampling Methods:** Not applicable

**J. Quality Control and Assurance:** Qualified and trained wildlife biologists will enter data.

**K. Data Form:** From ADF&G, BHIMS

**L. Data Storage:** BHIMS

**[L-1] Data Cleaning Methods:** Several agencies enter data into BHIMS; therefore the Forest does not have complete control over data cleaning. It is assumed that data will be edited if and when errors are found by those performing data entry.

**[L-2] Data Storage:** BHIMS

**M. Data Analysis:** Sample units will be by district; geographical area (Copper River Delta/Kenai Peninsula/Prince William Sound) and by sub-region; places delineated by nearest access point to the forest trail network, such as trailheads (as data accuracy permits); and brown bear core areas.

The methodology is an analysis to (A) determine trends in the number of DLPs and adverse encounters on the Chugach National Forest; (B) determine whether the number of DLP incidents or adverse encounters exceeds a recommended threshold; and (C) compare DLP and adverse encounters between brown bear core areas and the Kenai Peninsula.

Our method starts simple and builds in complexity. There are two steps: First is a straightforward analysis to determine the number and trends for DLPs and adverse encounters occurring on the Chugach National Forest. The analyses are forestwide and separated by sample unit location. If thresholds are reached or exceeded, the second step initiates investigations to evaluate ADF&G and BHIMS data to determine specific

locations where these incidents occur (e.g., private property bordering the forest, on the forest, and which trail(s)). With methods external to this protocol, investigations for how and why these DLPs or adverse encounters occurred, or why trends are rising, are recommended. The purpose is to reduce the likelihood of another DLP or adverse encounter, or to reverse an increasing trend.

(A) At the most basic level, the Chugach National Forest will evaluate the trend in numbers of DLP incidents and adverse encounters across the Forest. These will be reported as values separated by district or relevant geographical area, such as the Kenai Peninsula and brown bear core areas. Comparisons are required to determine if rises or declines in adverse encounters are significant.

Plot the frequency values of DLP incidents and, separately, the adverse encounters by year. The individual points are not connected directly together with a line, but expressed as a trend (Figure Q10-1). The simplest is a straight line fit, using least squares regression. The trend line describing the relationship connecting the respective points on the graph expresses a slope.

Our main interest is in comparing the slopes of these lines to determine if the trends are rising or falling. We can interpret the respective slopes visually and express them mathematically. The latter approach permits us to determine if the slopes in the trend lines are significantly different.

For example, in Figure Q10-1, we compared DLP data from the Kenai Peninsula, separated by two time periods (1990 to 1999 and 2000 to 2006). The slope for the trend line describing data from 1990 to 1999 is -0.03 and that for the trend line between 2000 and 2006 is 1.96.

For the data representing 1990 to 1999, a linear regression model is somewhat inappropriate, for the slope is essentially 0, and the model, therefore, has an unnecessary parameter. DLP trends for the first set are declining, but the relationship is weak. DLPs between 2000 and 2006 have a trend that is clearly rising, with an RSquared value of 0.61.

Clearly, the slopes are different. To evaluate them statistically, one generates an indicator variable (1 for data between 2000 and 2006, 0 representing the other set) and running a multiple linear regression.

The regression model then becomes:

$$Y= \beta 0+\beta 1X1+\beta 2X2+\beta 3X1X2$$

With $Y$ = year, $X1$ = DLP and $X1X2$ = Indicator variable (0 (data 1990 to 1999), 1 (data 2000 to 2006))

$P$ values below the value of significance (0.05) for $\beta 3$ indicate differences between the two slopes.

In this case, slopes are significantly different. Since 2000, DLP trends are increasing nearly twofold every year.

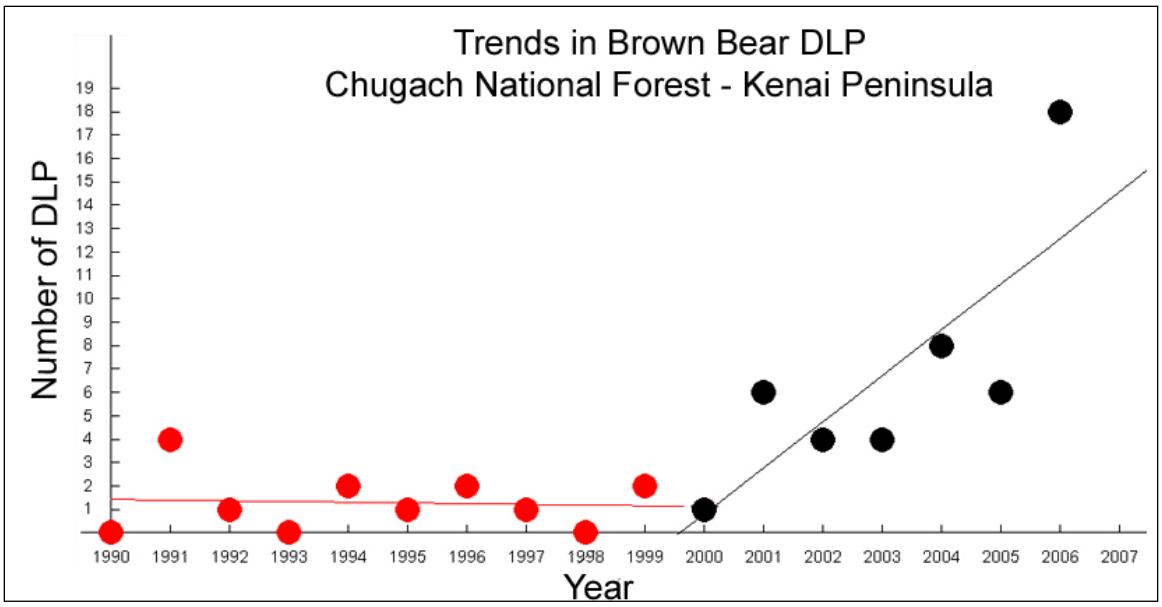


**Figure Q10-1. Trends in brown bear DLPs on the Chugach National Forest portion of the Kenai Peninsula. [Red covers data from 1990 to 1999; black covers the years spanning 2000 to 2006.]**

(B) Whether one year has more or less adverse encounters than another, or if these trends are significant is not always meaningful. One can visually interpret the trend in these data and the direction of the trend may be most important, or the absolute numbers of DLP. For example, DLP incidents are increasing between 2000 and 2006, and the number of DLPs are 2 to 4 times previous levels.

When a threshold is met, use BHIMS and ADF&G data to further evaluate where the incidents occurred. This is a straightforward analysis to determine if DLPs happen bordering National Forest System land, on National Forest System land, and if the latter, where. The purpose is to understand where incidents occur for managers to design appropriate mitigation strategies.

(C) Comparison between DLP incidents and adverse encounters within and outside brown bear core areas.

**N. Assumptions and Limitations:** We assume all bear encounters are reported. This is unlikely. Analyses are limited by the information populating them.

**O. Reporting Frequency:** We suggest these trends over time be compared yearly. Trends should occur in 5- and 10-year brackets, as well as across the entire DLP dataset. In using the historical data from ADF&G, we can also examine a running mean for the number of events in 3- to 5-year increments, to smooth the graph.

**P. Responsibility:** Chugach National Forest Supervisor's Resources Staff Officer

**Q. List of Preparers:**

M. Bray, Wildlife Biologist, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

G. Harris, Wildlife Ecologist, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

**R. 10-Year Cost Forecast:** Total 10-year estimated cost: $36,127 (Staff Officer Biologist [8 days] at $350 per day). For acquiring, analyzing, interpreting trend data, and writing report. Estimated annual cost in the revised forest plan is $10,000 (p. 5-9)

| | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| People | $3,151 | $3,246 | $3,343 | $3,444 | $3,547 | $3,653 | $3,763 | $3,876 | $3,992 | $4,112 |
| Travel | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Other | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **TOTAL** | **$3,151** | **$3,246** | **$3,343** | **$3,444** | **$3,547** | **$3,653** | **$3,763** | **$3,876** | **$3,992** | **$4,112** |

Cost in Inflated dollars ($)

**S. Literature Cited:**

Herrero, S. 1985. *Bear Attacks-Their Causes and Avoidance*. Winchester Press, Piscataway, NJ.

Interagency Brown Bear Study Team (IBBST). 2001. *A Conservation Assessment of the Kenai Peninsula Brown Bear*. Alaska Department of Fish and Game, U.S. Fish and Wildlife Service, National Park Service, and USDA Forest Service. 48 pp.

McLellan, B., F. Hovy, R. Mace, J. Woods, D. Carney, M. Gibeau, W. Wakkinen, and W. Kasworm. 1999. Rates and Causes of Grizzly Bear Mortality in the Interior Mountains of British Columbia, Alberta, Montana, Washington, and Idaho. *Journal of Wildlife Management* 63:911–920.

Suring, L. and G. Del Frate. 2002. Spatial Analysis of Locations of Brown Bears Killed in Defense of Life or Property on the Kenai Peninsula, Alaska, USA. *Ursus* 13:237–245.

Wilder, J.M., T. D. DeBruyn, T S. Smith, and A. Southwould. (In review). *Systematic Collection of Bear-human Conflict Information for Alaska's National Parks*.

## *13. What are the population trends for dusky Canada geese and the relationship to habitat change?*

### *13.1 Dusky Canada geese artificial nest island*

**A. Monitoring Item: *Dusky Artificial Nest Island***

**B. General Monitoring Question:** Forest plan Table 5-1 - What are the population trends for dusky Canada geese and the relationship to habitat change? MEIT interpretation: What are the population trends for dusky Canada geese and the relationship to habitat change? The protocol question associated with the explicit forest management activity: What is the use and nest success of dusky Canada geese using artificial nest islands on the Copper River Delta?

**C. Business Need and Rationale:** The majority of the dusky Canada goose (*Branta Canadensis occidentalis*) population breeds on the Copper River Delta, where the population has steadily declined due to effects of the 1964 earthquake. The 1964 earthquake uplifted the Copper River Delta 3 to 6 feet. Due to the shallow, flat aspect of the offshore sea floor, this uplift pushed large expanses of land above sea level. As a result of this event, previously subtidal land became intertidal, and intertidal land became supratidal. These changes consequently altered the general hydrology and habitat of the area. Initially, dusky Canada geese (Duskys) thrived in this new habitat. However, as shrubs and trees began to grow on the uplifted land, nest predation on Dusky nests became high, and consequently, overall nest success declined. Poor nest success has been identified as one of several factors contributing to the dusky Canada goose population decline (Bromley and Rothe 2003).

In response to a declining Dusky population and poor nest success, an artificial nest islands (ANI) program was implemented. Since1984, hundreds of ANIs were installed on the Copper River Delta in an attempt to increase nest success of dusky Canada geese. Chugach National Forest personnel have visited existing ANIs annually to determine use and estimate nest success rates. In recent years, these geese used between 40 and 45 percent of the approximately 330 active artificial nest islands on the Copper River Delta (Figure Q13.1-1). Dusky ANI nest success was consistently higher (Figure Q13.1-2) and often nearly double that of Duskys nesting in natural vegetation (Bromley and Rothe 2003).

By 2008, the Dusky breeding population had declined to 9,152, which heightened concern by the Pacific Flyway Committee. In response to the Dusky population decline, the Dusky subcommittee of the Pacific Flyway Council recommended increasing the number of ANIs on the Copper River Delta. In FY10, the Forest Service partnering with USFWS; Fish and Game Departments from Oregon, Washington and Alaska; Ducks Unlimited; and the National Fish and Wildlife Foundation installed 50 new ANIs. Future monitoring of ANIs will determine the effectiveness of this management action during a time when vegetation change continues on the Copper River Delta and while the Dusky population is of management concern.

In 2008, Chugach National Forest contracted Western EcoSystems Technology (WEST), Inc., to analyze existing data collected between 1984 and 2008 in an effort to determine

the sampling intensity (sample size) and monitoring schedule (yearly, every other year, or every three years) required to adequately monitor nest island use and nest success (Nielson and Stahl 2009). The monitoring protocol presented in this document is based on the results and recommendations of that report.

**D. Category:** Effectiveness

**E. Protocol Status, Source, and Re-evaluation Schedule**: This protocol will follow the same methodology of the past nest use and success monitoring that has occurred for the ANI program. To achieve a sufficient sample size, 40 percent of the nests will be randomly monitored annually. This amount of effort was determined through model simulations that found this to be the optimal amount of cost per unit effort needed for monitoring ANI use and success by Duskys (Nielson and Stahl 2009). Data results will be reported annually, and the monitoring protocol will be re-evaluated during 5-year reviews and revisions of the forest plan.

**F. Objective Statement:** This monitoring question addresses the effectiveness of the Revised Chugach National Forest Resource Land and Resource Management Plan (Revised Forest Plan) in fulfilling its forestwide objective to maintain or increase dusky Canada goose populations (Revised Forest Plan pp. 3-16, 3-18).

> **[F-1] Required by Law:** The National Forest Management Act of 1976 requires that National Forest System lands be managed for a variety of uses on a sustained basis to ensure in perpetuity a continued supply of goods and services to the American people.
>
> The Organic Administration Act, the Multiple-Use/Sustained-Yield Act, the National Forest Management Act, the Sikes Act, and USDA and Forest Service policy and agreements recognize the responsibilities shared between the Forest Service and Alaska wildlife agencies in managing fish and wildlife resources on Federal lands. These and other laws acknowledge State jurisdiction in resident fish and wildlife management. The Forest Service indirectly affects population numbers, diversity, and species viability through the management of habitat. The Alaska National Interest Lands Conservation Act (ANILCA) provides for the maintenance of sound populations of, and habitat for, wildlife species of value to the citizens of Alaska and the nation.
>
> ANILCA section 501 (b) directs that the Chugach National Forest administer lands in the Copper River Delta for the conservation of fish and wildlife and their habitat.
>
> All National Forest System land is managed under the Federal Land Policy and Management Act of October 21, 1976, stating that “lands be managed in a manner that will protect the quality of scientific, scenic, historical ecological…..values. Protect certain public lands in their natural condition; that will provide food and habitat for fish and wildlife.”
>
> The Fish and Wildlife Conservation Act of September 15, 1960, requires the Forest Service to plan, develop, maintain, and coordinate programs for conservation and rehabilitation of wildlife, fish, and game on public lands under their jurisdiction.

The dusky Canada goose is a sensitive species, and the forest plan directs that these species will be managed for stable or increasing levels.

**[F-2] Statistical Rigor Rationale:** The statistical rigor of the survey protocol, analysis methods and recommendations described is considered “high.” This level of rigor was determined by simulation models that estimated the statistical accuracy of sampling efforts (Nielson and Stahl 2009).

**[F-3] Data Precision, Reliability:** Class A: These methods are valid for monitoring resources and management actions. The methods produce statistically valid repeatable results. Reliability, precision, and accuracy are expected to be high.

**[F-4] Confidence:** These methods are scientifically sound for monitoring resources and management actions. The methods produce repeatable results and are statistically valid. The reliability, precision, and accuracy will be at a high level.

**[F-5] Change Detection:** This monitoring protocol is expected to provide detection of a 3 percent decrease in use and nesting success of ANI by Duskys with 0.68 power over 19 years (Nielson and Stahl 2009). This level of change detection is acceptable for monitoring.

**[F-6] Threshold:** A 3-year average of 25 percent for Dusky use and/or nest success of ANIs will be considered the threshold for management review. The nest success threshold at 25 percent would be approaching results similar to nest success by Duskys nesting in natural vegetation. Similarly, Dusky use of ANIs at 25 percent would need an evaluation as to the effectiveness and cost efficiency of the program. Therefore, at such levels, the Chugach National Forest will fully evaluate the ANI program and consider options and alternatives with consideration of the Dusky population. On the other end of the spectrum, if the Dusky population increases above 30,000 for a 3-year average, the need for ANIs will be reviewed.

**[F-7] Scope of Inference:** The ANI program for Duskys is limited to the Copper River Delta.

**G. Indicator and its Units of Measure:** Use and nest success of ANIs by Duskys.

**H. Sampling Design**: ANIs will be randomly selected annually. ANIs will be visited in a timely manner for data collection of use and nest success by Duskys.

**[H-1] Target Population:** Duskys on the Copper River Delta.

**[H-2] Sampling Frame:** Summer of each year.

**[H-3] Sample Selection Methods**: A stratified random method that samples 40 percent of the established ANIs annually will be used to determine the sample.

**[H-4] Sample Unit Description:** ANI.

**[H-5] Detection and Observer Bias Controls:** A data collection protocol will minimize observer biases for determining use and nest success of ANIs by Duskys. Furthermore, these datasets will be reviewed to ensure accuracy and standardization of the data.

**[H-6] Sample Size Estimate and Estimation Methods**: The sample size is 40 percent of the ANIs established to date. New nests will need to be established for three breeding seasons before they can be included in the sample.

**[H-7] Temporal Details of Sampling:** Forty percent of the ANIs will be sampled annually during the month of June.

**I. Data Collection:**

**[I-1] Methods for Locating Sample Units**: ANI locations have been documented and they can be located in the field with maps and GPS units.

**[I-2] Methods for Layout and Marking:** Each nest will be assigned a unique identification number and 40 percent of these will be randomly selected for sampling each year.

**[I-3] "Field" Sampling Methods:** Each randomly selected nest will be visited. Nest island monitoring will be conducted just after the majority of geese have completed their nesting cycle (usually the third week of June). Monitoring must occur soon after Duskys complete their nesting for biologists to accurately identify successful nests and estimate the number of fledglings from egg shell fragments and membranes. On average, this monitoring has been initiated during the last two weeks of June. Upon examination of the ANI, it will be determined if a Dusky had used it for nesting purposes; and if so, whether the nest was successful (eggs hatched), predated (and, if possible, identify the predator), abandoned, or other fate (includes unknown). Pictures will be taken of the site (with nest ID), egg fragments preserved (if present), and data recorded on the field form. For each ANI, this data will be reviewed and the results confirmed by the project supervisor.

**J. Quality Control and Assurance:** Observers will be trained to make scientific observations of nest use and nest success as outlined in the field protocol. The field data will be reviewed for accuracy and consistency before being entered into a corporate database. Data entry will also be reviewed for accuracy by someone other than the person who entered the data.

**K. Data Form**: See Attachment Q13.1-1.

**L. Data Storage:**

**[L-1] Data Cleaning Methods:** A technician will enter the data while the collector is available; therefore, the data will essentially be proofed as it is entered. If omissions or errors have occurred, the person entering the data will correct the discrepancy with the field crew leader. This will happen as soon as possible after the data are collected to ensure information is still fresh in the minds of the collectors. After data entry, the data should be proofread by another person.

**[L-2] Data Storage:** Data will be stored in an Access database at the Cordova Ranger District and entered into NRIS.

**M. Data Analysis:** Statistical analysis code ("R code for Analysis of DUSKY Artificial Nest Islands.txt") and data files for historic nest island use ("tblDateNestIslandVisits.cvs") and success ("CAGO use and status.csv") provided by Nielson and Stahl (2009) will be used for analyzing annual dusky Canada goose ANI datasets (see Attachment Q13.1-2, files archived: K drive: res\wildlife\Dusky Canada Goose\Data and Rcode for ANIs by WEST, Inc.).

**N. Assumptions and Limitations:** The assumption is that the assessment of nest success will be accurate and consistent from year to year. The limitations are visiting the randomly selected ANI in a timely manner before evidence of nesting activity is negatively impacted by weather, animals, and other factors.

**O. Reporting Frequency:** Reports with interpretations will be generated every year.

**P. Responsibility:** Chugach National Forest Wildlife Ecologist in coordination with district biologists and technicians.

**Q. List of Preparers**:

M. Bray, Wildlife Biologist, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

R. Nielson, Research Biometrician / Project Manager, WEST, Inc., 200 S. Second St., Suite B, Laramie, WY 82070.

**R. 10-Year Cost Forecast:**

| | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| Staff | $9,298 | $9,577 | $9,864 | $10,160 | $12,565 | $12,942 | $13,330 | $13,730 | $14,142 | $14,566 |
| Fleet | $2,859 | $2,945 | $3,033 | $3,124 | $3,220 | $3,315 | $3,414 | $3,517 | $3,622 | $3,732 |
| Other | $2,170 | $2,235 | $2,302 | $2,371 | $2,371 | $2,516 | $2,591 | $2,669 | $2,749 | $2,832 |
| **TOTAL** | **$14,327** | **$14,757** | **$15,200** | **$15,656** | **$18,156** | **$18,773** | **$19,336** | **$19,916** | **$20,513** | **$21,128** |

Total 10-year estimated cost: $177,762.

Calculations: The amount for the FY10 ANI work chunk submitted under the National Fish and Wildlife Foundation was $33,762 ($8,764 staff; $2,695 fleet; $2,046 other). Since the monitoring protocol requires monitoring 40 percent of the ANIs, the cost for the monitoring protocol was calculated to be 40 percent of the FY10 work chunk multiplied by 3 percent to adjust for annual inflation. The 0.03 inflation estimate was also applied to subsequent years. For FY16 to FY20, calculations include monitoring 40 percent of the 50 additional ANI added during FY10. Note: new ANIs are given 5 years for the geese to acclimate to them, and thereby, are then included into the monitoring question at that time.

Estimated annual cost in revised forest plan (5-9): $8,000 (for: What are the population trends for dusky Canada geese and the relationship to habitat?). For the 10-year

monitoring interval, the difference between the original estimate of $80,000 and new estimate of $170,543 is $90,543.

**S. Literature Cited:** Includes citations for all literature reviewed for this protocol.

Bromley, R.G. and T.C. Rothe. 2003. *Conservation assessment for the dusky Canada goose* (*Branta canadensis occidentalis* Baird). USDA General Technical Rpt. PNW-GTR-591.

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Butler, W.I., Jr., and W.D. Eldridge. 1991. *Development of an aerial breeding pair survey for dusky Canada geese (Branta canadensis occidentalis) on the Copper River Delta, Alaska*. Final Report. Unpubl. Rep. U.S. Fish and Wildlife Service, Anchorage, Alaska. 30 p.

Caughley, G. 1977. Sampling in aerial survey. *J. Wild. Manage*. 41:605-615.

Cochran, W.G. 1963. *Sampling techniques*. 2nd edition. John Wiley & Sons, Inc., N.Y. 413 p.

Crouse, J.A. 1993. *Summary of dusky goose nest distribution study on the Copper River Delta, Alaska*. Unpub. Rep. USDA Forest Service, Cordova, Alaska. 6 p.

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Crouse, J.A., D. Youkey, and S. Babler. 1995. *Dusky Canada goose nest distribution and abundance on the Copper River Delta, Alaska*. Unpub. Rep. USDA Forest Service, Cordova, Alaska. 9 p.

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Eldridge, W.D., W. Larned, C.P. Dau, and R. Platte. 1998. *Report to the Pacific flyway study committee on 1986-1998 breeding ground surveys of dusky Canada geese on the Copper River Delta*. Unpub. Rep. USFWS, Anchorage, Alaska. 5 p.

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Nielson, R. and M.B. Stahl. 2009. *Protocol for Monitoring Use of Artificial Nest Islands by Dusky Canada Geese*. Unpublished rept. in fulfillment of FS contract AG-0120-P-0031.

Pacific Flyway Council. 2007. *Pacific Flyway management plan for the dusky Canada goose*. Dusky Canada Goose Subcomm., Pacific Flyway Study Comm. [c/o USFWS], Portland, OR. Unpubl. rept. 53 p.

Snedecor, G.W. and W.G. Cochran. 1967. *Statistical Methods*. Iowa State University Press, Ames, Iowa. 593 p.

Stehn, R.A. 1991. *Nesting populations and production of geese on the Yukon-Kuskokwim Delta*. Unpubl. Rep. Alaska Fish and Wildlife Research Center, Anchorage, Alaska. 99 p.

Stehn, R.A. 1998. *Breeding ground surveys for monitoring cackling Canada geese*. Rep. U.S. Fish and Wildlife Service, Anchorage, Alaska. 30 p.

Westerskov, K. 1950. Methods for determining the age of game bird eggs. *J. Wildl. Manage*. 14:56-57.

Youkey, D., J.A. Crouse, and S. Babler. 1996. *Dusky Canada goose nest distribution and abundance on the Copper River Delta*, Alaska. Rep. U.S. Forest Service. 22 p.

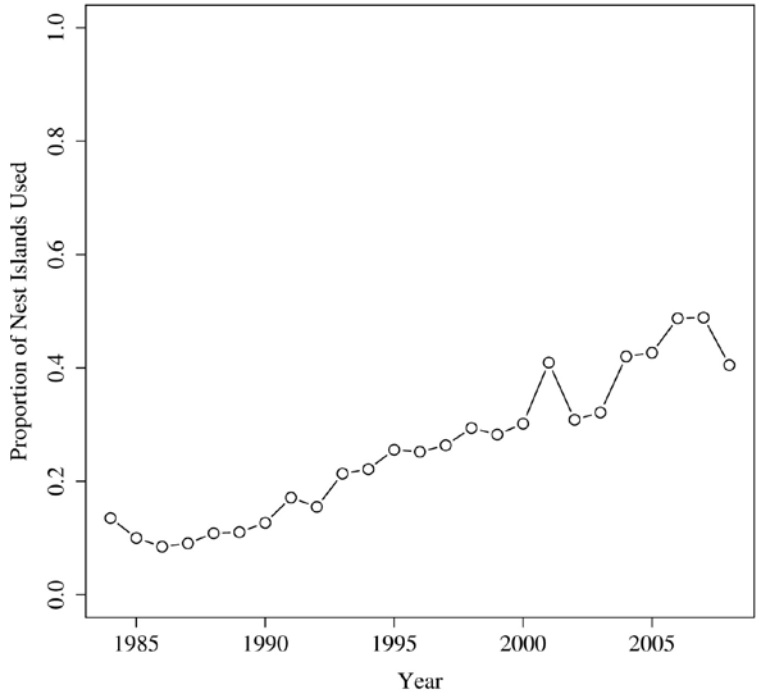


**Figure Q13.1-1. Proportion of available artificial nest islands in the Copper River Delta used by dusky Canada geese between 1984 and 2008 (Nielson and Stahl 2009)**

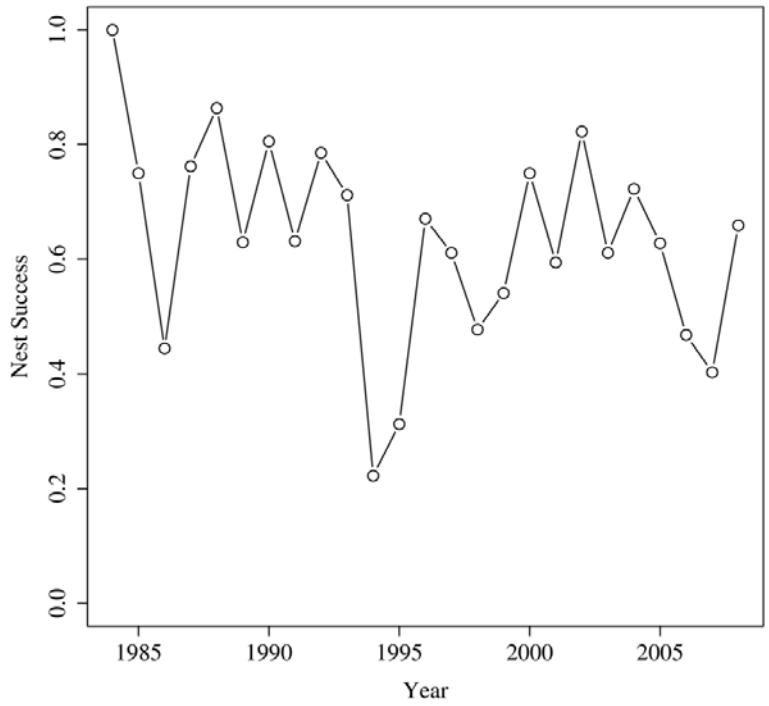


**Figure Q13.1-2. Proportion of successful artificial nest islands in the Copper River Delta used by dusky Canada geese between 1984 and 2008(Nielson and Stahl 2009)**

## *Attachment Q13.1-1.Nest island monitoring form*

**2009 Nest Island Monitoring Form**

| | | | | |
|---|---|---|---|---|
| __ __<br>Observer | __ __ __ __<br>Nest Island ID | __ __<br>Unit | __<br>AVAILABLE | _____<br>DATE |
| _____<br>Size (sq. meters) | _____<br>Dist. to Shore (m) | _____<br>Freeboard (cm) | _____<br>Pond Depth (cm) | |
| _____<br>Shrub Cover (%) | _____<br>Shrub Height (m) | _____<br>Bare (%) | _____<br>Beaver Damage (%) | _____<br>Muskrat Damage (%) |
| __ __ __ __<br>Species Use: | Nesting or Other<br>Type of Use | | Successful/Destroyed/Active/Abandoned/Unknown<br>Nest Status | |
| _____<br>NO. of EGGS | _____<br>NO. of MEMBRANES | _____<br>NO. of UNHATCHED | | |
| | None/Landscape/Anchors/Landscape and Anchors<br>Maintenance Required | | 0 1 2 3<br>Anchors Needed | |

Comments: _____

Species on Pond

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

| | | | | |
|---|---|---|---|---|
| MALL<br>☐☐☐ | AGWT | CAGO | RNDU | GRSC |
| ARTE | ALTE | MEGU | AMWI | NOPI |
| HOGR | RTLO | TRUS | SBDO | RNPH |
| _ _ _ _ | _ _ _ _ | _ _ _ _ | _ _ _ _ | |

***Attachment Q13.1-2. Code for analysis of dusky Canada goose data***

```
#-------------------------------------------------------------------------------------------------------

# ANALYSIS TO LOOK AT DISTRIBUTION AND PROPERTIES OF DUSKY GOOSE
NEST ISLAND USE DATA FOR CHUGACH NATIONAL

# FOREST.

#

# Ryan Nielson and Michelle Bourassa Stahl (WEST, Inc.)

#-------------------------------------------------------------------------------------------------------


# Library calls

library(gnlm)

library(MASS)

library(faraway)


# Import nest island data

islands.df = read.csv('tblDataNestIslandVisits.csv', header=TRUE)


# Calculate proportion of nest islands used by year

results.df = NULL

unique.year = unique(islands.df$YEAR)

for ( i in unique.year ) {

 temp.df = islands.df[islands.df$YEAR==i,]

 visited = nrow(temp.df)

 available = nrow(temp.df[temp.df$AVAILABLE=='AVAILABLE',])

 used = nrow(temp.df[temp.df$TYPE_USE=='NEST' & temp.df$SPP_USE=='CAGO',])

 prop.used = used/available

 results.df = rbind(results.df, data.frame(year=i,

                    visited=visited,
```

```
                available=available,
                used=used,
                prop.used=prop.used
                )
        )
}

# Sort by year
results.df = results.df[order(results.df$year),]

# Plot time series of number of nest islands visited
plot(results.df[,'year'],results.df[,'visited'], type='b', xlab='Year',ylab='Number of Nest Islands Visited',
 cex=1.5, cex.lab=1.5, cex.axis=1.5)

# Plot time series of number of nest islands available
plot(results.df[,'year'],results.df[,'available'], type='b', xlab='Year',ylab='Number of Nest Islands Available',
 cex=1.5, cex.lab=1.5, cex.axis=1.5)

# Plot time series of proportion of nest islands used
plot(results.df[,'year'],results.df[,'prop.used'], type='b', ylim=c(0, 1), xlab='Year',ylab='Proportion of Nest Islands Used',
 cex=1.5, cex.lab=1.5, cex.axis=1.5)

#Drop first two years of data
most.df = results.df[results.df$year>1985,]

# Center data based on year
```

```
most.df$cyear = most.df$year-median(most.df$year)

# Add in not used field
most.df$not.used = most.df$available-most.df$used

# Run a quasibinomial regression model: y = intercept + year
y = cbind(most.df$used,most.df$not.used)
x = most.df$cyear
model = glm(y~x, family=quasibinomial)
summary(model)

# Plot fitted regression line with 95% CI
plot(x+median(most.df$year), y[,1]/apply(y, 1, sum), type='p', ylim=c(0, 1),
  xlab='Year',ylab='Proportion of Nest Islands Used', cex=1.5, cex.lab=1.5, cex.axis=1.5)
pred = predict.glm(model, se.fit=T, type="response")
lines(x+median(most.df$year), pred$fit, lwd=2)
ll = pred$fit - 1.96*pred$se.fit
ul = pred$fit + 1.96*pred$se.fit
lines(x+median(most.df$year), ll, lwd=2, lty=3)
lines(x+median(most.df$year), ul, lwd=2, lty=3)
```

```
#-----------------------------------------------------------------------------------------------------------

# ANALYSIS TO LOOK AT DISTRIBUTION AND PROPERTIES OF DUSKY GOOSE
NEST ISLAND SUCCESS FOR CHUGACH NATIONAL

# FOREST.

#

# Ryan Nielson and Michelle Bourassa Stahl (WEST, Inc.)

#-----------------------------------------------------------------------------------------------------------


# Required contributed packages

require(gnlm)

require(MASS)

require(faraway)


# Import nest island data

islands.df = read.csv('CAGO use and status.csv', header=TRUE)


# Calculate proportion of successful used nest islands by year

islands.df = islands.df[islands.df$AVAILABLE == "AVAILABLE" &

          islands.df$SPP_USE == "CAGO" &

          islands.df$TYPE_USE == "NEST",]

islands.df$NEST_STATU[islands.df$NEST_STATU == "ACTIVE"] = "UNKNOWN"

islands.df = islands.df[islands.df$NEST_STATU != "UNKNOWN",]


results.df = NULL

unique.year = unique(islands.df$YEAR)

nests = successful = rep(NA, length(unique.year))

for (i in 1:length(unique.year)) {

 nests[i] = nrow(islands.df[islands.df$YEAR == unique.year[i],])

 successful[i] = nrow(islands.df[islands.df$YEAR == unique.year[i] &
```

```
        islands.df$NEST_STATU == "SUCCESSFUL",])
}
results.df = data.frame(year = unique.year, nests = nests,
      successful = successful)

# Sort by year
results.df = results.df[order(results.df$year),]

# Plot time series of number of nest islands used and where success is known
plot(results.df[,'year'],results.df[,'nests'], type='b', xlab='Year',ylab='Number of Nest Islands',
 cex=1.5, cex.lab=1.5, cex.axis=1.5)

# Plot time series of proportion of successful nest islands
plot(results.df[,'year'],results.df[,'successful']/results.df[,'nests'], type='b', ylim=c(0, 1), xlab='Year',ylab='Nest Success',
 cex=1.5, cex.lab=1.5, cex.axis=1.5)

# Scatterplot of proportion of nest success to nest islands used
plot(results.df[,'nests'], results.df[,'successful']/results.df[,'nests'], type='p',
  xlab='Number of Nest Islands Used', ylab='Nest Success', cex=1.5, cex.lab=1.5, cex.axis=1.5)

# Ingores first two years of data
most.df = results.df[results.df$year>1986,]

# Center data based on year
most.df$cyear = most.df$year - median(most.df$year)
```

```
# Add in unsuccessful field
most.df$unsuccessful = most.df$nests-most.df$successful

# Run a quasibinomial regression model : y = intercept + year
y = cbind(most.df$successful,most.df$unsuccessful)
x = most.df$cyear
model = glm(y~x, family=quasibinomial)
summary(model)

# Plot fitted regression line with 95 percent CI
plot(x+median(most.df$year), y[,1]/apply(y, 1, sum), type='p', ylim=c(0, 1),
  xlab='Year',ylab='Nest Success', cex=1.5, cex.lab=1.5, cex.axis=1.5)
pred = predict.glm(model, se.fit=T, type="response")
lines(x+median(most.df$year), pred$fit, lwd=2)
ll = pred$fit - 1.96*pred$se.fit
ul = pred$fit + 1.96*pred$se.fit
lines(x+median(most.df$year), ll, lwd=2, lty=3)
lines(x+median(most.df$year), ul, lwd=2, lty=3)
```

## *13.2 What are the population trends for dusky Canada geese and the relationship to habitat change?*

**A. Monitoring Item: *Dusky Canada Goose Population Trends***

**B. General Monitoring Question:** Forest plan Table 5-1 - What are the population trends for dusky Canada geese and the relationship to habitat change? MEIT interpretation: What are the population trends for dusky Canada geese and the relationship to habitat change? **Monitoring protocol question:** What are the population trends of dusky Canada geese on the Copper River Delta?

**C. Business Need and Rationale**: The Dusky is listed by the Chugach National Forest as a management indicator species and an Alaska Region Sensitive Species. The forest plan calls for monitoring trends of management indicator species in general and trends, habitat relationships, and habitat change for Duskys in the forest plan (USDA Forest Service 2002, table 5-1). The dusky Canada goose (Dusky, Duskys) is also considered a sensitive species (Goldstein et al. 2009) due to its current downward habitat and population trends (Forest Service Manual 2670.5.19). The majority of the Dusky population breeds on the Copper River Delta, where the population has steadily declined due to indirect effects of the 1964 earthquake (Bromley and Rothe 2003).

The 1964 earthquake uplifted the Copper River Delta 3 to 6 feet. Due to the shallow, flat aspect of the offshore sea floor, this uplift pushed large expanses of land above sea level. This event changed previously subtidal land to intertidal, intertidal land became supratidal, and consequently the general hydrology of the area was altered. Initially, Duskys thrived in this new habitat. However, as shrubs and trees began to grow on the uplifted land, nest predation on Dusky nests became high, and consequently, the population has been declining (Bromley and Rothe 2003).

Duskys winter in Oregon and Washington where management has become problematic because they mix with more numerous Canada geese subspecies that are hunted there. Hunters have difficulty distinguishing Duskys from other subspecies of Canada geese and a harvest quota for Duskys has been set to conserve them. However, conservation efforts that were implemented to prevent the over-harvest of Duskys, have often limited the harvest of other Canada geese subspecies. Consequently at times, geese occur at higher than preferred densities and inflict unacceptable levels of crop damage on farmers.

Further hunting restrictions are anticipated if the Dusky population continues to decline. Management and conservation recommendations formulated by the Pacific Flyway Council for geese include an analysis of the Dusky population surveys. The U.S. Fish Wildlife Service (USFWS) conducts annual surveys on the Copper River Delta Dusky where the majority of Duskys nest. Every third year, the Forest Service performs ground nest searches to assist with determining the detection rates of geese affected by vegetation cover. This enables the most accurate estimate of the Dusky population on the Copper River Delta. The USFWS developed the survey protocol identified in this document.

**D. Category:** Effectiveness

**E. Protocol Status, Source, and Re-evaluation Schedule:** This monitoring question will be answered by continuing to use a combination of population surveys. Aerial surveys are conducted annually. Ground nest searches are conducted every three years and are used to develop visibility correction coefficient for the aerial surveys. The Forest Service leads the ground surveys and the USFWS leads the aerial surveys. Results are provided annually.

**F. Objective Statement**: This monitoring question addresses the effectiveness of the Revised Chugach National Forest Resource Land and Resource Management Plan (Revised Forest Plan) in fulfilling its forestwide objective to maintain or increase dusky Canada goose populations (Revised Forest Plan pp. 3-16, 3-18).

**[F-1] Required by Law:** The National Forest Management Act of 1976 requires that National Forest System lands be managed for a variety of uses on a sustained basis to ensure in perpetuity a continued supply of goods and services to the American people.

The Organic Administration Act, the Multiple-Use/Sustained-Yield Act, the National Forest Management Act, the Sikes Act, and USDA and Forest Service policy and agreements recognize the responsibilities shared between the Forest Service and Alaska wildlife agencies in managing fish and wildlife resources on Federal lands. These and other laws acknowledge state jurisdiction in resident fish and wildlife management. The Forest Service indirectly affects population numbers, diversity, and species viability through the management of habitat. The Alaska National Interest Lands Conservation Act (ANILCA) provides for the maintenance of sound populations of, and habitat for, wildlife species of value to the citizens of Alaska and the nation.

ANILCA section 501 (b) directs that the Chugach National Forest administer lands in the Copper River Delta for the conservation of fish and wildlife and their habitat. All National Forest System Land is managed under the Federal Land Policy and Management Act of October 21, 1976, stating that “lands be managed in a manner that will protect the quality of scientific, scenic, historical and ecological values. Protect certain public lands in their natural condition; that will provide food and habitat for fish and wildlife.”

The Fish and Wildlife Conservation Act of September 15, 1960, requires the Forest Service to plan develop, maintain, and coordinate programs for conservation and rehabilitation of wildlife, fish, and game on public lands under their jurisdiction.

**[F-2] Statistical Rigor Rationale:** High. Dusky Canada goose breeding populations have been surveyed on the Copper River Delta since 1993. The Pacific Flyway Council has accepted these data as the best method for monitoring the population. In combination with ground surveys, we are able to obtain a population estimate with confidence intervals. A panel of wildlife scientists from Alaska Department of Fish and Game, Forest Service, Oregon Department of Fish and Game, USFWS, and U.S. Geological Survey determined that this method is the best, most direct way to estimate and monitor the Dusky population.

**[F-3] Data Precision, Reliability**: *Class A*: These methods are valid for monitoring resources and management actions. The methods produce repeatable results and are often statistically valid. Reliability, precision, and accuracy are statistically significant.

**[F-4] Change Detection:** Current methods of annual aerial surveys and triennial ground searches detect a 10-percent population decrease in 3 years with a power of 0.90 with 10 years of data and a significance level probability set at 0.10. This is within the necessary parameters.

**[F-5] Confidence:** These methods are scientifically sound for monitoring resources and management actions, producing statistically valid repeatable results. This protocol will estimate the population within 20 percent with 95 percent accuracy. For example, if the population estimate is 15,000 individuals, our 95 percent confidence interval should be 12,000 to 18,000.

**[F-6] Threshold:** (a) Methodology: The concern had been that the geese would become less visible from the air as the woody vegetation increased in density and size on the Copper River Delta. Survey data collected from 1993 to 2007 have not seen evidence of a change thus far, and it may require many more years and a major change in visibility rates to measure a change in this ratio (Hodges and Eldridge 2007). If there is no change in detection rate after the 2010 survey, then wider survey intervals (every 4 to 5 years versus every 3 years) should be evaluated. If there is a change in detection rate after the 2010 survey, then survey intervals would remain at 3-year intervals. (b) Management: See Dusky Management Action Plan Revised 2010.

**[F-7] Scope of Inference:** Most (approximately 90 percent) of the Duskys reside within the Copper River Delta geographical area. Therefore, the inference will be the Copper River Delta with implications for the entire Dusky population.

**G. Indicator and its Units of Measure:** Dusky population estimates.

**H. Sampling Design:** Aerial Surveys. The aerial survey will use a stratified sampling design, beginning with a random starting point, utilizing three sampling intensities.

- Transects on the western mainland are oriented in an east-west direction, and spaced 0.5 nautical miles (0.92 km) apart.
- Transects on the east delta are spaced at 1-nautical mile (1.84-km) intervals, also in an east-west fashion.
- Transects on Egg Island are at 0.8-km intervals in a north-south direction.

The west delta is stratified, based on geographic features and goose densities determined from aerial observations. Stratification boundaries have changed for various reasons through the years and were discussed in Eldridge and Platte (1995), Eldridge et al. (1998), and Hodges and Eldridge (2007). Surveys are flown to coincide with peak nest initiation and early incubation, usually in mid-May.

The aerial surveys are flown by USFWS personnel with a Cessna 206 aircraft on amphibious floats at an altitude of 35 to 45 meters at approximately 150 km per hour,

utilizing GPS (Butler et al. 1995). Observations are recorded directly into a laptop computer tied to the airplane GPS system so that each observation receives a coordinate location, using a program developed by John Hodges (USFWS, Juneau).

Densities of aerial observations are calculated by stratum. The mean and variance are ratio estimates (Cochran 1963 and Caughley 1977) calculated from birds observed and the sample areas surveyed for each segment of a transect that fell within a stratum boundary.

**a. Ground nest search method**

Forest Service personnel or personnel from other agencies under the guidance of the Forest Service will search for nests in randomly located ground plots within the same strata as the aerial survey (Attachment Q13.2-1). Sample plots are located by selecting a random pair of Universal Transverse Mercator (UTM) grid coordinates as the plot center point. The order of selection established the order of priority for plots searched. Plot boundaries are digitized onto digital ortho-photos to provide field maps to aid in finding plots, searching, and determining which nests are within plot boundaries. On the mainland, square plots 300 x 300 meters on a north-south, east-west axis are drawn around the point center.

Field personnel thoroughly search each plot following protocol established by Stehn (1991), and complete a data card at each nest with species, location, number of eggs, and other pertinent data recorded. Eggs from 20 clutches are floated to determine nest initiation dates (Westerkov 1950). The nest density and mean clutch size are calculated for each stratum. Active and destroyed nests are recorded and marked. Active and destroyed nests found on the first search are used for comparison with aerial survey results.

**b. Design for synthesis of air and ground data**

Estimation of the breeding population begins by determining the ratio of the number of nests found on plot searches to the number of single and paired geese seen from the air. If at least six ground plots are searched in a given stratum in a given year, the number of nests per $km^2$ is plotted against the number of singles and pairs per $km^2$ seen from the air.

A ratio estimate is used to calculate the ratio of nests per aerial index, with the assumption that the variance about the line is proportional to the density of geese and the y-intercept = 0 (Snedecor and Cochran 1967:166). The ratio is corrected by dividing by the nest detection rate of 0.832. While we know variability occurs with the detection rate, for the purpose of this exercise we assumed the variance to be 0. Nests are expanded to the entire Copper River Delta by multiplying the aerial index of singles and pairs by the nests per aerial index ratio. Variance for expanded nests is estimated using the standard formula for the variance of a product of two independent variables.

> **[H-1] Target Population:** The majority of the Dusky population is targeted and this is done in conjunction with a Dusky survey of Middleton Island. The combination of the two areas has more than 95 percent of the breeding Dusky population.

**[H-2] Sampling Frame:** The sampling frame will consist of the breeding population during the peak of nesting (two weeks in mid-May).

**[H-3] Sample Selection Methods:** Sampling will consist of stratified, systematic surveys covering most of the breeding area.

**[H-4] Sample Unit Description:** Sample units will consist of individual organisms for the population surveys.

**[H-5] Detection and Observer Bias Controls:** In 1993, it was predicted that as vegetation changed (increased), detection of individual geese would decrease, causing a general decrease in population counts over time. This was countered by using a correction factor developed from ground-based surveys.

**[H-6] Sample Size Estimate and Estimation Methods:** Previous surveys have resulted in counts of 2,000 to 3,000 birds. These numbers, in combination with pair estimation and ground count correction, are used to estimate a total population size.

**[H-7] Temporal Details of Sampling**: Aerial sampling will occur annually with ground-based surveys every third year (or less often). Aerial surveys will take approximately three days and will occur during the peak nesting activity—early to mid May. Ground surveys will take about two weeks, and cover the week before and the week after aerial surveys.

**I. Data Collection:** See descriptions above.

**[I-1] Methods for Locating Sample Units**: See descriptions above.

**[I-2] Methods for Layout and Marking:** See descriptions above.

**[I-3] "Field" Sampling Methods:** See descriptions above.

**J. Quality Control and Assurance**: Results of the aerial surveys are corrected by detection rates when compared with ground-based searches, which account for habitat change over time. These ground-based searches have been validated by a blind double count study.

**K. Data Form**: See Attachment Q13.2-2.

**L. Data Storage:**

**[L-1] Data Cleaning Methods:** A technician other than the one collecting the data will enter the data while the collector is available, therefore, the data will essentially be proofread as it is entered. If omissions or errors have occurred, the person entering the data will rectify the discrepancy with the field crew leader. This will happen as soon as possible after the data are collected to ensure information is still fresh in the minds of the collectors. After data entry, the data should be proofread with two people, one reading data from the card, and the other proofing the data in the database.

**[L-2] Data Storage:** Data will be stored in an Access database at the Cordova Ranger District

**M. Data Analysis:** See description above.

**N. Assumptions and Limitations:** We assume that the ability to detect nests on the ground does not change over time or among personnel. We assume that the change in the correction factor calculated from the ground surveys is negligible for two years after ground surveys. We assume that detection by aerial observers is consistent even though observers may change from year to year.

**O. Reporting Frequency:** Reports will be generated every three years for the ground nest searches and correction factor. Annual reports will be provided by USFWS for aerial surveys.

**P. Responsibility:** The Cordova Ranger District Supervisory Wildlife Biologist will be responsible for coordinating all aspects of ground-based survey and data entry described in this protocol.

**Q. List of Preparers:**

Martin Bray, Wildlife Biologist, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

Jason Fode, Wildlife Technician, USDA Forest Service, Cordova Ranger District, Cordova, Alaska.

Michael Goldstein, PhD., Wildlife and Terrestrial Ecology Program Leader, USDA Forest Service, Regional Office, Juneau, Alaska.

Paul Meyers, former Wildlife Biologist with USDA Forest Service, Cordova Ranger District, Cordova, Alaska.

**R. 10-Year Cost Forecast:**

| | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| Staff | $0 | $32,798 | $0 | $0 | $35,750 | $0 | $0 | $38,968 | $0 | $0 |
| Fleet | $0 | $3,543 | $0 | $0 | $3,862 | $0 | $0 | $4,210 | $0 | $0 |
| Other | $0 | $4,360 | $0 | $0 | $4,752 | $0 | $0 | $5,180 | $0 | $0 |
| **TOTAL** | **$0** | **$40,701** | **$0** | **$0** | **$44,364** | **$0** | **$0** | **$48,358** | **$0** | **$0** |

Total 10-year estimated cost: $133,423.

Estimated annual cost: $40,701 every third year with a 3 percent annual cost increase is calculated in the projected costs for subsequent years. Estimated annual cost in revised forest plan (p. 5-9): $8,000 every third year.

**S. Literature Cited**: Includes citations for all literature cited in the protocol and other reference material.

Bromley, R.G. and T.C. Rothe. 2003. *Conservation assessment for the dusky Canada goose (Branta canadensis occidentalis* Baird). USDA General Technical Rpt. PNW-GTR-591.

Butler, W.I., Jr., J.I. Hodges, and R.A. Stehn. 1995. Locating waterfowl observations on aerial surveys. *Wildl. Soc. Bull*. 23:148-154.

Butler, W.I., Jr., and W.D. Eldridge. 1991. *Development of an aerial breeding pair survey for dusky Canada geese (Branta canadensis occidentalis) on the Copper River Delta, Alaska.* Final Report. Unpubl. Rep. U.S. Fish and Wildlife Service, Anchorage, Alaska. 30 p.

Caughley, G. 1977. Sampling in aerial survey. *J. Wild. Manage*. 41:605-615.

Cochran, W.G. 1963. *Sampling techniques*. 2nd edition. John Wiley & Sons, Inc., N.Y. 413 p.

Crouse, J.A. 1993. *Summary of dusky goose nest distribution study on the Copper River Delta, Alaska*. Unpub. Rep. USDA Forest Service, Cordova, Alaska. 6 p.

Crouse, J.A. 1995. *Dusky Canada goose nest distribution and abundance on the Copper River Delta, Alaska*. Unpub. Rep. USDA Forest Service, Cordova, Alaska. 11 p.

Crouse, J.A., D. Youkey, and S. Babler. 1995. *Dusky Canada goose nest distribution and abundance on the Copper River Delta, Alaska*. Unpub. Rep. USDA Forest Service, Cordova, Alaska. 9 p.

DeVelice, R.L., J. DeLapp, and X. Wei. 1999a. *Vegetation Succession Model for the Copper River Delta*, Chugach National Forest and Ducks Unlimited, Inc. USDA Forest Service, Chugach National Forest, Anchorage, Alaska. 34 p.

Eldridge, W.D., and B. Platte. 1995. *Report to Pacific flyway study committee on 1986-1995 breeding ground surveys of dusky Canada geese on the Copper River Delta*. Unpubl. Rep. U.S. Fish and Wildlife Service, Anchorage, Alaska. 4 p.

Eldridge, W.D., W. Larned, C.P. Dau, and R. Platte. 1998. *Report to the Pacific flyway study committee on 1986-1998 breeding ground surveys of dusky Canada geese on the Copper River Delta*. Unpub. Rep. U.S. Fish and Wildlife Service, Anchorage, Alaska. 5 p.

Goldstein, M.I., D. Martin, and M.C. Stensvold. 2009. 2009 Forest Service Alaska Region Sensitive Species List. 47 p

Hodges, J. and W. Eldridge. 2007. *Methods used to analyze aerial Canada goose data in relation to the ground nest surveys on the Copper River Delta.* Unpub. Rep. U.S. Fish and Wildlife Service, Anchorage, Alaska. 9 p.

Logan, D. and D. Youkey. 1998. Interim report on dusky Canada goose nest survey. Unpubl. Rep. USDA Forest Service, Cordova, Alaska. 3 p.

Logan, D. and J. Fode. 2004. *Interim report on the dusky Canada goose nest survey.* Unpubl. Rep. USDA Forest Service, Cordova, Alaska.

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Snedecor, G. W. and W.G. Cochran. 1967. *Statistical Methods*. Iowa State University Press, Ames, Iowa. 593 p.

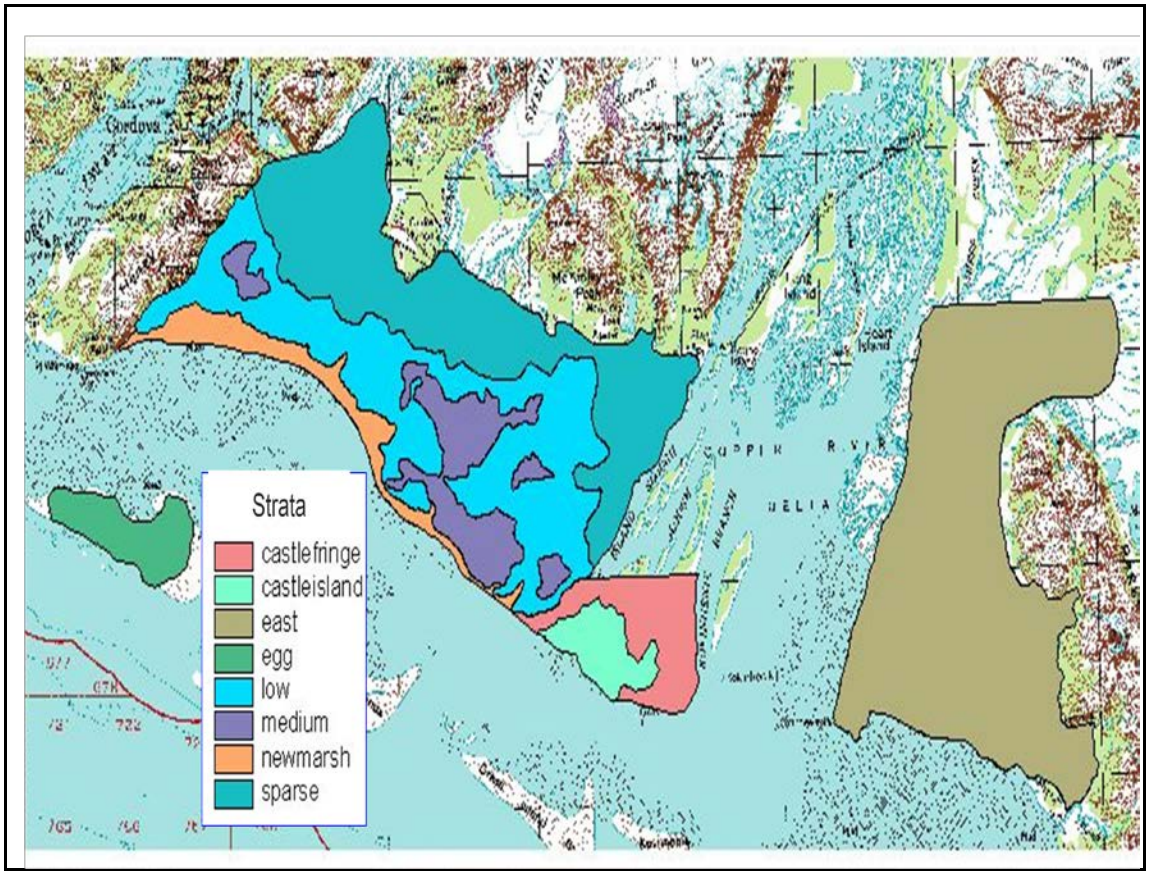
Stehn, R.A. 1991. *Nesting populations and production of geese on the Yukon-Kuskokwim Delta*. Unpubl. Rep. Alaska Fish and Wildlife Research Center, Anchorage, Alaska. 99 p.

Stehn, R.A. 1998. *Breeding ground surveys for monitoring cackling Canada geese*. Rep. USFWS, Anchorage, Alaska. 30 p.

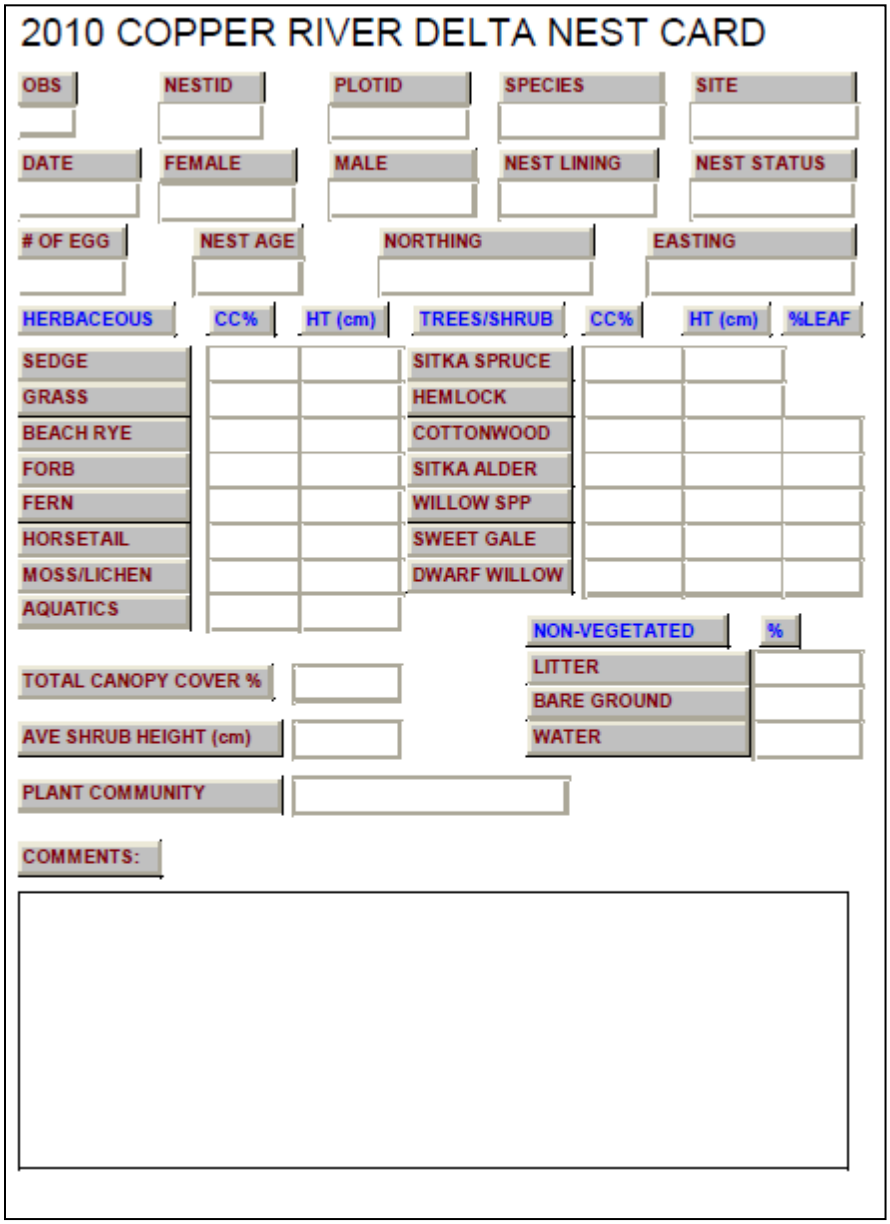
Westerskov, K. 1950. Methods for determining the age of game bird eggs. *J. Wildl. Manage.* 14:56-57.

Youkey, D., J.A. Crouse, and S. Babler. 1996. Dusky Canada goose nest distribution and abundance on the Copper River Delta, Alaska. Rep. U.S. Forest Service. 22 p.

***Attachment Q13.2-1. Copper River Delta stratification based on goose densities***



***Attachment Q13.2-2. Nest search form***



2010 COPPER RIVER DELTA NEST CARD

| OBS | NESTID | PLOTID | SPECIES | SITE |
|---|---|---|---|---|
| | | | | |

| DATE | FEMALE | MALE | NEST LINING | NEST STATUS |
|---|---|---|---|---|
| | | | | |

| # OF EGG | NEST AGE | NORTHING | EASTING |
|---|---|---|---|
| | | | |

| HERBACEOUS | CC% | HT (cm) | TREES/SHRUB | CC% | HT (cm) | %LEAF |
|---|---|---|---|---|---|---|
| SEDGE | | | SITKA SPRUCE | | | |
| GRASS | | | HEMLOCK | | | |
| BEACH RYE | | | COTTONWOOD | | | |
| FORB | | | SITKA ALDER | | | |
| FERN | | | WILLOW SPP | | | |
| HORSETAIL | | | SWEET GALE | | | |
| MOSS/LICHEN | | | DWARF WILLOW | | | |
| AQUATICS | | | | | | |

| NON-VEGETATED | % |
|---|---|
| LITTER | |
| BARE GROUND | |
| WATER | |

| TOTAL CANOPY COVER % | |
|---|---|
| AVE SHRUB HEIGHT (cm) | |
| PLANT COMMUNITY | |

COMMENTS:

## *14. What are the population trends for moose and the relationship to habitat change?*

**A. Monitoring Item: *Integrated Effectiveness Monitoring***

**B. General Monitoring Question:** Forest plan Table 5-1: What are the population trends for moose and the relationship to habitat change? MEIT Interpretation: What are the population trends for moose and the relationship to habitat change? Monitoring protocol question: What are the population trends for moose on the Chugach National Forest?

**C. Business Need and Rationale:**

The 1982 Planning Rule directs all national forests to monitor the trends in their management indicator species populations and their habitats (36 CFR 219 (19)(6)). This effectiveness monitoring is done to evaluate whether implementation of forest plans achieve their desired conditions, goals, and objectives. Moose (*Alces alces*) was selected as a management indicator species for the Chugach National Forest Revised Forest Plan because they are widespread across the forest and are an important subsistence species on the Kenai Peninsula and the Cordova Ranger District.

The Revised Forest Plan (p. 3-4) states, “maintain habitat to produce viable and sustainable wildlife populations that support the use of fish and wildlife resources for subsistence and sport hunting and fishing, watching wildlife, conservation, and other values.” In addition, the land areas and islands in Prince William Sound will continue to sustain much of the wildlife typical of Alaska such as brown and black bears, gray wolf, bald eagle, and osprey. Also, mountain goat, moose and Sitka black-tailed deer will be sustained for hunting and subsistence opportunities (Revised Forest Plan p. 3-16).

The Forest will monitor moose population trends by tracking survey data collected by Alaska Department of Fish and Wildlife.

**D. Category:** Effectiveness monitoring**.**

**E. Protocol Status, Source, and Re-evaluation Schedule**: Monitoring of moose population trends will be initiated in FY2013. Datasets will be obtained every 2 years from Alaska Department of Fish and Game (ADF&G). Moose trends will be described biennially in annual reports and will be re-evaluated during 5-year reviews of the forest plan.

**F. Objective Statement:** This monitoring question addresses the effectiveness of the Revised Forest Plan in fulfilling its forestwide objective to monitor moose populations over time.

> **[F-1] Required by Law:** The 1982 Planning Rule directs national forests to monitor trends in management indicator species populations and determine the relationship to habitat change (36 CFR 219 (19)(6)). Further, the National Forest Management Act of 1976 requires that National Forest System lands be managed for a variety of uses on a sustained basis to ensure in perpetuity a continued supply of goods and services to the American people.

The Organic Administration Act, the Multiple-Use/Sustained-Yield Act, the National Forest Management Act, the Sikes Act, and U.S. Department of Agriculture (USDA) and Forest Service policy and agreements recognize the shared responsibilities between the Forest Service and wildlife agencies in the management of fish and wildlife resources on Federal lands. These and other laws acknowledge state jurisdiction in resident fish and wildlife management. ANILCA provides for the maintenance of sound populations of, and habitat for, wildlife species of value to the citizens of Alaska and the nation. Specifically, ANILCA section 501 (b) directs that the Chugach National Forest administer lands in the Copper River Delta for the conservation of fish and wildlife and their habitat.

**[F-2] Statistical Rigor Rationale:** The method for quantifying population trends of moose relies on aerial surveys by ADF&G that will provide a minimum count of animals. This method precludes estimates of error or confidence intervals.

**[F-3] Data Precision, Reliability:** Surveys will be flown only once a year (not replicated), but should be reliable enough to evaluate population trends of a species with inherent high detection rates.

**[F-4] Confidence:** The minimum count will be used to determine population trends, but will not provide confidence intervals for these datasets.

**[F-5] Change Detection:** This will be determined by tracking population trends from survey data.

**[F-6] Threshold:** A population of moose within a Game Management Unit that has declines greater than 35 percent in any 10-year period would warrant consultation with Alaska Department of Fish and Game. The outcome of this consultation will be reported to the forest leadership team.

**[F-7] Scope of Inference:** Hunt units within game management units on the Chugach National Forest.

**G. Indicator and its Units of Measure:** The minimum count of moose in hunt units within game management units on the Chugach National Forest.

**H. Sampling Design:**

**[H-1] Target Population:** The target will be the number of moose in hunt units within game management units on the Chugach National Forest.

**[H-2] Sampling Frame:** The sampling frame will be hunt units within game management units on the Chugach National Forest.

**[H-3] Sample Selection Methods:** Not applicable. The proposed method is an attempt to conduct a complete count without correction for variation in detection rates.

**[H-4] Sample Unit Description:** Not applicable. The proposed method is an attempt to conduct a complete count in hunt units.

**[H-5] Detection and Observer Bias Controls:** Observers are experienced at identifying moose and they will follow standardized survey protocols.

**[H-6] Sample Size Estimate and Estimation Methods:** Not applicable. The proposed method is an attempt to conduct a complete count (census) and is an index of population abundance for individual hunt units.

**[H-7] Temporal Details of Sampling:** Surveys will be during fall and winter months when snow cover is present.

**I. Data Collection:**

[**I-1] Methods for Locating Sample:** Sample units are hunt units within game management units on Chugach National Forest.

**[I-2] Methods for Layout and Marking:** Not applicable

[**I-3] "Field" Sampling Methods:**

Aerial surveys of areas known to contain high concentrations of moose in hunt units within game management units will be targeted. The method used to enumerate trends of moose numbers will be the direct count method, or a modified Gasaway method (Kellie and DeLong 2006). The survey areas will be hunt units within game management units, and have been delineated into sample units that can be completed in one flight. Flight lines are recorded in real-time using a lap-top computer with a GPS unit, or drawn on sample unit maps. Searches are completed drainage by drainage to avoid duplicate counts and in an attempt to systematically cover the entire hunt unit. Due to weather, budgets, and other factors, some hunt units may not be sampled annually, and therefore, data may not be available for those years.

The method is standardized by time of day, sunlight, and temperature, to maximize the detection of moose. Flight start and stop times for the survey are recorded, and search effort (minutes per square mile) is calculated. Surveys will be scheduled for fall and winter months when there is snow cover, and moose will be classified as bull, cows, and calves.

**J. Quality Control and Assurance:** Wildlife biologists will summarize the trend data.

**K. Data Form:** None needed for summarizing data.

**L. Data Storage:**

**[L-1] Data Cleaning Methods:** Initially data will be organized by ADF&G.

**[L-2] Data Storage:** Districts will store data in NRIS.

**M. Data Analysis:** General quantitative summaries will be used for analyzing the moose population trends by hunt units within game management units, assuming the detection rate is consistent across years.

**N. Assumptions and Limitations:** The minimum number of moose observed during surveys will represent the majority of the population and will be sufficient to evaluate

trends. The approach assumes that detection rates remain relatively constant across years and, therefore, a similar proportion of the population is detected each year.

**O. Reporting Frequency:** Forest Service zone wildlife biologist will summarize data biennially.

**P. Responsibility:** Wildlife biologist at the supervisor's and zone offices.

**Q. List of Preparers:**

Martin Bray, Wildlife Biologist, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

**R. 10-Year Cost Forecast:**

| | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| PWSZ (Staff) | $0 | $4,000 | $0 | $2,000 | $0 | $2,200 | $0 | $2,250 | $0 | $2,300 |
| KPZ (Staff) | $0 | $4,000 | $0 | $2,000 | $0 | $2,200 | $0 | $2,250 | $0 | $2,300 |
| SO (Staff) | $0 | $500 | $0 | $500 | $0 | $500 | $0 | $500 | $0 | $500 |
| **TOTAL** | **$0** | **$8,500** | **$0** | **$4,500** | **$0** | **$4,900** | **$0** | **$5,000** | **$0** | **$5,100** |

Total 10-year estimated cost: $ 28,000

Estimated annual cost in Revised Forest Plan (p. 5-9): $5,000

**S. Literature Cited:**

Kellie, K.A., and R.A. DeLong. 2006. *Geospatial Survey Operations Manual*. Alaska Department of Fish and Game. Fairbanks, Alaska.

## *15. What are the population trends for mountain goat and the relationship to habitat change?*

**A. Monitoring Item: *Integrated Effectiveness Monitoring***

**B. General Monitoring Question:** Forest plan Table 5.1: What are the population trends for mountain goats and the relationship to habitat change? MEIT Interpretation: What are the population trends for mountain goats and the relationship to habitat change? Monitoring protocol question: What are the population trends for mountain goats on the Chugach National Forest?

**C. Business Need and Rationale:**

The 1982 Planning Rule directs all national forests to monitor the trends in their management indicator species populations and their habitats (36 CFR 219 (19)(6)). This effectiveness monitoring is done to evaluate whether implementation of forest plans achieve their desired conditions, goals, and objectives. Mountain goats (*Oreamnos americanus*) were selected as a management indicator species for the Chugach National Forest Resource Land and Resource Management Plan (Revised Forest Plan) because they are widespread across the forest and are an important subsistence species on the Kenai Peninsula and the Cordova Ranger District.

The Revised Forest Plan (p. 3-4) states, “maintain habitat to produce viable and sustainable wildlife populations that support the use of fish and wildlife resources for subsistence and sport hunting and fishing, watching wildlife, conservation, and other values.” In addition, the land areas and islands in Prince William Sound will continue to sustain much of the wildlife typical of Alaska such as brown and black bears, gray wolf, bald eagle, and osprey. Also, mountain goat, moose, and Sitka black-tailed deer will be sustained for hunting and subsistence opportunities (Revised Forest Plan p. 3-16).

The Forest will monitor mountain goat population trends by tracking survey data collected by Alaska Department of Fish and Game (ADF&G).

**D. Category:** Effectiveness monitoring.

**E. Protocol Status, Source, and Re-evaluation Schedule**: Monitoring of mountain goat population trends will be initiated in FY12. Datasets will be obtained every 2 years from ADF&G. Mountain goat trends will be described biennially in annual reports and will be re-evaluated during 5-year reviews of the Revised Forest Plan.

**F. Objective Statement:** This monitoring question addresses the effectiveness of the Revised Forest Plan in fulfilling its forestwide objective to monitor mountain goat populations over time.

> **[F-1] Required by Law:** The 1982 Planning Rule directs national forests to monitor trends in management indicator species populations and determine the relationship to habitat change (36 CFR 219 (19)(6)). Further, the National Forest Management Act of 1976 requires that National Forest System lands be managed for a variety of uses on a sustained basis to ensure in perpetuity a continued supply of goods and services to the American people.

The Organic Administration Act, the Multiple-Use/Sustained-Yield Act, the National Forest Management Act, the Sikes Act, and U.S. Department of Agriculture (USDA) and Forest Service policy and agreements recognize the shared responsibilities between the Forest Service and wildlife agencies in the management of fish and wildlife resources on federal lands. These and other laws acknowledge state jurisdiction in resident fish and wildlife management. The Alaska National Interest Lands Conservation Act (ANILCA) provides for the maintenance of sound populations of, and habitat for, wildlife species of value to the citizens of Alaska and the Nation. Specifically, ANILCA section 501 (b) directs that the Chugach National Forest administer lands in the Copper River Delta for the conservation of fish and wildlife and their habitat.

**[F-2] Statistical Rigor Rationale:** The method for quantifying population trends of mountain goats relies on aerial surveys by ADF&G that will provide a minimum count of animals. This method precludes estimates of error or confidence intervals.

**[F-3] Data Precision, Reliability:** Surveys will only be flown once a year (not replicated), but should be reliable enough to evaluate population trends of a species with inherent high detection rates.

**[F-4] Confidence:** The minimum count will be used to determine population trends, but will not provide confidence intervals for these datasets.

**[F-5] Change Detection:** This will be determined by tracking population trends from survey data.

**[F-6] Threshold:** A population of mountain goats within a game management unit that has declines greater than 35 percent in any 10-year period would warrant consultation with the ADF&G. The outcome of this consultation will be reported to the forest leadership team.

**[F-7] Scope of Inference:** Hunt units within game management units on the Chugach National Forest.

**G. Indicator and its Units of Measure:** The minimum count of mountain goats in hunt units within game management units on the Chugach National Forest.

**H. Sampling Design:**

**[H-1] Target Population:** The target will be number of mountain goats in hunt units within game management units on the Chugach National Forest.

**[H-2] Sampling Frame:** The sampling frame will be hunt units within game management units on the Chugach National Forest.

**[H-3] Sample Selection Methods:** Not applicable. The proposed method is an attempt to conduct a complete count without correction for variation in detection rates.

**[H-4] Sample Unit Description:** Not applicable. The proposed method is an attempt to conduct a complete count in hunt units.

**[H-5] Detection and Observer Bias Controls:** Observers are experienced at identifying mountain goats and they will follow standardized survey protocols.

**[H-6] Sample Size Estimate and Estimation Methods:** Not applicable. The proposed method is an attempt to conduct a complete count (census) and is an index of population abundance for individual hunt units.

**[H-7] Temporal Details of Sampling:** Surveys will occur during summer months when snow cover is minimal.

**I. Data Collection:**

**[I-1] Methods for Locating Sample Units:** Sample units are hunt units within game management units on Chugach National Forest.

**[I-2] Methods for Layout and Marking:** NA

**[I-3] "Field" Sampling Methods:** The method used to enumerate trends of mountain goat numbers is a direct count method, or a standard census (Gonzalez-Voyer et al. 2001). Surveys will attempt to sample the entire hunt unit area in one flight. A contour route along ridge complexes at an elevation of 500 feet or more is flown with a pilot and observer, maintaining 60- to 70-mph airspeed.

Flight lines are recorded in real-time using a laptop computer with a GPS unit, or drawn on sample unit maps. These flight lines follow contours, starting at the tops of ridges and repeating passes downward in elevation, or starting at tree line and repeating passes upward in elevation. Width of the search area between passes is limited to no more than 500 feet elevation. Observations are generally made on the side of the aircraft toward steep topography. Searches are completed drainage by drainage to avoid duplicate counts and to insure systematic coverage. Due to weather, budgets, and other factors, some hunt units may not be sampled annually, and therefore, data may not be available for those years.

The method is standardized by time of day, sunlight, and temperature, to maximize detection of mountain goats. Flights occur in the morning, within 3 hours after sunrise, or in the evening, within 3 hours of sunset. Start and stop times for the survey are recorded, and search effort (minutes per square mile) will be calculated. Surveys will occur in August and September, and mountain goat classifications will include adults and kids, based on body size.

**J. Quality Control and Assurance:** Wildlife biologists will summarize the trend data.

**K. Data Form:** None needed for summarizing data.

**L. Data Storage:**

**[L-1] Data Cleaning Methods:** Initially data will be organized by ADF&G.

**[L-2] Data Storage:** Districts will store data in NRIS.

**M. Data Analysis:** General quantitative summaries will be used for analyzing the mountain goat population trends by hunt units within game management units assuming the detection rate is consistent across the years.

**N. Assumptions and Limitations:** The minimum number of mountain goats observed during surveys will represent the majority of the population and will be sufficient to evaluate trends. The approach assumes that detection rates remain relatively constant across years and, therefore, a similar proportion of the population is detected each year.

**O. Reporting Frequency:** Forest Service zone wildlife biologist will summarize data biannually.

**P. Responsibility:** Wildlife biologist at the supervisor's and zone offices.

**Q. List of Preparers:**

Martin Bray, Wildlife Biologist, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

**R. 10-Year Cost Forecast:**

| | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| PWSZ(Staff) | $4,000 | $0 | $2,000 | $0 | $2,200 | $0 | $2,250 | $0 | $2,300 | $0 |
| KPZ (Staff) | $4,000 | $0 | $2,000 | $0 | $2,200 | $0 | $2,250 | $0 | $2,300 | $0 |
| SO (Staff) | $500 | $0 | $500 | $0 | $500 | $0 | $500 | $0 | $500 | $0 |
| **TOTAL** | **$8,500** | **$0** | **$4,500** | **$0** | **$4,900** | **$0** | **$5,000** | **$0** | **$5,100** | **$0** |

Total 10-year estimated cost: $ 28,000

Estimated annual cost in Revised Forest Plan is $10,000

**S. Literature Cited:**

Gonzalez-Voyer, A., M. Festa-Bianchet, and K.G. Smith. 2001. Efficiency of Aerial Surveys of Mountain Goats. *Wildlife Society Bulletin*, Vol. 29, No. 1, 140-144.

USDA Forest Service. 2002. *Revised Land and Resource Management Plan, Chugach National Forest*. USDA Forest Service, Chugach National Forest, R10-MB-480c.

## *17. What are the population trends for black oystercatchers and the relationship to habitat?*

**A. Monitoring Item: *Integrated Effectiveness Monitoring***

**B. General Monitoring Question:** Forest Plan Table 5-1: "What are the population trends for black oystercatchers and the relationship to habitat change?" MEIT interpretation: What are the population trends for black oystercatchers and the relationship to habitat?

**C. Business Need and Rationale:**

Status: Over 50 percent of the world's black oystercatcher (Figure Q17-1) population breed in Alaska (Andres and Falxa 1995). An estimated 800 to 1,200 individuals inhabit Prince William Sound. The black oystercatcher is listed as a "species of high concern" in the U.S. National Shorebird Conservation Plan, a Focal Species for the U.S. Fish and Wildlife Service (USFWS), a Chugach National Forest management indicator species and an Alaska Region sensitive species.

Chugach National Forest Business Needs: The Chugach Revised Forest Plan calls for monitoring trends of management indicator species in general and trends, habitat relationships, and habitat change for black oystercatchers in particular (USDA Forest Service 2002, pp. 5–10). The Forest has been monitoring black oystercatcher territory locations in Prince William Sound since 1999. Poe et al. (2009) have already identified relationships between black oystercatcher nesting locations and habitat characteristics, including levels of human use along shorelines. Other research has examined the influence of predators, boats, and tide surge. The objective, and focus of this protocol, is to define the approach to monitor trends in black oystercatcher abundance within Prince William Sound.

**D. Category:** Effectiveness.

**E. Protocol Status, Source, and Re-evaluation Schedule**: We propose working with potential cooperators to refine this proposal in 2011 and implementing in 2012. This protocol will be reevaluated following 5 years of field data collection; it may be updated at that time (or earlier if necessary) based on an assessment of efficacy. Given the objectives of this monitoring effort, a field test is unnecessary as the field evaluation methods proposed have been successfully implemented in Prince William Sound during prior inventory work (e.g., Andres and Poe 2001 and Meyers 2002) as well as an integrated assessment applied at focal areas across the species' range.

**F. Objective Statement:** We aim to monitor population trends of black oystercatchers within Prince William Sound by monitoring density of oystercatchers along sample shorelines. If a consistent, downward trend of 2 percent annually is noted over any period of 6 years or longer, a secondary evaluation will be initiated to examine potential management- or habitat-related factors (along with other drivers) that may be contributing to the pattern. For the purposes of this monitoring effort, trends in density of oystercatchers (number per km shoreline) and density of territories (number per km shoreline) will act as indices of population trend. This target for identifying problematic population decline may be modified as understanding of the species improves.

Habitat associations and relationships with potential human disturbance in Prince William Sound have been analyzed by Poe et al. (2009). These relationships will be periodically re-examined if oystercatcher declines are observed. Current efforts under the Prince William Sound Framework are revaluating patterns and intensities of human use throughout the region. This comprehensive evaluation of human activity is intended to result in recommendations for long-term monitoring of human use in Prince William Sound.

**[F-1] Required by Law:** The proposed monitoring scheme for black oystercatchers is designed to meet the intent of the 1982 Forest Planning Rule for National Forests to monitor the trends in their management indicator species populations and determine the relationship to habitat change (36 CFR 219 (19)(6)).

The black oystercatcher is a management indicator species, and the Chugach Forest Plan (5-8) calls for monitoring trends of management indicator species in general and trends, habitat relationships, and habitat change for black oystercatchers in particular (5-10) (USDA Forest Service 2002). The black oystercatcher was named a regional forester's sensitive species in the Alaska Region during the 2008 revision. Sensitive species are delineated in the Forest Service Manual 2670 based on significant current or predicted downward trends in population numbers or density or significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution. The black oystercatcher was identified as a sensitive species because nest location data indicate extensive overlap between nest territories and remote shoreline campsites, because populations in some areas have dramatically declined due to unknown causes (from 48 pairs (1940) to 2 pairs (1985), and rebounding to 10 pair (2006) in Sitka Sound, southeast Alaska), and because there is high overlap between nest sites and areas permitted for recreational use (e.g., Prince William Sound).

The Organic Administration Act, the Multiple-Use/Sustained-Yield Act, the National Forest Management Act, the Sikes Act, and USDA and Forest Service policy and agreements recognize the shared responsibilities between the Forest Service and Alaska wildlife agencies in managing fish and wildlife resources on Federal lands. These and other laws acknowledge the Forest Service's role in affecting population numbers, diversity, and species viability through the management of habitat. The Alaska National Interest Lands Conservation Act (ANILCA) provides for the maintenance of sound populations of, and habitat for, wildlife species of value to the citizens of Alaska and the Nation.

All National Forest System Land is managed under the Federal Land Policy and Management Act of October 21, 1976, stating that "lands be managed in a manner that will protect the quality of scientific, scenic, historical ecological…..values. Protect certain public lands in their natural condition; that will provide food and habitat for fish and wildlife." Fish and Wildlife Conservation Act of September 15, 1960, requires the Forest Service to plan, develop, maintain, and coordinate programs for conservation and rehabilitation of wildlife, fish, and game on public lands under their jurisdiction.

**[F-2] Statistical Rigor:** The statistical rigor of the survey protocol and analysis methods described below is considered “moderately high” based on the sampling design, sampling intensity, and field methods proposed. This level of rigor is necessary to accurately estimate the density of oystercatcher nesting territories and to monitor trends.

**[F-3] Data Precision, Reliability:** *Class A* based on sampling design, sampling intensity, and field methods: [Class A data are defined as: These methods are generally well accepted for modeling or measuring the resource. The methods produce repeatable results and are considered statistically rigorous. Reliability, precision, and accuracy are very good. The cost of conducting these measurements is higher than other methods. These methods are often quantitative in nature.]

**[F-4] Confidence:** Population trends for the density of nesting territories will be evaluated at a temporal scale of 6 years or more with $\alpha = 0.20$.

**[F-5] Change Detection:** There is insufficient data at this time to rigorously evaluate the power of the monitoring protocol and analysis method to detect changes in the density of nesting territories in Prince William Sound. However, based on a similar design, power was evaluated using data from Prince William Sound prior to 2007 using the program MONITOR (Gibbs 1995). Results suggested power to detect a 10-percent decline over 10 years would exceed 80 percent. Because of differences in sampling design, the power of the current proposal is unclear. However, given the sample sizes (i.e., number of bays and total length of shoreline) and proposed analysis methods, statistical power is expected to be sufficient. The target is to be able to detect a 2-percent decline per year, over a period of 10 years, with a statistical power greater than 80 percent. Evaluation will be more frequent, however, and a consistent decline at a 2-percent annual rate will motivate discussion with partners at any 6-year evaluation period.

**[F-6] Threshold:** Population trends will be analyzed for changes in density. A detected 2-percent annual decrease in density of nesting territories measured over a period of 6 years or longer will trigger notification of the forest leadership team and the USFWS Migratory Bird Management Nongame Branch in Anchorage. A detected 25-percent decrease in the density of nesting territories estimated for any temporal period in a single region (east or west Prince William Sound) will trigger notification of the lead wildlife biologists and district rangers for the Prince William Sound Zone as well as Forest and regional wildlife biologists, who will collectively develop a plan to evaluate the cause of decline.

**[F-7] Scope of Inference:** The breeding population of black oystercatchers on the Chugach National Forest in Prince William Sound. A trend analysis will be conducted every 6 years beginning in 2018 for the duration of the monitoring program (2018 is chosen for the first evaluation because of the nature of the panel design). Data from other agencies (e.g., National Park Service, USFWS) from neighboring waters will be used as context to aid in interpreting results.

**G. Indicator and its Units of Measure:** The density of occupied territories or density of occupied sites from sample sites along shoreline habitats on Chugach National Forest in

Prince William Sound. Territories are defined as shoreline occupied by a pair of adults engaged in laying or incubation of eggs, brooding of chicks, or behaviors such as courting, nest-building, or copulation from May to July (Poe et al. 2009).

**H. Sampling Design:** We use a stratified random sample within the framework of a split-panel rotating design (McDonald 2003). A single strata is used—a geographic strata including two groups—eastern and western Prince William Sound. Sample selection is indirectly weighted toward suitable habitat by selecting sites from a pool of over 400 previously located oystercatcher observations from an inventory of the Sound. A split-panel design is used to provide a balance between emphasis of temporal and geographic dispersion of samples. A split-panel rotating design has the advantage of allowing more shorelines to be visited during the life of the monitoring program while maintaining a strong time series on some sites.

**[H-1] Target Population:** The target population for monitoring is the nesting black oystercatcher population within that portion of Prince William Sound managed by the Chugach National Forest. The focal season is the last week of May and first two weeks of June, at which time detection of nesting territories is assumed to be at a maximum (Andres 1998).

**[H-2] Sampling Frame:** A pool of transects, 20 km in length, will be identified from Prince William Sound for sample unit selection. The pool of transects will be formed by designating a potential transect centered on each, previously identified, oystercatcher territory from Forest inventories of Prince William Sound (n is approximately 400). As of June 2007, surveys had been completed for essentially the entire Prince William Sound shoreline on the Chugach National Forest (hence, all shoreline across the Sound was ‘available’ within the sampling frame). The resulting transects will contain at least one black oystercatcher territory, and based on surveys from Prince William Sound, likely one to seven territories per transect (USFS unpublished data). Based on the rationale of adaptive sampling (Thompson and Seber 1996), a small number of transects which do not include at least 20 km of shoreline may be dropped from the sample set if selected through the process (all transects will be required to include at least 20 km of shoreline). Similarly, small islet groups (less than 1 km in total circumference) associated with shoreline paralleled by transects will also be included in the survey.

**[H-3] Sample Selection Methods:** We will randomly select 30 transects using a stratified random design linked to existing oystercatcher locations (see previous paragraph). Half of the transects will be located in the eastern and half in the western half of the Sound (geographic strata to assure dispersion). Within each half, a simple random sample will be drawn from existing point locations of black oystercatcher observations. Once a point is selected, all other sightings within 10 km on either side will be eliminated from the pool and additional sites chosen until 15 sites are chosen from each geographic strata. The effect of this approach will be a weighted sample emphasizing quality habitat and avoiding non habitat. These samples will represent the locations for the “Chugach Panel,” the “Partner Panel,” and “New” panel (see Table Q17-1).

Unless identified through the random sampling described immediately above, shoreline segments in Harriman Fjord, Green Island, and the Dutch Group will be

added to the random-sampled locations described in the previous paragraph to define the samples that will be visited more frequently (see panel illustration Table Q17-1). Earlier plans included the west side of Montague Island. However, because this survey must be done by foot, rather than skiff, it will not be included because of the potential differences in detection probabilities. The broad approach of including these three areas is based on suggestions of several biologists as a way to assure that high-quality habitat is included in a portion of the sample. In addition, one other transect will be “randomly chosen” from the east and two from the western geographic strata to add to the high-frequency panel (see Table Q17-1).

**[H-4] Consequences of Sampling Scheme:** An ideal stratified sample based on two stratification criteria (geography and abundance), would classify the entire sampling frame based on these strata and then draw a sample from the resulting pool. Our geographic stratum is well defined. However, our “habitat quality” stratum is not explicit. Instead, habitat quality is implicitly incorporated through the outcome of 6 years of inventory in the Sound and the resulting location of oystercatcher sightings. Portions of the Sound with extensive, quality habitat have numerous oystercatcher observations and thus, a higher probability of being sampled (which is appropriate for a strata based on habitat quality). Therefore, our approach represents a strong surrogate for a strict classification of this stratum (e.g., habitat modeling based on the sample resulting in classification of habitat quality by shoreline type). Given that the sampling scheme is not currently designed to estimate abundance across the Sound, it is not necessary to link the sample design directly to a habitat classification. Therefore, the scheme represents a suitable approach to drawing a sample to examine trend in abundance.

Careful examination of the sampling scheme illustrated in Table Q17-1 shows that surveys for oystercatchers will take place every year. In an ideal design with fewer limits on resources, the top six sample sites would be visited every year to establish a strong time series for trend analysis. However, our design expands the spacing of samples from a more ideal design by reducing the sampling effort by 50 percent each year. (We considered simply taking an existing panel design and sampling every other year.) The consequence of this change is a 50-percent reduction in the temporal sampling that would occur with the initial (complete) split-panel design. We justify this change based on the long-lived nature of oystercatchers and their strong site tenacity.

**[H-5] Sample Unit Description:** Detected black oystercatcher nesting territories will be recorded on sampled shoreline segments. Shoreline segments will be identified using the Environmental Sensitivity Index, further categorized as described in Table Q17-2. It is expected that categorizations will be based on ShoreZone data at some point.

**[H-6] Detection and Observer Bias Controls:** Potential biases that influence probability of detection include variation in observer ability, ability of survey crews to access the shoreline, and weather and habitat characteristics. To minimize potential biases based on observer ability, all observers will receive formal training in identifying occupied oystercatcher nesting territories, use of a global

positioning system (GPS), and recording data on the field data forms. In addition, seasoned observers experienced with oystercatcher surveys and this protocol will be partnered with less experienced observers, if present, and the observers on the two teams will be shuffled, as much as possible.

Survey teams will attempt to eliminate bias due to differences in abilities to access the shoreline by conducting surveys in shallow water areas within 2 hours of high tide, which will allow the survey vessel to approach close to shore (10 to 15 meters).

Probability of detection will be evaluated during the next decade, depending on the availability of partner field crews or extra survey time during any particular sample year. If necessary for the particular analytical model employed, the statistical analysis methods will correct for occupied territories that are not detected during the survey period. Correction will be based on existing information on detection probability (and new data collected during the course of the monitoring period). In addition, time of day, weather conditions, and habitat characteristics (Environmental Sensitivity Index (ESI) classification based on Table Q17-2; later based on ShoreZone: http://www.fakr.noaa.gov/habitat/shorezone/factsheet.pdf) of each shoreline segment will be recorded during the survey, regardless of territory occupancy. If necessary, as additional data becomes available, this information can be included in the statistical analysis to adjust for probability of detection and reduce associated biases. If variation in detection probabilities is not demonstrated, then detection rates will be eliminated from trend analysis (as it will not influence the outcome of estimates).

**[H-7] Sample Size Estimate and Estimation Methods:** A total of 28 unique sample units will be visited during 5 years of implementing the rotating panel. In any individual year, however, only eight or nine sample units will be visited (note the ”new” site sampled each year).

**[H-8] Temporal Details of Sampling:** Shoreline surveys will be conducted every year between the last week of May and the first two weeks of June, and prior to or at least 5 days following, the season’s highest tide. This survey interval was selected to coincide with the peak of the breeding season AND to avoid a period of territorial ambiguity immediately after the most likely flooding event of high tide. The season’s highest tide can flood nests and result in occupied nesting territories being harder to detect. It is expected that two weeks will be required to complete the survey each year.

The panel-rotation design developed for this monitoring allows for every-other year visits to historically important survey regions that have been identified as having relatively high densities of occupied territories. It also provides for samples from a large total number (approximately 17) of sample units, and a single new random unit, through the panel rotation.

**I. Data Collection:**

**[I-1] Methods for Locating Sample Units:** Observers will navigate on watercraft to sampled shoreline segments using GPS and nautical charts.

**[I-2] Methods for Layout and Marking:** Shoreline segments will be identified based on ShoreZone coastal habitat mapping using a Geographic Information System (GIS). Start and end points for sampled shoreline segments will be identified using GPS coordinates. These coordinates will be provided to survey personnel. In addition, survey maps identifying the sampled shoreline segments will be provided to each crew. Start and end points for surveys will be recorded in a GPS in the field, to account for any accidental or purposeful changes in the lengths of shorelines surveyed. The location of all known black oystercatcher territories will be marked on the map so observers are aware of the locations in future surveys.

**[I-3] Field Sampling Methods:** Surveys will be conducted by one or two teams of two observers each from small skiffs traveling less than 5 knots, 10 to 15 meters from shoreline. Surveys will be conducted during **medium to high** tidal stages except if this presents a safety concern. Furthermore, for those shoreline types where tide has little influence on territorial behavior, crews may exercise flexibility in sample timing.

Observers will scan all shoreline, attempting to locate all black oystercatchers. GPS locations of all observations will be recorded, along with the size of the oystercatcher group, names of each crew, survey conditions, and whether the oystercatchers are considered to be part of a “breeding pair.” A breeding pair is defined as a pair of adults engaged in laying or incubation of eggs, brooding of chicks, or behaviors such as courting, nest-building, copulation, or acting territorial.

When safe to do so, and necessary for verification, the skiff will be brought to shore at the nearest convenient location so that at least one observer can walk the shoreline where oystercatchers were first observed to verify whether a territorial pair has been identified. This is only necessary when territorial occupancy is in doubt. If a second oystercatcher is detected above the high tide line, search efforts will be focused where that individual was first detected, keeping in mind that it may have moved several meters prior to detection. In the absence of the above clues to nest location, observers will search the beach above the high-tide line to locate the nest. To avoid prolonged potential disturbance of nesting territories, observers will limit total time spend searching for nests and chicks to less than 10 minutes.

All oystercatcher locations will be marked on an aerial photograph or USGS quad 1:63,560 and the GPS location recorded. Unique sighting numbers will be assigned for all detections and a matching record will be created in the GPS. The category of general shoreline type according to definitions within the Environmental Sensitivity Index layer defined for Prince William Sound (NOAA 2000), later ShoreZone, will also be recorded. The number of eggs or chicks, date, and time will also be recorded (although it is recognized that this information is virtually anecdotal and doesn’t represent a good estimate of reproductive parameters). The breeding status will be assigned as follows: Non-breeder(s): individual or groups of birds whose behavior is not indicative of a breeding pair; or territorial pair: chicks or eggs are present, or practice scrapes

are found, or a pair of birds are present and their behavior includes territorial displays (head bobbing, chasing of intruders, territorial calls).

To estimate probability of detection, coordinated surveys will be organized with partner agencies with the goal of verifying detection rates. The schedule and sample size will depend on partner agency participation. During surveys designed to evaluate detection rates, each shoreline segment will be surveyed by two independent teams within 28 hours. During this double-sampling, the two teams must operate independently and thus not discuss locations or numbers of observed nesting territories until the survey is complete. If possible, survey teams will not be informed that they are conducting a “detection rate” survey. This should be possible because partner agencies will also be conducting surveys of transects not involved in double sampling.

Data collected for every shoreline segment surveyed will include: shoreline ID, names of observers, date, start and stop time, weather conditions, and the numbers of unique oystercatchers and unique territories or breeding pairs observed. Incidental, but pertinent information on the number of nests, eggs, predators, proximal campers, etc. will also be recorded. The type of each shoreline segment, along with the number of hours since the day’s high tide will be included in the survey data back in the office prior to analysis.

During surveys, observations of birds other than oystercatchers will not be recorded, nor should survey crews focus on species other than oystercatchers with one exception—Colonies of puffins, auklets, cormorants, and other colonial nesting birds will be recorded. Otherwise, to motivate consistent, high detection rates, focus will be entirely on observing oystercatchers.

**J. Quality Control and Assurance:** Standardized datasheets (Attachment Q17-1) will be used during all data-collection efforts. Field teams will be trained and tested each survey year. Mechanical controls associated with data entry into a standardized database will also minimize errors in transcription and during analysis.

**K. Data Form:** The field data form is provided in Attachment Q17-1.

**L. Data Storage:** Data will be stored in the USFS corporate Natural Resource Information Systems (NRIS) WILDLIFE database.

**M. Data Analysis:**

**I. Partner Participation:**

More effective monitoring of black oystercatchers will be possible if partner agencies assist with field sampling and data analysis. This protocol is designed to stand alone. However, increased sampling through field collaboration and coordinated analysis through integrated analysis will substantially improve precision and interpretation of results.

Analysis of trend can range from graphical approaches to sophisticated modeling. Approaches to analysis of the oystercatcher time series will depend on the complexity of the data obtained through field sampling. In any case,

assistance from partner agencies or academic collaborators will be sought to assist with data analysis.

Data analysis approaches will depend, in part, on the ability of the Chugach National Forest to attract partners to collaborate and assist by conducting double sampling. In the absence of significant double sampling, the analytical model used may differ significantly from that described below. Regardless, exploratory data analysis will be used to understand basic patterns in the time series within and across sample sites. Depending upon characteristics of data identified in the exploratory analysis, analytical models will vary in sophistication. See the following section on double sampling as an example.

**II. Example if binomial-Poisson Mixture Model is used**

**Double-sampling:** After 5 years, if sufficient double sampling has been conducted, the binomial-Poisson mixture model described by Royle (2004) and Royle and Dorazio (2008; pp. 274–283) will be used to estimate probability of detection and densities of oystercatcher nesting territories. Modeling will include consideration of covariates that may influence probability of detection (e.g., tidal stage, ShoreZone classification, weather conditions, date) and/or be related to oystercatcher densities (e.g., ShoreZone classification, etc.). An information theoretic approach such as Akaike's information criterion (Burnham and Anderson 2002) will be used to select the most parsimonious model. Poe et al. (2009) identified that shorelines of some ESI types (Table Q17-2) were preferentially selected more by nesting oystercatchers. Thus, the binomial-Poisson mixture model will contain a covariate for ESI type as a minimum. A cross-reference to ShoreZone will replace ESI in the future if deemed appropriate. A covariate for ESI type may facilitate estimating the total number of occupied territories in all of Prince William Sound.

The binomial-Poisson mixture model does not require marking individuals as in a capture-recapture study. This model merely requires that shoreline segments are identified, a portion of segments are surveyed more than once in a season, revisits are independent, and the numbers of observed occupied territories be recorded for each shoreline segment. For example, Table Q17-3 contains some example data from the 2009 survey for oystercatchers along the shorelines of Montague and Green Islands and Harriman Fjord. Shoreline segments were determined by ESI (Table Q17-2) or ShoreZone classifications along the survey route. R (R Development Core Team 2009) code to analyze the 2009 survey data is provided in Figure Q17-2.

A computer simulation was developed to look at the performance of the binomial-Poisson mixture model under various densities and probabilities of detection. Royle (2004) presented a similar simulation, but with a much larger number of repeat visits (20 to 50) to each site within a season. The simulation presented here consisted of only 2 repeat visits for a total of 40 shoreline segments of varying lengths. The length of each shoreline segment was drawn from a uniform distribution with a minimum of 2 km and a maximum of 28 km, and so the average total length of shoreline surveyed in each simulation run was 600 km. These lengths were based on the 2009 oystercatcher survey. Two hundred replications of each combination of abundance ($\lambda$ = 0.05, 0.1, 0.2, 0.3 and 0.4

occupied territories per km) and probability of detection (0.4, 0.5, 0.6, 0.7 and 0.8) were used in this simulation.

Results of this simulation (Figure Q17-3) indicate that the binomial-Poisson mixture model can be expected to produce reliable results of oystercatchers' territory densities, provided that at least 40 shoreline segments are surveyed within a year and probability of detection is at least 0.6. Analysis of the 2009 survey, which included double-observer sampling, indicated that probability of detection was closer to 0.7.

**Analysis of Yearly Status:** If, in some years, a sufficient number of sites receive double sampling, the density of occupied territories, along with a 90-percent confidence interval (CI), will be estimated using the binomial-Poisson mixture model. In years when double sampling does not occur, the estimates of probability of detection based on previous surveys involving double sampling can be used to adjust for the number of occupied territories that were missed. For example, since the probability of detection has been estimated as 0.7, the probability of detection parameter in the binomial-Poisson mixture model will be held fixed at that value (e.g., *p* in Figure Q17-2 would be set equal to 0.7).

When an offset term for length of shoreline is included as a covariate, the binomial-Poisson mixture model estimates the rate of occurrence (*λ*), or density of occupied territories per km of shoreline. If indicator variables for four of the five ESI classifications in Table Q17-2 are included as covariates related to density (the fifth ESI type would be the reference level), the total number of oystercatcher territories for Prince William Sound can be estimated using the following formula:

$$Total = L_1\hat{\lambda}_1 + L_2\hat{\lambda}_2 + L_3\hat{\lambda}_3 + L_4\hat{\lambda}_4 + L_5\hat{\lambda}_5$$

where the $L_i$ is the total length of shoreline in Prince William Sound of ESI type *i*, and $\hat{\lambda}$ is the estimated density of occupied territories in ESI type *i*. A 90-percent CI for the total can be calculated by

$$Total \pm SE(Total) \times 1.645$$

where

$$SE(Total) = L_1 SE(\hat{\lambda}_1) + L_2 SE(\hat{\lambda}_2) + L_3 SE(\hat{\lambda}_3) + L_4 SE(\hat{\lambda}_4) + L_5 SE(\hat{\lambda}_5)$$

The total number of occupied territories within a sampled site can be estimated similarly.

Estimating "total oystercatchers" should not be attempted, though, until a thorough evaluation of shoreline classification is completed and the classification of sample shorelines examined carefully. Furthermore, the proposed sampling scheme will require estimation by strata (east and west Prince William Sound) separately.

**Analysis for Trend:** Analysis for trend begins with replacing the Xs in the split-panel rotating design matrix (Table Q17-1) with the estimated densities for each sample site in each year. The overall trend and/or sample site-specific trends can be estimated using a variety of methods, each with their own assumptions,

strengths, and limitations. The type of method we see as most preferable is a hierarchical analysis (Royle and Dorazio 2008) that simultaneously estimates site-specific and overall trends in densities. Although many different formulations and software could be used to estimate the trend components in a hierarchical model, and future advancements are expected throughout the life of the monitoring program, we chose to demonstrate the linear trend analysis of Piepho and Ogutu (2002) because of its generality.

The linear model of Piepho and Ogutu is

$$y_{ij} = \mu + w_j\beta + b_j + a_i + w_j t_i + c_{ij}$$

where $y_{ij}$ is the density estimated for site *í* during sampling occasion *j*, $\mu$ is the mean of responses on all sites over all time periods, $w_j$ is a fixed covariate specifying the sample occasion (e.g., $w_j$ = 1, 2, 3, …, or *wj* = 1996, 1997, 1998, …), $b_j$ is the random effect of the $j^{th}$ year on responses from all units, $a_i$ is the random effect on the intercept of the $i^{th}$ site, $t_i$ is the random effect on the slope of the $i^{th}$ site, and $c_{ij}$ is the random effect of the $i^{th}$ site during the $j^{th}$ occasion. A picture of this model and its effects is given in Figure Q17-4.

Piepho and Ogutu (2002) assumed that all random effects were normally distributed with means of 0 and unknown variances. Depending on the application, spatial or temporal correlation among the random (and fixed) effects in the linear model can be modeled in a variety of ways.

The objective of the analysis is to estimate the fixed overall slope, $\beta$, and assess the strength of evidence that an overall trend exists. To do this, Piepho and Ogutu (2002) propose both an “inter-site” (random site effect) and “intra-site” (fixed site effect) analysis; however, their subsequent simulations showed little practical difference between the two, except that the fixed “intra-site” analysis converged more often. Estimation can be carried out using R (R Development Core Team 2009), or similar programs which use either restricted-maximum-likelihood or maximum-likelihood techniques. Generalized linear mixed models can be used when the normality of responses is in question, although the regular mixed model is known to be reasonably robust to violations of normality.

**N. Assumptions and Limitations:** This monitoring strategy assumes the protocol will be implemented correctly, detection probabilities center on a consistent value. If the analysis described above is used, then we also assume that densities are Poisson distributed, and that probability of detection and densities are modeled correctly using appropriate covariates. The binomial-Poisson mixture model and the double-sampling approach require the additional assumption that a shoreline segment is demographically and geographically closed during the repeated visits (i.e., the number of occupied territories does not change) (Royle 2004).

**O Reporting Frequency:** Each year’s survey efforts will be summarized in a single survey report. Every 5 years a summary report evaluating trends in the density of occupied territories will be completed.

**P. Responsibility:** Forest supervisor’s resources staff officer.

**Q. List of Preparers:**

This protocol has a complex history and a number of biologists have contributed significant ideas over the years. We apologize if acknowledgement of some significant contributions may have been lost over the years. Responsibility for the current version of the protocol rests with Greg Hayward. Significant contributions to the analytical framework were made by Ryan Nielson.

- Martin Bray, Wildlife Biologist, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.
- Michael Goldstein, PhD. Wildlife and Terrestrial Ecology Program Leader, USDA Forest Service, Regional Office, Juneau, Alaska.
- Gregory D. Hayward, Wildlife Ecologist, USDA Forest Service, Chugach National Forest and Alaska Region, Anchorage, Alaska.
- Ryan M. Nielson, Research Biometrician, Western EcoSystems Technology, Inc. 200 S. Second St., Suite B, Laramie, WY, 82070.
- Aaron Poe, Wildlife Biologist, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

David Tessler, Richard Lanctot, and Heather Coletti provided significant input through protocol review. Jason Fode and the Cordova Ranger District provided substantial logistical input.

**R. 10-Year Cost Forecast**: The statistical analysis methods described above are identified as moderately complex, and proper implementation requires input by an experienced biometrician. The Forest will seek help from Forest Service Research or partner agencies in executing this analysis. Expert quantitative help will be particularly important for trend analysis after 5 years. We have not budgeted for these services—collaboration with the intent of publication will be the focus to accomplish the analysis. Furthermore, because of similarities in National Park Service monitoring and the Forest Service protocol, the Forest Service wildlife ecologist, in consultation with the National Park Service analyst, will be in a strong position to complete the analysis.

The annual cost for field work is estimated at around $19,500. This includes cost for use of a Forest Service fleet vessel (at approximately $1,600 per month) (Table Q17-4). Some additional analytical costs may be incurred within the next decade as human use distribution data returned by the Prince William Sound Framework is evaluated relative to the results of trend data.

Total 10-year estimated cost is $223,546 (assuming 3 percent annual inflation). See Table Q17-3 for more details.

| | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| Vessel | $1,600 | $1,648 | $1,697 | $1,748 | $1,801 | $1,855 | $1,910 | $1,968 | $2,027 | $2,088 |
| Salary | $16,200 | $16,686 | $17,187 | $17,702 | $18,233 | $18,780 | $19,344 | $19,924 | $20,522 | $21,137 |
| Misc. | $1,700 | $1,751 | $1,804 | $1,858 | $1,913 | $19,71 | $2,030 | $2,091 | $2,154 | $2,218 |
| **TOTAL** | **$19,500** | **$20,085** | **$20,688** | **$21,308** | **$21,947** | **$22,606** | **$23,284** | **$23,983** | **$24,702** | **$25,443** |

Estimated annual cost: $19,500 (first year – future will increase due to inflation)

Estimated annual cost in Revised Forest Plan (5-10): $8,000

**S. Literature Cited**

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**Table Q17-1. Example of split-panel design modeled after earlier examples but reducing effort by 50 percent**[36]

| Site | Year Visited | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Harriman Fjord | X | | X | | X | | X | | X | | X | |
| Dutch2 | | X | | X | | X | | X | | X | | |
| Green Island | X | | X | | X | | X | | X | | X | |
| Montague Is | | X | | X | | X | | X | | X | | |
| Random 1 | X | | X | | X | | X | | X | | X | |
| Random 2 | | X | | X | | X | | X | | X | | |
| | | | | | | | | | | | | |
| **Chugach Panel** | | | | | | | | | | | | |
| 7 | X | | | | X | | | | X | | | |
| 8 | | | X | | | | X | | | | X | |
| 9 | | X | | | | X | | | | X | | |
| 10 | | | | X | | | | X | | | | |
| 11 | X | | | | X | | | | X | | | |
| 12 | | | X | | | | X | | | | X | |
| 13 | | X | | | | X | | | | X | | |
| 14 | | | | X | | | | X | | | | |
| 15 | X | | | | X | | | | X | | | |
| 16 | | | X | | | | X | | | | X | |
| 17 | | X | | | | X | | | | X | | |
| 18 | | | | X | | | | X | | | | |
| 19 | X | | | | X | | | | X | | | |
| 20 | | | X | | | | X | | | | X | |
| 21 | | X | | | | X | | | | X | | |
| 22 | | | | X | | | | X | | | | |
| 23 | X | | | | X | | | | X | | | |
| | | | | | | | | | | | | |
| **Partner Panel** | | | | | | | | | | | | |
| 24 | | | X | | | | X | | | | X | |
| 25 | | X | | | | X | | | | X | | |
| 26 | | | | X | | | | X | | | | |
| 27 | X | | | | X | | | | X | | | |
| 28 | | | X | | | | X | | | | X | |

[36] Design includes a panel sampled every other year and two additional panels sampled every 4th year in Prince William Sound, Alaska. The last row titled “New” represents sites that will be visited only once. Thus, the New sample transects visited in year 1 will be replaced by a New transect for year 2. Design results in 8 or 9 sites sampled each year by the Chugach National Forest but a geographic extent of 28 sites sampled over course of 5 years. Partner agencies would be encouraged to first survey transects represented in the top panel (e.g., Harriman, Dutch2, etc.), and then additional sites in the ”Partner Panel.”

**Table Q17-1. Example of split-panel design modeled after earlier examples but reducing effort by 50 percent[36]**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29 | | X | | | | X | | | | X | | |
| 30 | | | | X | | | | X | | | | |
| 31 | X | | | | X | | | | X | | | |
| 32 | | | X | | | | X | | | | X | |
| New Chugach. | X | X | X | X | X | X | X | X | X | X | X | |
| Total Chugach Surveys | 9 | 8 | 8 | 8 | 9 | 8 | 8 | 8 | 9 | 8 | 8 | |

**Table Q17-2. Condensed environmental sensitivity index (ESI) types and the total length of shoreline in Prince William Sound, AK. ShoreZone**

| Condensed ESI Type | Total Length (km) |
|---|---|
| Gravel Beach | 3,011 |
| Wavecut Platforms | 471 |
| Sheltered Rocky Shore | 1,108 |
| Exposed Rocky Shore | 570 |
| Salt Marsh and Tideflat | 767 |

**Table Q17-3. Example of data collected during the double-sampling trial survey in Prince William Sound, Alaska (Harriman Fjord, Green, and Montague Islands) in May and June 2009**

| Segment ID | Site | ESI Type | Length (m) | Count | |
|---|---|---|---|---|---|
| | | | | Visit 1 | Visit 2 |
| 1 | GREEN | Gravel Beach | 3630.545184 | 0 | 0 |
| 2 | GREEN | Wavecut Platforms | 589.7911491 | 1 | 1 |
| 3 | GREEN | Gravel Beach | 1941.066413 | 1 | 0 |
| 4 | GREEN | Wavecut Platforms | 666.6102564 | 0 | 0 |
| 5 | GREEN | Gravel Beach | 1257.050628 | 1 | 1 |
| 6 | GREEN | Gravel Beach | 10985.28084 | 1 | 0 |
| 7 | GREEN | Gravel Beach | 563.6380119 | 0 | 0 |
| 52 | HARRIMAN | Gravel Beach | 6081.783474 | 2 | 3 |
| 53 | HARRIMAN | Sheltered Rocky Shore | 319.2517889 | 0 | 0 |
| 54 | HARRIMAN | Gravel Beach | 1604.547567 | 0 | 1 |
| 55 | HARRIMAN | Gravel Beach | 715.6054802 | 1 | 1 |
| 56 | HARRIMAN | Sheltered Rocky Shore | 983.2440276 | 0 | 0 |
| 57 | HARRIMAN | Gravel Beach | 1124.358505 | 2 | 2 |

**Table Q17-3. Example of data collected during the double-sampling trial survey in Prince William Sound, Alaska (Harriman Fjord, Green, and Montague Islands) in May and June 2009**

| | | | | | |
|---|---|---|---|---|---|
| 105 | MONTAGUE | Gravel Beach | 811.3932573 | 1 | 2 |
| 106 | MONTAGUE | Gravel Beach | 8814.122986 | 6 | 3 |
| 107 | MONTAGUE | Gravel Beach | 1449.598067 | 2 | 2 |
| 108 | MONTAGUE | Wavecut Platforms | 367.4371744 | 0 | 1 |
| 109 | MONTAGUE | Gravel Beach | 459.4953161 | 0 | 0 |
| 110 | MONTAGUE | Wavecut Platforms | 319.7518892 | 0 | 0 |
| 111 | MONTAGUE | Gravel Beach | 8814.122986 | 0 | 0 |
| 112 | MONTAGUE | Wavecut Platforms | 576.4889478 | 0 | 0 |
| 113 | MONTAGUE | Gravel Beach | 2209.031268 | 3 | 3 |
| 114 | MONTAGUE | Gravel Beach | 5654.146767 | 6 | 4 |
| 115 | MONTAGUE | Wavecut Platforms | 1575.055631 | 0 | 2 |

**Table Q17-4. Estimate yearly costs for surveying Black Oystercatchers in Prince William Sound, Alaska, along with statistical analysis.**

| FY | Vessel | Salary | Miscellaneous | Yearly Analysis | Trend Analysis | Total |
|---|---|---|---|---|---|---|
| 2012 | $1,600 | $16,200 | $1,700 | Forest WL Ecologist | | $19,500 |
| 2013 | Adjust | 3 percent | inflation | Forest WL Ecologist | | $20,085 |
| 2014 | | | | Forest WL Ecologist | | $20,688 |
| 2015 | | | | Forest WL Ecologist | | $21,308 |
| 2016 | | | | Forest WL Ecologist | | $21,947 |
| 2017 | | | | Forest WL Ecologist | Collaboration | $22,606 |
| 2018 | | | | Forest WL Ecologist | | $23,284 |
| 2019 | | | | Forest WL Ecologist | | $23,983 |
| 2020 | | | | Forest WL Ecologist | | $24,702 |
| 2021 | | | | Forest WL Ecologist | | $25,443 |

**Figure Q17-1. A banded black oystercatcher observed in Prince William Sound, Alaska, observed during the 2009 survey. Birds were banded previously for a different study.**

```
Nmix.MLE = function(counts, lengths, type1, type2) {
  expit = function(x){ 1/(1 + exp(-x)) }
  logit = function(x){ log(x/(1-x)) }
  logLike = function(counts, nrepls, lambda, p, NinftyMaximum=5000) { #LogLike
    nsites = length(nrepls); logLike = rep(NA, nsites)
    for (i in 1:nsites) {
      y = counts[i, 1:nrepls[i]]; Nmin = max(y)
      # compute normalizing constant for Poisson
      Ninfty = Nmin deltaNinfty = 1; denom = 0
      while (abs(1-denom)>=0.001 & Ninfty<NinftyMaximum) {
        Ninfty = Ninfty + deltaNinfty; supportOfN = 0:Ninfty
        denom = sum(exp(dpois(supportOfN, lambda=lambda[i], log=TRUE)))
      }
      siteSum = 0   # compute marginal likelihood for site
      if (Nmin==0) {
        siteSum = siteSum + exp(-lambda[i]) ; Nmin=1
      }
      N = Nmin:Ninfty ; logSum = dpois(N, lambda=lambda[i], log=TRUE)
      for (j in 1:nrepls[i]) {
        logSum = logSum + dbinom(y[j], size=N, prob=p[i], log=TRUE)
      }
      siteSum = siteSum + sum(exp(logSum)) ; logLike[i] = log(siteSum)
   }
   sum(logLike)
  }
  negLL = function(param) { # define negative log likeihood function
    pVec = rep(expit(param[1]), nsites)
    lambdaVec = exp(param[2]+log(lengths)+param[3]*type1+param[4]*type2)
    (-1)*logLike(counts, nrepls, lambdaVec, pVec)
  }
  nsites = dim(counts)[1] ; nrepls = rep(0, nsites)
  for(i in 1:nsites){ nrepls[i] = sum(!is.na(counts[i,])) }
  yMax = rep(NA, nsites)
  for (i in 1:nsites) { yMax[i] = max(counts[i, 1:nrepls[i]], na.rm=TRUE)/lengths[i] }
  pGuess = 0.5 ; lambdaGuess = mean(yMax)/pGuess
  fit = optim(par=c(logit(pGuess), log(lambdaGuess), 0.5, 0.5), fn=negLL, method='BFGS')
  if(fit$convergence == 0){
    pdetect = expit(fit$par[1]) ; lambda.1 = exp(fit$par[2]) ; lambda.2 = exp(fit$par[2] + fit$par[3])
    lambda.3 = exp(fit$par[2] + fit$par[4])
    fit = list(logLikelihood=-fit$value, pdetect = pdetect, lambda.other = lambda.1,
          lambda.gravel.beach = lambda.2, lambda.sheltered.rocky.shore = lambda.3 )
    return(fit)
  }
}
bloy = read.csv("bloy_2009_example.csv", header=T, as.is=T)
type1 = type2 = rep(0, nrow(bloy))
type1[bloy$shoretype == "Gravel Beach"] = 1; type2[bloy$shoretype == "Sheltered Rocky Shore"] = 1
Nmix.MLE(counts = matrix(c(bloy$visit1, bloy$visit2), nrow=nrow(bloy), ncol=2, byrow=FALSE),
  lengths = bloy$length/1000, type1=type1, type2=type2)
```

**Figure Q17-2. R code to fit the binomial-Poisson mixture model to the 2009 black oystercatcher survey data from Prince William Sound, Alaska [37]**

[37] Uses ESI types (Table Q17-2) as predictor variables for density, and an offset term for length of shoreline segment. The input data file "bloy_2009_example.csv" is on file at Chugach National Forest.

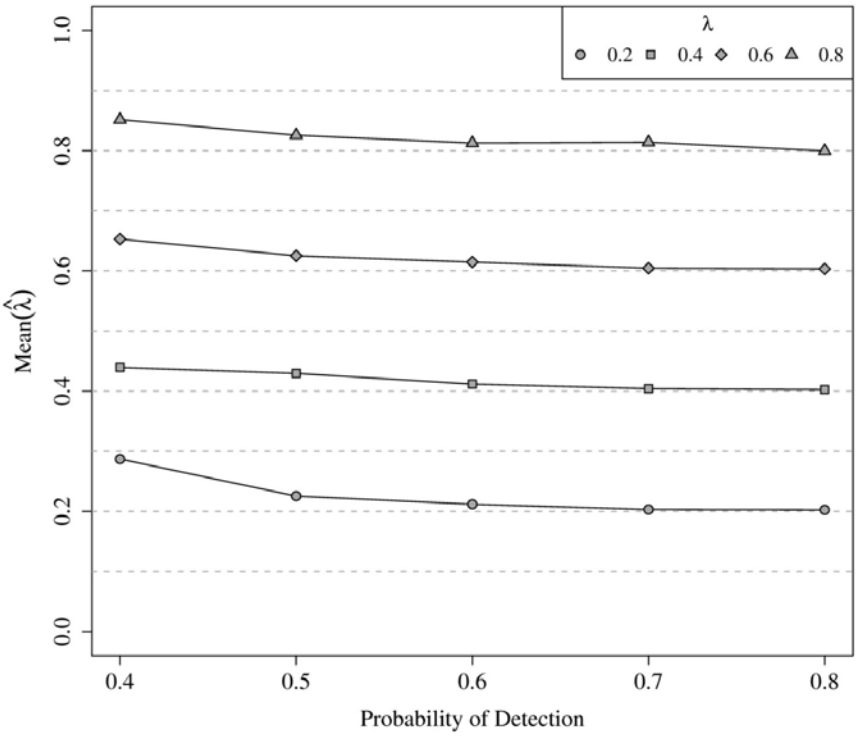



**Figure Q17-3. Simulation results for the binomial-Poisson mixture model, based on two revisits to 40 black oystercatcher nest sites in Prince William Sound, Alaska, in May and June 2009**

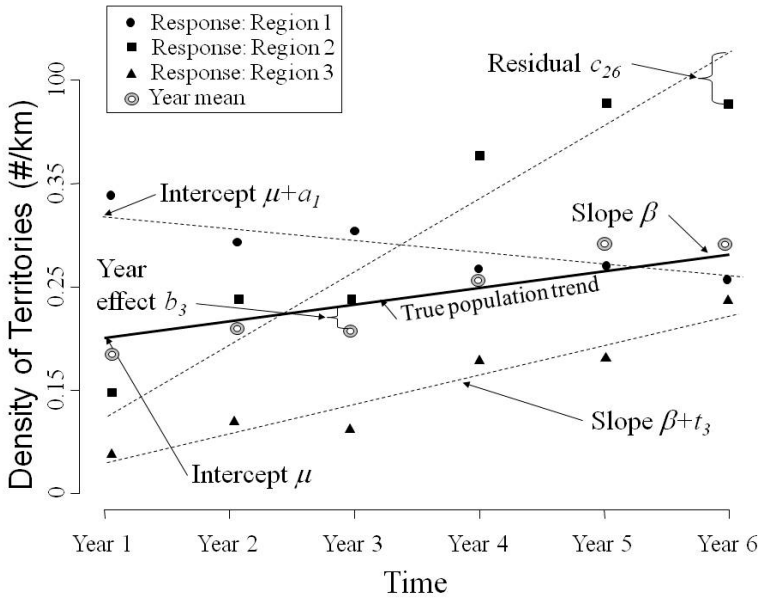
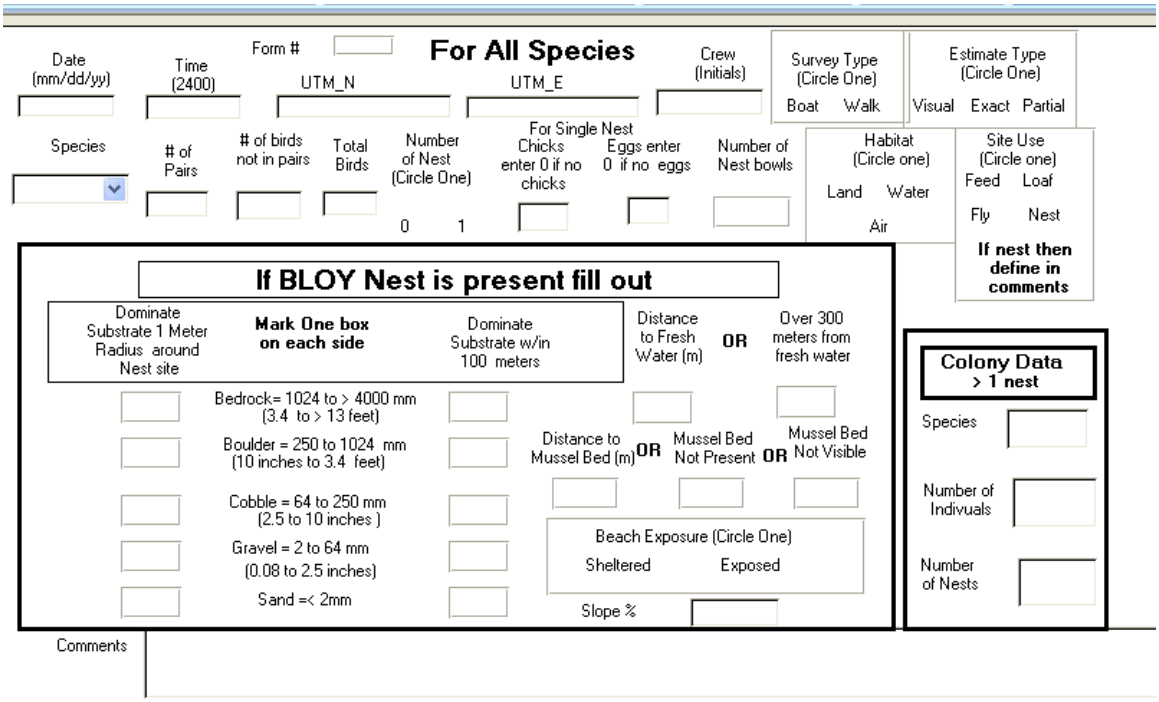



**Figure Q17-4. Pictorial representation of the mixed linear model proposed by Piepho and Ogutu (2002) to detect trends[38]**

[38] Random effects are $a_i$ (unit intercept) $b_j$ (year), $c_{ij}$ (residual), and $t_i$ (unit slope). Fixed effects are μ and β. As proposed, trend is detected if $\beta \neq 0$. Lines are "eyeballed" estimates for illustration only.

## *Attachment Q17-1. Field data form for recording black oystercatcher observations*

Only the colony and oystercatcher portions of form will be used. Furthermore, field crews will be trained to place all focus on oystercatchers and secondarily on colonies. They will avoid recording, or focusing upon, other species.



# *Species of Special Interest*

## *21. What are the population trends for Kenai wolverines and the relationship to habitat change?*

**A. Monitoring Item: *Kenai Wolverine Population Trends***.

**B. General Monitoring Question**: Forest plan Table 5-1 Is Forest management maintaining favorable conditions for sustaining Kenai wolverines? MEIT questions: What are the population trends for Kenai wolverines and the relationship to habitat change? Explicit management question: Are the effects of management (heli-skiing) as predicted (no significant impact) for wolverines? Monitoring protocol question: What is the abundance and trend of the wolverine population in Chugach National Forest (primarily in upper Turnagain Arm and the Kenai Mountains, with special emphasis in areas used for heli-skiing?

**C. Business Need and Rationale:** The wolverine (*Gulo gulo*) is considered a wilderness species and potential indicator of ecosystem health (Carroll et al. 2001). Wolverines have low reproductive potential and usually occur at low densities relative to other furbearer species (Copeland and Whitman 2003), and they also have relatively low survival rates (Krebs et al. 2004). Because of their life history strategies, wolverines are sensitive to harvest and human disturbance. In addition, the extent and availability of refugia from harvest could be a key factor in maintaining a sustainable yield. Therefore, it is important to have timely and reliable data on population abundance, distribution, availability of refugia, and harvest levels and patterns to manage wolverines adequately.

The Alaska Department of Fish and Game (ADF&G) manages and monitors wolverine numbers to maintain harvestable populations. On the Kenai Peninsula, wolverines are harvested through regulated hunting and trapping. However, annual harvest levels on the Kenai Peninsula have averaged only 20 wolverines between 1984 and 2007 and 22 from 1971 to 2007, with a high proportion of the Kenai Peninsula having no harvest. The trend in the proportion of area without harvest has been very stable at 73 to 96 percent (Golden et al. 2007a).

Wolverines seem to be most associated with the hills and mountains of the Kenai Peninsula (Magoun 1996). The Chugach National Forest encompasses much of this habitat. The Chugach National Forest manages winter recreation activities, using a multiple-use framework that permits a diversity of recreational use, providing these activities do no long-term harm to wildlife or vegetation. Monitoring by Chugach National Forest indicates that winter recreation activities are rising. For helicopter skiing (heli-skiing), Chugach Powder Guides has 400 exploratory and 1,800 “priority days” or person days. Five people on a 5-day trip use 25 priority days. This generates the potential for approximately 1,800 helicopter skiers per year using the backcountry via Chugach Powder Guides. Between 2006 and 2008, Chugach Powder Guides logged an annual average of approximately 1,000 user days under their permit. This use level represents 55 percent of their annual allocation, which is similar to other permitted activities on the forest, and these activities appear to be increasing.

Krebs et al. (2007) found that female wolverine habitat use during the winter in British Columbia was negatively associated with heli-skiing areas. However, this may have

been due to confounding variables associated with the analysis. They recommended obtaining additional data to assess adequately whether there are any significant impacts to wolverines from heli-skiing activities. The purpose of the proposed monitoring protocol for Chugach National Forest is to obtain additional data that will assist with future analysis.

In March 2004, a population estimate was conducted in a 4,340-$km^2$ area in Turnagain Arm and the Kenai Mountains using the sample unit probability estimator (SUPE) technique (Becker et al. 2004). This survey resulted in a population estimate of 13 (11–15) wolverines for a density of 3.0 (2.5–3.4) wolverines per 1,000 $km^2$ and a coefficient of variation of 12 percent (Golden et al. 2007b). This density estimate was somewhat lower than earlier density estimates of 4.7 to 5.2 wolverines per 1,000 $km^2$ reported for other areas of south-central Alaska (Becker 1991 and Becker and Gardner 1992).

Simulation results indicated a higher sampling effort was needed for wolverine SUPEs than the sampling fraction of 51 percent of available sample units used in Turnagain Arm and the Kenai Mountains in 2004 (Golden et al. 2007b). A subsequent wolverine survey during April 2008 in Game Management Unit 14C in the Chugach Mountains, which is adjacent to the north and west of Turnagain Arm and the Kenai Mountains, used an overall sampling fraction of 65 percent. It resulted in a density estimate of 4.9 wolverines per 1,000 $km^2$ with a relatively low coefficient of variance of 8.9 percent (Becker and Golden 2008).

At this time, the monitoring questions for this protocol can best be answered (considering cost efficiency, feasibility, and scientific methods) by using the SUPE aerial survey technique. This technique uses probability sampling and provides a scientifically robust population estimate. The goal of this project is to provide a protocol for monitoring wolverine abundance in the Chugach National Forest, primarily in upper Turnagain Arm and the Kenai Mountains and with special emphasis in areas used for helicopter skiing. This information should provide Chugach National Forest with better information on wolverine populations and trends within the forest management area.

**D. Category:** Effectiveness

**E. Protocol Status, Source, and Re-evaluation Schedule:** This will be the final protocol. The methodology will be the SUPE, which uses network sampling of tracks in snow in a stratified random system of quadrats or sample units (Becker et al. 1998, Becker et al. 2004, Golden et al. 2007b). The source of the data will be aerially based track surveys, using 3 to 5 fixed-wing pilot-observer teams, conducted every 2 to 5 years during winter, primarily late January through early April.

**F. Objective Statement**: Estimate wolverine abundance and trend within Chugach National Forest. Compare wolverine abundance within and outside areas used for helicopter skiing.

> **[F-1] Required by Law**: The 1982 Planning Rule directs national forests to monitor trends in management indicator species populations and determine the relationship to habitat change (36 CFR 219 (19)(6)). Further, the National Forest Management Act of 1976 requires that National Forest System lands be managed for a variety of uses on a sustained basis to ensure in perpetuity a continued supply of goods and services to the American people.

**[F-2] Statistical Rigor Rationale**: The statistical rigor is high to ensure a high level of precision and confidence in the generated estimates. Quadrats in the areas outside the heli-skiing areas will be stratified into high and medium-low strata. Data will be gathered through stratified-random sampling with sampling fractions of 65 to 70 percent of the high stratum and 45 to 50 percent of the medium-low stratum, for an overall sampling fraction of 65 percent. Quadrats within the heli-skiing areas will be sampled at 100 percent due to the limited size of the survey area.

**[F-3] Data Precision, Reliability:** Class A

**[F-4] Confidence:** *H1 = Wolverine population abundance does not differ over time*. Wolverine abundance will be estimated in the areas outside the heli-skiing areas confidence intervals of 80 percent and 90 percent. *H2 = Wolverine abundance does not differ between areas used for helicopter skiing and adjacent areas in which no helicopter skiing occur.* Differences in wolverine abundance over time will be tested at $\alpha = 0.05$ level of significance.

**[F-5] Change Detection:** Population estimates (± standard error (SE)) will be generated with confidence intervals (CI) at the 80 and 90 percent levels, which are considered reasonable levels of precision for wolverine population estimates (Becker et al. 2004, Golden et al. 2007b). Desired precision for the estimates should result in coefficients of variation of less than 10 percent.

**[F-6] Threshold**: Consistent changes in wolverine abundance of greater than 30 percent for more than two consecutive sampling periods will be examined carefully to determine if there may be problems with survey procedures or if any management action is required.

**[F-7] Scope of Inference:** The preferred spatial scale for monitoring wolverine abundance will be the entire heli-skiing area and the survey area outside it. The precision of the estimates is highest with a large sample of wolverines and diminishes as the survey area is reduced. A minimum of three and preferably five consecutive sampling periods should be conducted to evaluate population trend.

**G. Indicator and its Units of Measure:** The primary units of measure are wolverine tracks deposited in fresh snow. Secondary units of measure are the total number of individual wolverines observed to have made the tracks, because more than one animal may travel in the same track trail. The population estimate and variance depend upon the number of sample units per strata they travel through and the inclusion probability that animal groups are observed.

**H. Sampling Design:** The recommended procedures for conducting a SUPE follow Becker et al. 2004 and Golden 2007).

**[H-1] Target Population**: The target will be wolverine tracks that occur within the boundaries of the survey area.

**[H-2] Sampling Frame:** A network of systematically spaced quadrats is established within the survey area (Figure Q21-1). The network should be a

single contiguous area. Quadrats, or sample units, are labeled with an alphanumeric code for identification.

**[H-3] Sampling Selection Methods:** Past knowledge of abundance, habitat use, harvest patterns, and distribution of wolverines and their prey are used to stratify sample units according to their relative likelihood of containing wolverine tracks. The purpose of the stratification is to allow proportionately more sampling effort in higher strata and less effort in lower strata, thereby improving the precision of the estimate. Each area will be divided into high and medium-low strata, and a simple random sample without replacement will be used to select sample units to survey.

**[H-4] Sample Unit Description:** Sample units are approximately 25 $km^2$ in size and based on a 3-minute latitude by 5-minute longitude grid.

**[H-5] Detection and Observer Bias Controls:** Experience in identifying and following wolverine tracks from the air varies among pilot-observer teams, but it is essential that at least one of the team members is skilled at these tasks. Care must be taken to ensure that snow conditions (i.e., depth, freshness, and hardness), available lighting, wind conditions, and forest canopy cover are suitable for accurately observing and following tracks.

**[H-6] Sample Size Estimate and Estimation Methods:** Sampling fractions for wolverine SUPE surveys should be 65 to 70 percent of sample units in high strata and 45 to 50 percent in medium-low strata.

**[H-7] Temporal Details of Sampling:** The sampling procedure is initiated shortly after a snowstorm. It is recommended to commence within 12 to 24 hours to allow time for wolverines to make tracks. It is best to try to complete surveys within 2 to 3 days, because wolverines often circle back to a hole or den site. This can cause confusion in determining the number of animals making the track.

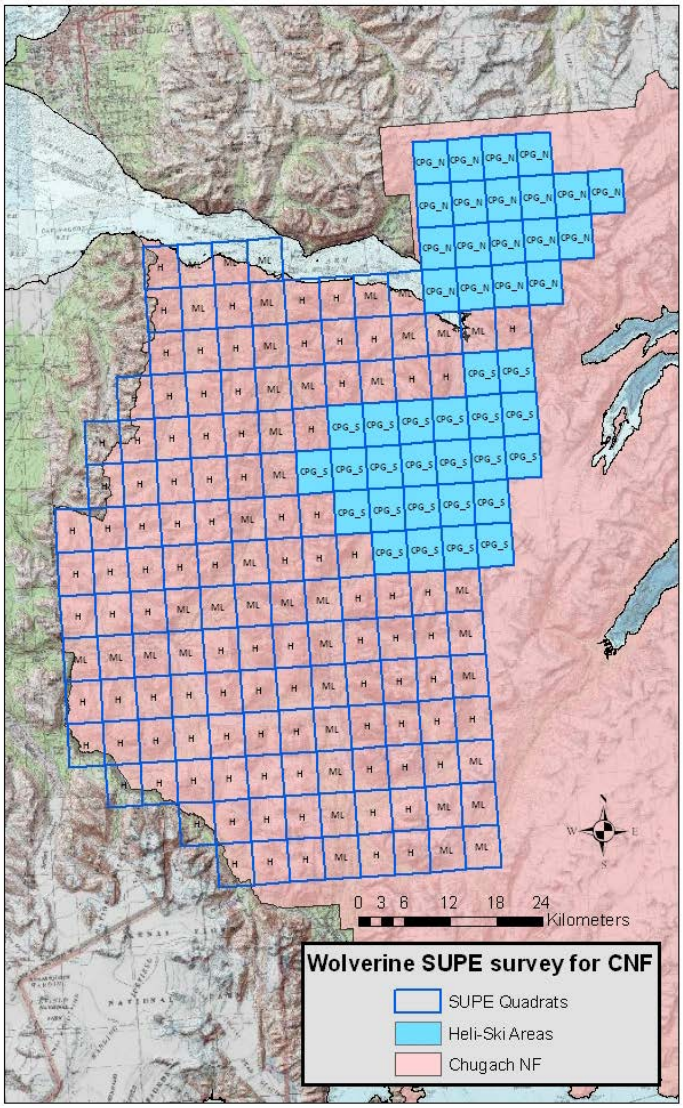



**Figure Q21-1. Survey areas for wolverine SUPE estimates and helicopter-ski area population counts indicating all quadrats and selected quadrats or sample units**

**I. Data Collection:** Data collection will follow the methods described by Becker et al. (1998), Becker et al. (2004), and Golden et al. (2007b).

**[I-1] Methods for Locating Sample Units:** Sample units selected from the survey grid for sampling in the high and medium-low strata are located in the field using Global Positioning System (GPS) coordinates for each corner of the unit.

**[I-2] Methods for Layout and Marking:** The existing survey area contains 43 quadrats within the helicopter skiing area and 139 quadrats outside that area. All of the 43 quadrats (100 percent) in the helicopter skiing area will be surveyed. Of those quadrats sampled outside that area, 69 (70 percent of 98) will be in the high strata and 21 (50 percent of 41) will be in the medium-low strata, for an overall sample of 90 (65 percent of 139) quadrats. Combined with the helicopter skiing area, this will result in 133 quadrats being surveyed.

**[I-3] "Field" Sampling Methods**: Surveys will be flown with Super Cub (the New Piper Aircraft, Inc., Vero Beach, Florida) or similar aircraft because of their ability for low-level, maneuverable flight. The optimal survey period is from the last week of January through the first week of April, depending upon snow conditions. Snow depths should be sufficient to cover low shrubs completely. Surveys should commence within 12 to 24 hours after a fresh snowfall of several centimeters. Skies should be mostly clear and there should be only light wind during surveys. It is best to survey the entire survey area within 2 to 3 days, and 3 to 5 pilot-observer teams are preferable to expedite surveys. Poor snow or flying conditions may prevent completion of surveys on consecutive days. To ensure no wolverines are missed or double counted between survey days, sample units should be flown as a contiguous block each day with no gaps in coverage.

Each team should be assigned 10 to 15 sample units to survey in a day. Teams should be spaced out and keep in close radio communication for safety. Aircraft normally fly at 90 to 130 km per hour at altitudes of 35 to 150 meters above ground level while searching for tracks along ridges, hillsides, and valley bottoms. All portions of a selected sample unit must be searched until the teams are confident no fresh wolverine tracks are missed and that the model assumptions are met. Survey time per sample unit normally varies between 5 and 20 minutes, although more time may be needed depending upon sightability conditions (e.g., density of vegetation, canopy cover, and lighting) and topography. It is important to document snow age (days) and condition, light quality, and habitat type. A general rating for overall survey conditions, which could range from poor to excellent, should be assigned to each sample unit.

Once a fresh track or track-trail is found, it must be followed forward to its end. The number of wolverines should be enumerated from direct observation or from the number of separate tracks in a trail. Each trail must be backtracked to its beginning, which may have been a resting hole or den site or where it was obscured from the last snowfall. GPS coordinates for the start and end of each track should be recorded. The entire track line must be recorded on maps to document the selected sample units where the track was first found and all other quadrats that it passed through. This mapping effort also will help ensure that tracks identified from a previous day's survey, which crossed into the new day's survey area, are not recorded again. A rule should be observed that if a track goes outside the boundary of the survey area it is followed it to its end to determine the proportion of the track within the study area (Becker et al. 2004). This proportion is then used to calculate the proportion of that track's group size (i.e., number of wolverines) to be used in the total population estimate for the survey area.

**J. Quality Control and Assurance**: Finding and following wolverine tracks within sample units is the most critical quality control issue. To ensure tracks are not missed, it is essential to have experienced team members and teams that conduct surveys by strictly following survey procedures and verifying that the assumptions are being met. If a team determines that survey conditions are not adequate for a particular sample unit, the other teams should be notified, and that sample unit will be deleted from the survey if it cannot be surveyed on a subsequent day.

**K. Data Form:** Data will be recoded using wolverine SUPE data sheets (Figure Q21-2) and SUPE instructions (Figure Q21-3).

## WOLVERINE SUPE FORM

Sheet ____ of ____

Date _____ Area _____ Aircraft Hours _____

Pilot _____ Observers _____

| Snow Age | Snow Cover | Light Type | Light Intensity | Predominant Habitat in SU | Survey Rating |
|---|---|---|---|---|---|
| 1. 1-2 days | 1. Complete | 1. Bright | 1. High | 1. OPEN lower elev. shrubs/wetland | A. Excellent |
| 2. 3-4 days | 2. Some low veg showing | 2. Flat | 2. Medium | 2. DECIDUOUS FOREST | B. Good |
| 3. 5-6 days | 3. Bare ground showing | | 3. Low | 3. MIXED FOREST | C. Fair |
| 4. 7+ days | | | | 4. OPEN CONIFEROUS FOREST | D. Poor |
| | | | | 5. DENSE CONIFEROUS FOREST | |
| | | | | 6. SUB-ALPINE FOREST | |
| | | | | 7. BURN | |

| SAMPLING ORDER | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| SU ID | | | | | | | | | | |
| SNOW AGE | | | | | | | | | | |
| SNOW COVER | | | | | | | | | | |
| LIGHT TYPE | | | | | | | | | | |
| LIGHT DENSITY | | | | | | | | | | |
| HABITAT TYPE | | | | | | | | | | |
| SURVEY RATINGS | | | | | | | | | | |
| START TIME | | | | | | | | | | |
| STOP TIME | | | | | | | | | | |
| COMMENTS | | | | | | | | | | |

### GROUP INFORMATION

| Ref. # | SU track 1st spotted | Time 1st spotted | SUs with tracks | SUs with wolverines | Time tracking ended | Group Size | In/Out | GPS Coordinates/Comments |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

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**Figure Q21-2. Data sheet for wolverine SUPE surveys**

# WOLVERINE SUPE INSTRUCTIONS

**OBJECTIVE** — For every **selected** sample unit (usually 5×5 km or 3×3 mi squares) we must determine if a wolverine group (≥ 1 wolverine) made **fresh tracks** in the sample unit (SU). Once fresh tracks are found in a selected SU, they are followed (forward and backward) to determine which other sample units they entered and the number of wolverines in the group. To obtain a good population estimate, it must be assumed that: (1) fresh tracks in selected SUs are not missed, and (2) all SUs containing fresh tracks enumerate the number of wolverines.

**FRESH TRACKS** — Tracks made since the last snow fall (or major wind storm) and new enough to track (usually < 2 days old).

**OLD TRACKS** — Tracks that are not "FRESH TRACKS."

**SURVEY PROCEDURE** —

1. Divide the selected sample units (SUs) among the pilot/observer teams, and have all teams work through their SUs by traveling in the same general direction to maintain safe spacing among planes.
2. It is optimal to survey from SuperCubs at 95–130 kph (60–80 mph) and at 90–150 m (300–500 ft) above ground level (agl).
3. Spend 12–13 min/selected SU. Use more time if necessary to meet the above objective (e.g., in forested SUs).
4. Once a fresh wolverine track is observed in the selected SU, back-track it to the location were the track would be considered too old to follow if first observed at that point, and forward-track it to the location of the wolverine. Record the track location on the map, and note the time the track was found, and the SUs containing the track on the survey form. It is also a good idea to record the track with a GPS using the unit's tracking mode set to update the signal every second.
5. SAFETY — Broadcast your flight path to other pilots while following tracks.
6. For all wolverine observations, note the location (i.e., SUs containing the track), direction of travel, number of wolverines, and time the animal was observed on the survey form. Mark the location of the wolverine on the map. Record GPS coordinates of the beginning and end of each track trail.
7. When backtracking, if localized environmental conditions have caused the track to be classified as "OLD", quickly search for undetected "FRESH" track segments (> 0.8 km or 0.5 mi) farther down the trail to ensure that there are no unrecorded SUs with fresh segments from this animal. Use dotted lines to connect the fresh segments on the map. On the data form, only record SUs with **fresh track** locations.
8. Once tracking has been completed, quickly survey the remainder of the **selected** SU to determine if additional wolverine tracks are present. If any are found, treat as above (#4, #5, & #6), and note whether or not the tracks connected with other tracks. Tracks that do connect will be treated as 1 animal for survey purposes, unless they can be separated temporally.
9. If fresh tracks go outside the study area, follow them to determine if more than half of their length lies outside of the study area; if so stop tracking the animal and record it as "OUT" on the data form.
10. **Alternative Method:** Follow tracks outside the study area to the wolverines. Draw out the track system in sufficient detail to determine the proportion of the track length in and outside of the study area. Apply this proportion to group size to determine an "effective study area group size." Use this value in the SUPE calculations to obtain the population estimate. Pick a method and use for all groups.

* Note: When testing to measure the accuracy of the SUPE for wolverines where daily replicate surveys of the same SUs are being conducted, take care to record only tracks that are new since the previous day's surveys.

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**Figure Q21-3. Instructions for conducting wolverine SUPE surveys**

**L. Data Storage:**

**[L-1] Data Cleaning Methods:** Observations by each pilot-observer team recorded on data sheets and maps should be examined and discussed with other teams and the team leader at the end of each survey day and compiled onto a master map and in a data file.

**[L-2] Data Storage:** Data compiled onto the master map and the master data file will be kept in safe storage during surveys and then housed at Alaska Department of Fish and Game until analyses are completed.

**M. Data Analysis:** Data will be pooled from each survey day in the program SUPEPOP, which is available at ftp://ftpr3.adfg.state.ak.us/MISC/PROGRAMS/SUPEPOP/, to calculate the population size for the SUPE area outside the Chugach Powder Guides areas. This site also contains detailed descriptions of the program, population estimation procedures, data entry protocol, and results output. Calculations used in SUPEPOP are based on formulas presented in (Becker et al. 1998). SUPEPOP uses the number of independent track groups observed in each stratum, the number of sample units each track group passes through, and the original sampling fraction of quadrats per stratum to estimate a population size and variance for each survey area.

Population estimates (± SE) for the SUPE areas are generated with confidence intervals at the 80-percent and 90-percent levels, which are considered reasonable levels of precision for wolverine population estimates. Density estimates and coefficients of variation, which indicate survey efficiency, are also calculated. Because wolverine population levels measured for the heli-skiing areas are actual counts derived from surveys of 100 percent of the quadrats, estimates with measures of variance are not generated for those areas. However, the heli-skiing counts will be compared with the SUPE estimates to determine where those counts fall within the confidence intervals of those estimates. Population estimates for the SUPE area and counts for the heli-skiing areas will be derived independently each survey year, but will be compared among survey years to indicate population trend.

**N. Assumptions and Limitations:** The following assumptions must be met: “(1) all animals of interest move during the course of the study; (2) their tracks are readily recognizable from a small, low-flying aircraft; (3) tracks are continuous; (4) movements are independent of the sampling process; (5) pre- and post-snowstorm tracks can be distinguished; (6) post-snowstorm tracks in the searched sample units are not missed; (7) post-snowstorm tracks found in selected sample units can be followed (forward and backward) to determine, without error, all sample units containing those tracks; and (8) group size is correctly enumerated (Becker et al. 1998: 969). Two additional assumptions are required if a study area is too large to be surveyed in one day: “(1) animals do not move from unsampled to sampled areas and they leave no fresh tracks in the unsampled areas; and (2) no animals are double counted by moving from sampled to unsampled areas” (Becker et al. 1998: 969).

The SUPE design allows observers, while conducting the survey, to determine whether most of the assumptions are being met (Golden et al. 2007b). The only assumption where this does not apply is “all animals of interest move during the course of the study.” This assumption is being tested using GPS-collared animals and double sampling through a study by ADF&G (Golden 2007). Recent GPS telemetry data from a male and

female wolverine indicated lack of movement was not likely to be a serious concern, particularly if surveys are begun at least 18 hours after snowfall ends. More data are needed to determine if beginning surveys as soon as 12 hours after the end of snowfall will no longer be recommended.

These surveys were not designed to consider the potential influence of animal movement from adjacent areas. Each survey result should be considered a point estimate or “snapshot” and, therefore, appropriate care should be taken in making temporal or spatial comparisons.

**O. Reporting Frequency**: Annual reports will be prepared by September 30 of each survey year.

**P. Responsibility**: ADF&G will be the lead agency and share some project responsibilities with the Forest Service. ADF&G will conduct the wolverine surveys; the Forest Service will provide support with logistics and data on heli-skiing activities. Data or other information gained from this project will be the property of Alaska Department of Fish and Game and Chugach National Forest. No data or information on this project will be disseminated externally, without the written consent of each agency. ADF&G and Chugach National Forest will conduct data analyses and prepare project reports and publications. Authorship of any report or publication will be agreed upon by project collaborators and confirmed in writing by both agencies. The leads for this project will be the ADF&G Furbearer/Wildlife Biologist and Chugach National Forest’s Wildlife Ecologist.

**Q. List of Preparers:**

Earl Becker, Research Coordinator, Alaska Department of Fish and Game, Division of Wildlife Conservation, Anchorage, Alaska.

Martin Bray, Wildlife Biologist, USDA Forest Service, Chugach National Forest, Regional Office, Anchorage, Alaska.

Howard Golden, Wildlife Biologist, Alaska Department of Fish and Game, Division of Wildlife Conservation, Anchorage, Alaska.

**R. 10-Year Cost Forecast:**

| | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| Staff | $0 | $2,865 | $0 | $3,036 | $0 | $3,218 | $0 | $3,411 | $0 | $3,616 |
| Fleet | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Sikes Agreement | $0 | $38,600 | $0 | $40,900 | $0 | $43,400 | $0 | $46,000 | $0 | $48,760 |
| **TOTAL** | **$0** | **$41,465** | **$0** | **$43,936** | **$0** | **$46,618** | **$0** | **$49,411** | **$0** | **$52,376** |

Total 10-year estimated cost: $233,806

ADF&G cost estimates are shown by contract year on a biennial basis to allow flexibility regarding survey conditions and to provide five surveys within a 10-year period.

Cost breakdown for ADF&G: salary for four survey personnel (Wildlife Biologists I, II, and III, and Fish and Wildlife Technician IV) per survey year = $12,000.

Aircraft Charter = $15,000

Lodging, per diem, overtime = $5,000

Total for ADF&G over the 10-year period = $180,700. Forest Service funds will be transferred to ADF&G via a Sikes Agreement, and 13.5 percent for administrative costs was incorporated into these costs.

Chugach National Forest staff costs are 6 days for the wildlife ecologist where displayed in the boxes above.

Estimated annual cost in Revised Forest Plan (5-11): $5,000. Actual annual cost for protocol will be $23,381.

**S. Literature Cited:**

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# *Forest Products*

## *28. Are harvested forest lands restocked?*

**A. Monitoring Item: A. *Forest Products***

**B. MEIT Interpretation of General Monitoring Question:** Are harvested forestlands restocked?

**C. Business Need and Rationale:** This monitoring item was developed to address the need to meet National Forest Management Act 16 U.S.C. 1604(g)(3)(E) that specifies that we ensure that timber will be harvested from National Forest System lands only where there is assurance that such lands can be adequately restocked within 5 years after harvest. In the past this question has been monitored annually through the reporting of reforestation stocking certification. Once this reporting was completed, the Regional Timber Management Staff prepared a status of reforestation 5 years after final harvest report, which identified the current certification status for all harvest units.

*Currently the Chugach National Forest does not have any outstanding acres where timber was harvested that have not been certified as being adequately restocked. Since the reforestation needs associated with timber harvest on the Chugach National Forest were zeroed out at the end of FY06, no more reports are necessary. In addition, under the Revised Forest Plan, no areas of the forest are designated for timber production so there are no restocking needs at this time. The "restocking" protocol is a placeholder should the Forest embark in activities that require restocking certification, but that this is not anticipated. All that is expected to be reported in FY12 is that there is no change in that status.*

**D. Category:** *Implementation*. In the forest plan, it was listed as an effectiveness monitoring; however, it fits implementation category because it determines whether standards and guidelines are being met.

**E. Protocol Status, Source, and Re-evaluation Schedule:** As of 2007, this protocol is no longer needed. There are regional protocols in place if, and when, this protocol is needed. R10 Supplement FSH 2409.17-99-3, chapter 2 includes definitions of adequate stocking levels and acceptable crop trees. This activity is not anticipated to occur within the life of the current forest plan.

**F. Objective Statement:** This monitoring item was developed to ensure that timber will be harvested from National Forest System lands only where there is assurance that such lands can be adequately restocked within 5 years after harvest to meet the legal requirements listed in the National Forest Management Act.

> **[F-1] Required by Law:** National Forest Management Act 16 U.S.C. 1604(g)(3)(E), as listed above. The Forest and Rangeland Resource Planning Act of 1974 Sec. 3. [16 U.S.C. 1601] (d) states: "It is the policy of the Congress that all forested lands in the National Forest System shall be maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple use sustained yield management in accordance with land management plans." This

requires the Forest to determine if the treated acres are regenerating to the desired composition of tree species.

**[F-2] Statistical Rigor Rationale:** It is unlikely that any timber harvested on the Chugach National Forest will require restocking certification. Therefore, this monitoring may not be implemented. Any monitoring that is implemented will not be statistical in nature, but rather a complete check of restocking records.

**[F-3] Data Precision, Reliability:** The data precision is Class A for determining if harvested acres are restocked.

**[F-4] Confidence:** Use the guidelines described in FSM 2472.4 and FSH 2409.17, chapter 2.

**[F-5] Change Detection:** Not applicable

**[F-6] Threshold:** Any amount of acres that does not meet the restocking requirement as defined in FSM 2472.4 and FSH 2409.17, chapter 2.

**[F-7] Scope of Inference:** Any acres where timber harvest occurs that require restocking certification on the Chugach National Forest.

**G. Indicator and its Units of Measure:** The indicator would be acres of harvested land that are adequately restocked and not adequately restocked within 5 years of harvest.

**H. Sampling Design:** A census of all records.

**[H-1] Target Population:** Not applicable

**[H-2] Sampling Frame:** Not applicable

**[H-3] Sample Selection Methods:** Not applicable

**[H-4] Sample Unit Description:** Restocking certification records

**[H-5] Detection and Observer Bias Controls:** Not applicable

**[H-6] Sample Size Estimate and Estimation Methods:** Not applicable

**[H-7] Temporal Details of Sampling:** Every year where final harvest occurred 5 years prior.

**I. Data Collection:** Not applicable

**[I-1] Methods for Locating Sample Units:** Not applicable

**[I-2]Methods for Layout and Marking:** Not applicable

**[I-3] “Field” Sampling Methods:** Not applicable

**J. Quality Control and Assurance:** Not applicable

**K. Data Form:** Not applicable

**L. Data Storage:** Not applicable

**[L-1] Data Cleaning Methods:** Not applicable

**[L-2] Data Storage:** Not applicable

**M. Data Analysis:** Not applicable

**N. Assumptions and Limitations**: It is assumed that for the rest of the planning cycle this protocol will not be needed because no final harvest is planned on the Chugach National Forest.

**O. Reporting Frequency:** Since the reforestation needs associated with timber harvest on the Chugach National Forest were zeroed out at the end of FY06, no more reports are necessary.

**P. Responsibility:** Supervisor's Office Resources staff forester.

**Q. List of Preparers:**

Robert L. DeVelice (Ph.D.), Forest Ecologist, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

Colleen Grundy, Regional Silviculturist, USDA Forest Service, Regional Office, Juenau, Alaska.

Susan E. Kesti, Silviculturist, USDA Forest Service, Chugach National Forest, Cordova Ranger District, Cordova, Alaska.

**R. 10-Year Cost Forecast:** The total estimate for next 10 years is $3,225. The Revised Forest Plan estimate was $50,000 ($5,000 per year). The following estimate is based on district personnel turning in a report each year and upward reporting by forest timber staff that shows no change. If timber harvest occurs, then the cost will be higher to reflect cost of ground surveys on those acres harvested.

An average rate of inflation of 3 percent is used in the following table (based on records for the years 1986 through 2005 http://www.minneapolisfed.org/Research/data/us/calc/hist1913.cfm).

| | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| People | $281 | $290 | $299 | $307 | $317 | $326 | $336 | $346 | $356 | $367 |
| Travel | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Other | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **TOTAL** | **$281** | **$290** | **$299** | **$307** | **$317** | **$326** | **$336** | **$346** | **$356** | **$367** |

Cost in inflated dollars ($)

**S. Literature Cited:** Not applicable

## *29. Have lands once identified as unsuitable for timber production been examined to determine if they have become suitable?*

**A. Monitoring Item: *Forest Products***

**B. MEIT Interpretation of General Monitoring Question:** Have conditions changed that would affect the suitability of timber production lands?

**C. Business Need and Rationale**: This monitoring item was developed to address the need to meet National Forest Management Act 16 U.S.C. 1604(k) Development of land management plans and the Forest and Rangeland Resource Planning Act of 1974 Sec 3 [16 U.S.C. 1601](d)3: Over the planning cycle (2002 to 2012) it is necessary to compile information to ascertain changes in physical and social conditions which may impact the assignment of suitability for timber production and ensure forested lands in the National Forest System are maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple-use sustained-yield management in accordance with land management plans.

The forest plan goal for forest products is to "…provide opportunities to use forest products for personal and commercial uses" (Revised Forest Plan p. 3-6). It was developed to address the "Resource Development" Situation Statement, the "Vegetation Management" Guidelines, and the "Special Forest Products" Standards. The objective is to provide non-chargeable timber for sawtimber, poles, cabin logs, and firewood for personal and commercial uses. Provide special forest products (berries, cones, seedlings, saplings, boughs, conks, etc.) for personal and commercial uses on a case-by-case basis (Revised Forest Plan p. 3-6).

The desired condition for Resource Development and Use is located on page 3-14 of the Revised Forest Plan. It states that "road accessible personal use/free use and small scale commercial (non-chargeable) harvest of forest products will be available on the forest, usually near existing roads or as a result of restoration activities." The Vegetation Management Guidelines are located on pages 3-25 through 3-26 of the Revised Forest Plan.

**D. Category:** *Implementation:* Originally coded as a validation; however, protocol fits the implementation category since it is meant to check to see if suitability determinations have been made on schedule.

**E. Protocol Status, Source, and Re-evaluation Schedule:** The protocol is final; the source is the forest plan and FSH 1909.12, chapter 62. Re-evaluation schedule is once every 10 years.

**F. Objective Statement:** Confirm that the suitability review occurs per procedures outlined in FSH 1909.12, chapter 62.

> **[F-1] Required by Law:** National Forest Management Act 16 U.S.C. 1604 (k) Development of land management plans: "In developing land management plans pursuant to this subchapter, the Secretary shall identify lands within the management area which are not suited for timber production, considering physical, economic, and other pertinent factors to the extent feasible, as

determined by the Secretary, and shall assure that, except for salvage sales or sales necessitated to protect other multiple-use values, no timber harvesting shall occur on such lands for a period of 10 years. Lands once identified as unsuitable for timber production shall continue to be treated for reforestation purposes, particularly with regard to the protection of other multiple-use values. The Secretary shall review his decision to classify these lands as not suited for timber production at least every 10 years and shall return these lands to timber production whenever he determines that conditions have changed so that they have become suitable for timber production." On the Chugach National Forest, this work was accomplished in 2002 as a result of forest plan revision using procedure outlined in appendix B of the Chugach National Forest Plan Revision Final Environmental Impact Statement, pages B10 to B25. Over the planning cycle (2002 to 2017) it is necessary to compile information to ascertain changes in physical and social conditions which may impact the assignment of suitability for timber production.

**[F-2] Statistical Rigor Rationale:** Not applicable (no statistics apply)

**[F-3] Data Precision, Reliability:** The data precision is Class B for determining change in timber suitability.

**[F-4] Confidence:** By the year 2017, we want to be 100 percent confident that the assessments are occurring as often as determined appropriate by the responsible official.

**[F-5] Change Detection:** Not applicable

**[F-6] Threshold:** Suitability analysis needs to occur as part of preparing for the next planning effort so it would be done by 2011 to 2012.

**[F-7] Scope of Inference**: Forestwide at year 2012.

**G. Indicator and its Units of Measure:** The indicator would be has an assessment of suitability taken place every 10 years per the National Forest Management Act. Unit of measure would be one assessment complete by 2012.

**H. Sampling Design:** Suitability determination will be obtained from analysis using appendix B of the FEIS of the forest plan.

**[H-1] Target Population:** (see above for H-1 through H-7)

**[H-2] Sampling Frame:**

**[H-3] Sample Selection Methods:**

**[H-4] Sample Unit Description:**

**[H-5] Detection and Observer Bias Controls:**

**[H-6] Sample Size Estimate and Estimation Methods:**

**[H-7] Temporal Details of Sampling:**

**I. Data Collection:** Not applicable

**[I-1] Methods for Locating Sample Units:**

**[I-2]Methods for Layout and Marking:**

**[I-3] "Field" Sampling Methods:**

**J. Quality Control and Assurance:** Not applicable

**K. Data Form:** Not applicable

**L. Data Storage:** Original suitability analysis is in Chugach National Forest Corporate Database and planning record.

**[L-1] Data Cleaning Methods:**

**[L-2] Data Storage:**

**M. Data Analysis:** Not applicable

**N. Assumptions and Limitations:** It is assumed that for the lands currently classified as unsuitable due to lack of information (Alaska National Interest Lands Conservation Act additions), we will have sufficient information to classify them at the end of 10 years. It is also assumed that sufficient data will be available to make determinations on allocations of suitability, based upon multiple-use objectives, and refinements will be made to datasets to make this analysis (i.e., land cover classification) at sufficient detail to answer the suitability questions. This includes Exxon Valdez oil spill (EVOS) acquired lands. It is assumed that the social factors would remain static for the next 10 years unless industry informs us that they desire timber products to be made available for harvest.

**O. Reporting Frequency:** Every 10 years

**P. Responsibility:** Chugach National Forest Planning Staff

**Q. List of Preparers:**

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Colleen Grundy, Regional Silviculturist, USDA Forest Service, Regional Office, Juneau, Alaska.

Susan E. Kesti, Silviculturist, USDA Forest Service, Chugach National Forest, Cordova, Alaska.

**R. 10-Year Cost Forecast:** It is assumed that the actual suitability analysis would be part of the planning effort and funded through that effort. The total estimate for the next 10 years is $12,910. The Revised Forest Plan estimate was $10,000.

| | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| People | $12,910 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Travel | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Other | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **TOTAL** | **$12.910** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** | **$0** |

Cost in inflated dollars ($)

## S. Literature Cited:

USDA Forest Service. 2002. *Final Environmental Impact Statement: Chugach National Forest Land Management Plan Revision*. R10-MB-480e. Anchorage, Alaska.

# *Heritage Resources*

## *32. Are National Register eligible heritage resources being adequately maintained and protected?*

**A. Monitoring Item: *Heritage Resources***

**B. General Monitoring Question:** Are National Register eligible heritage resources being adequately maintained and protected?

**C. Business Need and Rationale:**

Heritage Resources include prehistoric and historic sites, buildings, structures, objects, districts, and travel ways, and are non-renewable. If the properties of heritage resources that make them eligible to the National Register of Historic Places are altered or destroyed, they are permanently lost and the site may lose its National Register of Historic Places status, i.e., those qualities that convey the nation's past, and that connect people to places. Development of heritage resource-specific management plans integrated with continued heritage resource inventory and evaluation is critical to the preservation of the Forest's heritage resources. Any undertaking listed on the Schedule of Proposed Actions that is not reviewed under the National Historic Preservation Act Section 106 process will be the primary trigger for management action.

The forestwide goal stated for heritage resources in the Chugach Land Management Plan of 2002 (Revised Forest Plan) is to "Protect heritage resources" (p. 3-7). Several objectives for achieving this goal are outlined in the plan. The first objective is to "implement management area direction for protection and data recovery from heritage resources" (Revised Forest Plan 3-7). Heritage resources are not addressed in the "Desired Conditions" section of the Revised Forest Plan (chapter 3: pp. 3-13 to 3-19). Heritage resources are addressed in the Management Prescriptions, but the condition described varies from one management prescription to another.

No goals, objectives, or standards and guidelines for heritage resources are specifically defined for the individual categories or the associated management area prescriptions in the Revised Forest Plan. However, the Revised Forest Plan expresses interest in evaluating the protection afforded heritage resources, through posing monitoring questions, and as reflected in the measurements of interest in the Revised Forest Plan as noted in table 5-1 (p. 5-14).

Heritage resources are unique, and the following laws, regulations, agreements, and executive orders were created to help preserve those values. National policy in the FSM 2362.03 directs forest supervisors to implement heritage resource monitoring for all levels of land use and project planning.

The National Historic Preservation Act (16 U.S.C. 470); Section 110 requires that known historic properties on Federal lands be managed and maintained in such a way that their historic, archeological, architectural, and cultural values be preserved. As defined in the act, preservation includes evaluation, documentation, protection, management, stabilization, maintenance, and conservation, among other things.

The Code of Federal Regulations (36 CFR 800) for compliance with Section 106 of the National Historic Preservation Act allow land managing agencies to create Programmatic Agreements with the National Advisory Council on Historic Preservation and the State Historic Preservation Officer to streamline procedures for meeting the requirements. The Programmatic Agreement for Management of Cultural Resources, between Region 10 of the Forest Service, the Alaska State Historic Preservation Officer, and the National Advisory Council on Historic Preservation stipulates that a monitoring program will be set up for each forest in the Region (USFS Region 10 Agreement # 02MU-111001-076, p. 7 of 28). Violation of the programmatic stipulations could result in foreclosure and loss of the programmatic streamlined protocols.

The Archaeological Resources Protection Act of 1979 was enacted to protect archeological resources on public lands from humanly caused destruction.

The Preserve America Executive Order 13287 of 2003, Section 3 requires assessment of condition of cultural resources to determine management needs and how the Forest will meet those needs (http://www.preserveamerica.gov/EOtext.html). Along with The Federal Real Property Executive Order 13327, it establishes Federal policy to provide leadership in preserving America's heritage by actively advancing the protection, enhancement, and contemporary use of the historic properties owned by the Federal Government.

Statement of Federal Financial Accounting Standards Number 29 (SFFAS Number 29) changes the classification of information reported for heritage assets and stewardship land, and requires that Federal agencies reference a note on the balance sheet that discloses information about heritage assets and stewardship land, but no asset dollar amount should be shown. (FSH 6509, Service-Wide Finance and Accounting Handbook, p. 8). FSH 6509 requires condition assessments of heritage assets as part of agency financial reporting, and also requires that data in the National Forest Service Infrastructure Database (INFRA) be updated and validated.

*Strategy:* Monitor undertakings (using the Schedule of Proposed Actions and available NEPA documents) to ensure each is in compliance with the National Historic Preservation Act Section 106 process.

**D. Category:** Effectiveness (effectiveness monitoring evaluates how effective our management actions are at achieving desired outcomes. Ref: http://www.fs.fed.us/institute/IMI/Monitoring.shtml )

**E. Protocol Status, Source, and Re-evaluation Schedule:**

The following monitoring protocol is in pilot status. The pilot data will be collected and reported annually. The protocol will be re-evaluated every 5 years thereafter.

The national INFRA and GIS Core Data Standards for documentation of heritage site monitoring will be used.

The following protocol is developed for the forest level.

The protocol will be housed in the monitoring guide and stored on the Chugach National Forest's corporate drives. Data will be stored in the national heritage INFRA database.

**F. Objective Statement:**

The objective of this protocol is to monitor the effectiveness of Revised Forest Plan reaching the goal of protecting heritage resources. The status of each undertaking, the number of management plans developed, and the number of heritage resources evaluated must be known in order to determine the existing condition.

The protocol monitors the effectiveness of protecting heritage resources:

**[F-1] Required by Law:** Cultural resource inventories, evaluations, condition assessments, and protection of heritage, or cultural, resources are required by the National Historic Preservation Act (Sections 106 and 110), the Archaeological Resources Protection Act, the Region 10 Programmatic Agreement, the FSM, Executive Orders 13287 and 13327, and SFFAS number 29. A lack of management action, when condition status is determined to be critical, does not follow established congressional direction.

**[F-2] Statistical Rigor Rationale:** Heritage resource monitoring will incorporate both quantitative and qualitative measures. Monitoring will quantify the number of undertakings in compliance with the National Historic Preservation Act section 106 (unit of measure 1), and the number of heritage resources evaluated/ nominated to the National Register (unit of measure 3), providing Class A data. Other monitoring will analyze whether management plans have been developed (unit of measure 2) and whether collaborative heritage inventory and monitoring programs have been developed (unit of measure 4), providing Class B data.

**[F-3] Data Precision, Reliability:** Precision and reliability is a mix of Class A and Class B given that the protocol relies on methods associated with other program monitoring or assessment requirements that generate non-random results and/or results that are less valid statistically (e.g., development of management plans, site monitoring and evaluation conducted as a result of legal requirements for project implementation associated with other resource programs). The evaluation of the monitoring plan, as well as the use of existing reports and secondary data to characterize heritage resource conditions would be categorized as Class A in terms of precision and reliability.

The national INFRA database is the primary source of information for evaluation of all components although program management files and Schedule of Proposed Actions will also be referenced. These monitoring components will determine if heritage resources are adequately protected and maintained and the timeliness of appropriate management response.

**[F-4] Confidence:** Data collected using this protocol will allow managers to confidently determine the number of undertakings in compliance with the National Historic Preservation Act.

**[F-5] Threshold:** Heritage resources will not be adequately protected and maintained and will trigger management action if: (1) the National Historic Preservation Act Section 106 process is not completed on one or more undertaking; (2) no management plans developed within the 5-year period; (3) less than five sites are evaluated annually; (4) or a collaborative inventory and

monitoring program has not been developed within the 5-year period. Heritage resources will only be formally nominated to the National Register when appropriate and resources allow.

**[F-6] Scope of Inference:** Temporal requirements include the development of management plans, inventory, and evaluation of heritage resources within a 5-year period. The spatial scope of inference is the Chugach National Forest.

**G. Indicator and Units of Measure:**

The measurements of interest and indicators in Table Q32-1 will be used to determine whether eligible heritage resources (including unevaluated heritage resources) are being adequately maintained and protected.

The units of measure triggering management action are:

1. If any undertakings are NOT reviewed under the National Historic Preservation Act Section 106.
2. If no management plans developed annually.
3. If no heritage resources evaluated for eligibility to the National Register.
4. If no establishment of a collaborative inventory and monitoring program.

**Table Q32-1. Measurable results**

| Measurements of Interest | Indicators | Monitoring Frequency | Evaluation Frequency | Precision / Reliability |
|---|---|---|---|---|
| Determine whether consultation with Alaska State Historic Preservation Office and tribes was completed in accordance with the proposed action, prior to the release of the DEIS or EA for public review, or before signing a DM. | Has the National Historic Preservation Act Section 106 process been completed on each undertaking? | Annual | 5 Years | A |
| Develop management plans for long-term preservation of heritage resources that are either listed on or eligible for the National Register of Historic Places. | Have Cultural Resources Management Plans been completed? | Annual | 5 Years | B |
| Reduce the backlog of heritage resources that require evaluation and nomination to the National Register of Historic Places. | Have National Register of Historic Places evaluations/ nominations been completed? | Annual | 5 Years | A |
| Collaborate with representatives from appropriate tribes/ universities to develop a heritage resource inventory and monitoring (National Historic Preservation Act Section 110) program | Have collaborative inventory and monitoring program been established? | Annual | 5 Years | B |

**H. Sampling Design:**

**[H-1] Target Population:** The target population is the number of undertakings within a fiscal year listed on the Schedule of Proposed Actions on the Chugach National Forest that receive National Historic Preservation Act Section 106 review.

**[H-2] Detection and Observer Bias Controls:** The forest archeologist will compile data for analysis from the national INFRA database, Schedule of Proposed Actions, Heritage Program condition status monitoring reports, consultation and agreements documentation, and the National Forest Work Plan System, and will verify results with the district and zone archeologists,

**I. Data Collection:** Data collected will come from database reviews.

**J. Quality Control and Assurance:** Heritage program staff enter all national core data into INFRA for site documentation, following national direction and definitions. These data are validated each year before being pulled by the WO for national reporting requirements.

**K. Data Forms:**

The National INFRA Heritage Resource Monitoring Record will have all appropriate fields completed to document measurements of interest and indicators for each fiscal year as a core component of the heritage program. Compiled data will be generated in an INFRA-generated tabular “userview” report format and will include an indication of whether management action is needed for protection, and, whether the necessary actions are consistent with the desired condition for the prescription as stated in the Revised Forest Plan.

**L. Data Storage:**

**[L-1] Data Cleaning Methods:**

The forest, zone, and district archeologists will review the collected data for errors, completeness, and consistency with national INFRA requirements.

**[L-2] Data Storage:**

The forest plan monitoring data will be entered into the heritage module of the INFRA as an event, and linked with individual heritage resources.

**M. Data Analysis:**

The forest archaeologist will compile the following data each fiscal year.

- Compare undertakings listed in the Schedule of Proposed Actions with those reviewed under National Historic Preservation Act Section 106 (available from INFRA).
- Heritage Resource management plans for the previous fiscal year (available from INFRA).

- Consultation and agreements documentation regarding site monitoring, filed electronically for each heritage resource on Chugach National ForestO drive.
- Work chunks, and appropriate Project Work Plan information available on the National Forest Work Plan System.

**Management Action Trigger(s):**

The forest archeologist will determine:

- If any undertakings were NOT reviewed under the National Historic Preservation Act Section 106.
- If no management plans were developed annually.
- If no heritage resources were evaluated for eligibility to the National Register.
- If no establishment of a collaborative inventory and monitoring program.

The 5-year analysis for this monitoring protocol will:

- Present the analysis results of heritage resource condition status monitoring, and discuss the adequacy of data collected.
- Discuss the results of a comparison of protective management actions for heritage resources and the desired condition, in light of the Chugach National Forest Revised Land and Resource Management Plan goal of “Protect Heritage Resources.”
- Answer the “measurements of interest” questions noted above in section G.
- Analyze trends in heritage resource condition, if conditions are generally remaining the same, or deteriorating, and if management actions are adequate to counter the loss of significant heritage properties.
- Analyze where there are data gaps, both spatially and, and temporally and determine if these gaps introduce a bias into the analysis. Suggest future actions to acquire data to fill the information gaps.

**N. Assumptions and Limitations:**

**[N-1] Assumptions:** Adequate data will be available from the INFRA database and associated Chugach National Forest records to analyze monitoring results.

**[N-2] Limitations:** Not applicable

**O. Reporting Frequency:**

Data are entered into INFRA annually with some data analysis as described previously to determine which heritage resources to monitor the next field season; an analysis of trends and data gaps as described previously will occur every 5 years.

**P. Responsibility:** Chugach Public Services Staff Officer, delegated to Forest Archeologist in coordination with Glacier-Cordova Zone Archeologist and Seward District Archeologist.

**Q. List of Preparers:**

Robert (Max) Dean, Archeologist, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

Heather C. Hall, Cordova-Glacier Zone Archeologist, USDA Forest Service, Chugach National Forest, Glacier Ranger District, Girdwood, Alaska.

Jeremy M Karchut, Archeologist, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

Sherry D. Nelson, Seward Zone Archeologist, USDA Forest Service, Chugach National Forest, Seward Ranger District, Seward, Alaska

**R. 10-Year Cost Forecast:**

Annual cost in FY10 dollars estimated at $5,000; cost over 10 years, with an increase every fifth year for trend evaluation reporting, calculated with 3 percent inflation rate, estimated at $66,250 over the 10-year period.

| FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|
| $5,150 | $5,305 | $5,464 | $10,300 | $5,628 | $5,797 | $5,971 | $6,150 | $10,150 | $6,335 |

**S. Literature Cited**

Code of Federal Regulations for National Historic Preservation Act (36 CFR 800), effective August 5, 2004.

Executive Order 13287, Preserve America, issued March 5, 2003.

Forest Service Handbook 6509, Service-Wide Finance and Accounting Handbook

National Historic Preservation Act (16 U.S.C. 470) of 1966, as amended.

Programmatic Agreement for Management of Cultural Resources, between Region 10 of the Forest Service, the Alaska State Historic Preservation Officer, and the National Advisory Council on Historic Preservation, # 02MU-111001-076 (Region 10 Programmatic Agreement) executed July 29, 2002.

Statement of Federal Financial Accounting Standards Number 29 (SFFAS Number 29).

USDA Forest Service. 2000. National Deferred Maintenance Protocols.

USDA Forest Service. 2002. Chugach National Forest Land and Resource Management Plan. (forest_plan_web.pdf).

USDA Forest Service. 2003. Monitoring Implementation Guide: Black Hills National Forest. Custer, South Dakota. 75 p. (mon_guide_2003_0701.pdf)

http://www.fs.fed.us/institute/IMI/Monitoring.shtml

http://www.preserveamerica.gov/EOtext.html

# *Recreation Opportunities, Tourism, Access, and Facilities*

## *36. Is the Revised Forest Plan direction for motorized and nonmotorized access working?*

**A. Monitoring Item:** ***Recreation Opportunities, Tourism, Access, and Facilities***

**B. MEIT Interpretation of General Monitoring Question:** Interpreted as stated.

**C. Business Need and Rationale:** The business need for this monitoring is summarized in the Revised Forest Plan's summary of the current management situation. It states "Demand for recreation opportunities on the Chugach National Forest is now greater than ever. Increased tourism, an increased state population and the proximity to Anchorage have combined to make the Chugach the place where many people seek from road accessible to wild and remote recreation opportunities. Improved access to the Forest is expected to further accelerate recreation and tourism uses on the Forest" (chapter 2, p. 11).

Nonmotorized access restricts the distance people can go in a day, so those areas most readily accessible from population centers are also those with the highest demand for nonmotorized access. Motorized recreation is one of the fastest growing forms of outdoor recreation nationwide (Cordell 1999), and one Anchorage dealer has been Skidoo's leading seller nationwide for the past 5 years (phone communication with Alaska Mining & Diving 2007). Many people want to use motorized vehicles to get farther into the forest more quickly than is possible without motors, and feel their use should not be restricted. Since National Forest System lands are public land, available to the public for their use, people feel they are being treated unfairly when their choice of use is restricted. This issue was one of the most contentious during the plan revision process.

Therefore, this monitoring question addresses the social aspects of the motorized and nonmotorized user access on the Chugach National Forest and will contribute information for the following goals of the Revised Forest Plan (chapter 3, pp. 7-8).

- Maintain quality settings for motorized recreation opportunities.
- Maintain quality settings for nonmotorized recreation opportunities.
- Maintain areas where natural quiet predominates consistent with the management area direction and recreation opportunity spectrum settings.

**D. Category:** Effectiveness

**E. Protocol Status, Source, and Re-evaluation Schedule:** This protocol is a pilot and was developed by the Chugach National Forest; it will be re-evaluated after 2 years of implementation.

**F. Objective Statement:** We will monitor the number, spatial occurrence, and trend in off highway vehicle (OHV) and over-snow vehicle (OSV) noncompliances with nonmotorized access prescriptions on the forest.

> **[F-1] Required by Law:** Although not a requirement of forest plan monitoring, regulation 36 CFR 212.57 requires "For each administrative unit of the National

Forest System, the responsible official shall monitor the effects of motor vehicle use on designated roads and trails and in designated areas under the jurisdiction of that responsible official, consistent with the applicable land management plan, as appropriate and feasible."

**[F-2] Statistical Rigor Rationale:** There is no indication the motorized and nonmotorized access plan is not "working" from a social point of view. Therefore, this monitoring will be based on opportunistic sampling. If the results of this monitoring suggest the plan is not "working," then more statistically based sampling and analyses will be considered.

**[F-3] Data Precision, Reliability:** Class A

**[F-4] Confidence:** This monitoring is not based on probabilistic statistics, so we do not address confidence from this perspective. Law enforcement records should provide an adequate indicator of OHV and OSV user noncompliance with the Chugach National Forest nonmotorized prescriptions and trends in noncompliance.

**[F-5] Change Detection:** Trends in noncompliance will be obtained from reports of OHVs and OSVs entering nonmotorized designated areas reported by Chugach National Forest law enforcement officers. We will account for the level of effort law enforcement officers put into detecting these noncompliances so changes in staffing are controlled for.

**[F-6] Threshold:** Meeting or exceeding any of the following conditions for OHV or OSV use will lead to a management review of the access plan by the forest leadership team. The thresholds below should be applied to OHV use and OSV use separately.

1. Clustered noncompliances: More than one cluster of OHV or OSV noncompliances within a single year and occurring 3 out of 5 years. A cluster of OHV noncompliances is defined as: Three or more noncompliances (see definition below) occurring in a calendar year within a 2.5-mile radius.

2. Repeated clustered noncompliance: A cluster of OHV or OSV noncompliances occurs in the same location 3 out of 5 years even though once the situation was detected, attempts are made to rectify the situation through signage and increased law enforcement officer presence.

3. Noncompliance trends: An increasing trend in noncompliances over a 5-year period.

**[F-7] Scope of Inference:** Forestwide and district.

**G. Indicator and its Units of Measure:**

1. Number of OHV noncompliances documented: A noncompliance is defined as a warning notice*, incident report**, or violation notice*** issued for use of an OHV in areas of the Chugach National Forest designated for nonmotorized use only.

2. Number of OSV noncompliances documented: The definition is the same as above except that it applied to use of OSV.

   [Note: *A warning notice is issued when, in the mind of the officer issuing it, the violation occurred because of inadvertence, lack of understanding, or misinformation.

   **An incident report is a written record of a violation, or multiple violations, of law, where, generally, the violations are discovered after the fact and the violator(s) identity is unknown. The Forest Officer should document each illegal incident they observe.

   ***A violation notice is issued to a violator because, in the mind of the officer, the violator knew or should have known that the act or omission of an act violated Forest Service regulations. The violator would receive one violation notice for each offense code that had been violated and the violation notice can only be issued to one individual at a time, a single violation notice cannot be issued to multiple violators.]

**H. Sampling Design:** This protocol employs opportunistic sampling.

**[H-1] Target Population:** Recreationists who use an OHV or OSV in areas of the Chugach National Forest designated for nonmotorized use only.

**[H-2] Sampling Frame:**

Patrols for noncompliances will occur on roads near areas designated for nonmotorized access.

**[H-3] Sample Selection Methods:**

All records of noncompliances for motorized use in a designated nonmotorized area of the Chugach National Forest in the Law Enforcement and Investigation (LEI) Management Attainment Reporting System (LEIMARS) database.

**[H-4] Sample Unit Description:**

**[H-5] Detection and Observer Bias Controls:**

All noncompliances entered into the LEIMARS database were originally documented by Chugach National Forest law enforcement officers and forest protection officers who are knowledgeable of the location and details of the forest's motorized and nonmotorized prescriptions.

**[H-6] Sample Size Estimate and Estimation Methods:** NA.

**[H-7] Temporal Details of Sampling**: LEIMARS records will be queries for a minimum of a 5-year period starting October 15 and ending October 14. These data will then be split out by year starting and ending with the same dates. This will result in a separate set of records for each of the years in the query. Also note that patrols for noncompliances likely occur more often in the winter than in the summer because there appears to be more noncompliances in the winter due to easier access.

**I. Data Collection:**

All employees on each district will be asked to report any observations of noncompliances to the district law enforcement officer or forest protection officer. However, verification and documentation of noncompliances as well as their entry into LEIMARS will be done by the law enforcement program. Therefore, noncompliances data will be obtained from the Law Enforcement and Investigation Office at the Alaska Regional Office.

**J. Quality Control and Assurance:** Law enforcement officers and forest protection officers use standardized forms to document noncompliances.

**K. Data Form:** Attachment Q36-1 is a form for recording communications with the public about motorized and nonmotorized access on the Chugach National Forest. Attachment Q36-3 is an outline for the annual district meetings that should also be used to record the meeting.

**L. Data Storage:**

**[L-1] Data Cleaning Methods:** This will be performed by the law enforcement staff. Trained specialists on the forest perform data entry into the LEIMARS database for the Chugach National Forest. LEIMARS has very strict access rules and securities. In addition, the database is periodically audited for errors by the regional office LEIMARS specialist.

**[L-2] Data Storage:** These data are stored in the LEIMARS database to which generally only the Forest Service law enforcement staff has access.

**M. Data Analysis:** All noncompliance data will be obtained from the LEIMARS specialist in the regional office law enforcement and investigation staff. Annual data will be analyzed separately for OHV and OSV noncompliances. This will be done for noncompliances forestwide and by district.

*Clustered noncompliances*: The latitude and longitude of each noncompliance is recorded in LEIMARS and can be mapped in a GIS. Analysis can then be done to determine whether noncompliances are occurring in clusters (three or more noncompliances occurring within a 2.5-mile radius). The number and location of clusters can also be determined.

The general analysis will involve drawing a circle (polygon) with a 2.5-mile radius centered on, and around, each noncompliance in a year. All polygons encompassing three or more noncompliances will be deemed a noncompliance cluster. When counting noncompliance clusters, those that overlap will be counted as a single cluster. A separate GIS layer will be created for each year’s analysis.

*Repeated clustered noncompliances:* Annual layers of noncompliance clusters will be overlaid to determine if they are occurring in the same area over time. Any overlap between clusters will be deemed a repeated cluster noncompliance. The number of years each cluster noncompliance is repeated will be counted and their locations noted.

*Annual noncompliances and trends:* To control for bias due to changing effort, noncompliances will be divided by the number of hours logged in LEIMARS for patrols for OHV and OSV noncompliances. **Annual noncompliances and the resulting trends will be determined using only noncompliances documented by** law enforcement officers since the effort of forest protection officers is unknown. The annual calculation will then be:

(The annual number of noncompliances documented by law enforcement officers) ÷ (number of hours logged by law enforcement officers for OHV and OSV patrols)

These data will then be plotted and assessed visually for trends. Reliable data are generally not available before 2003, so we do not have a baseline for prior to implementation of the Revised Forest Plan. Data between 2003 and 2007 will indicate the trend in noncompliances on the Chugach National Forest after the Revised Forest Plan was implemented and before the Kenai Winter Access decision was made. Data from 2008 and after will reflect changes made to the Forest motorized access plan as a result of the Kenai Winter Access decision.

**N. Assumptions and Limitations:**

We assume that the level of effort by law enforcement officers and forest protection officers will allow detecting when the threshold for clustered noncompliances is surpassed.

**O. Reporting Frequency:** Every 5 years.

**P. Responsibility:** Chugach National Forest Supervisor's Public Services Staff Officer.

**Q. List of Preparers:**

Mary Friberg, Inventory and Monitoring Coordinator, USDA Forest Service, Regional Office, Juneau, Alaska.

Steve Hennig, Landscape Architect, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

Alison Rein, Recreation Specialist, USDA Forest Service, Chugach National Forest, Glacier Ranger District, Girdwood, Alaska.

**R. 10-Year Cost Forecast**: Total 10-year cost: $5,830. This estimate includes work for 6 person days at roughly $450 per day and every fifth year. Estimated annual cost in Revised Forest Plan (p. 5-15) is $ 5,000.

| | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Total** | $2,700 | $0 | $0 | $0 | $0 | $3,130 | $0 | $0 | $0 | $0 |

**S. Literature Cited:**

Alaska Mining & Diving. 2007. Personal communication; phone conversation.

Cordell, H. Ken [and others]. 1999. Outdoor Recreation Participation Trends. In: Cordell, H. Ken; [and others]. 1999. *Outdoor Recreation in American Life: A National Assessment of Demand and Supply Trends*. Sagamore Publishing; Champaign, Illinois. pp. 219–321.

## *Attachment Q36-1. Motorized/Nonmotorized User Reports Form*

**Instructions:** Use this form to guide and record any unsolicited communications with Forest users regarding their satisfaction with motorized and nonmotorized access, and conflicts between motorized and nonmotorized users, on the Forest (see the back of this form for further important guidance). Communications may be received in any form. Record the details of the communication except any personal information about the person (e.g. name, address, phone number). Even if you are asked to take down their name and number for someone to get back to them, do not record it here. Fill this report out either during the communication or immediately after so as not to lose information to memory. Submit the completed form (electronically or paper) immediately to your district/SO recreation planner. See Attachment Q36-2 for an example of this formed filled out.

**TYPE OF USE**

1. Which of the following best characterizes the type of recreation the user engages in most on the Forest?
   ___ Motorized
   ___ Nonmotorized
   ___ Both motorized and nonmotorized recreation
   ___ No information on type of recreation use

**SATISFACTION**

2. Did the user indicate their satisfaction with motorized/nonmotorized access on the Forest?
   ___Yes
   ___ No

   If yes, for the following set of questions, indicate the response that most accurately represents the user's satisfaction and the season of access for which it applies. Enter a **W** for winter, **S** for summer, and **N** for no information on season. More than one season may be attributed to a single response and a single season may be attributed to more than one response.

   a. Which of the following characterizes the user's satisfaction with motorized and nonmotorized access on the Forest?

      ___ Satisfied with motorized access on the Forest
      ___ Unsatisfied with motorized access on the Forest
      ___ Satisfied with nonmotorized access on the Forest
      ___ Unsatisfied with nonmotorized access on the Forest

   b. Did the user express a desire for and/or expectation of the Forest to take action(s) to improve the user's satisfaction?

      ___ Yes: Specify the action:_____

      ___ No: The user indicated they do not have a desire for and/or expectation of action(s)
      ___ No information on desire and/or expectation of action(s)

**CONFLICTS**

3. Did the user report a conflict(s) between motorized and nonmotorized users of the Forest?
   ___ Yes
   ___ No

   If yes, for the following set of questions, indicate the response that most accurately represents the conflict(s) and the season of access for which it applies. Enter a **W** for winter, **S** for summer, and **N** for no information on season. Again, more than one season may be attributed to a single response and a single season may be attributed to more than one response.

   a. Was the user the motorized or nonmotorized user in the conflict(s)?
      ___ Motorized
      ___ Nonmotorized
      ___ User has been in conflicts as a motorized and as a nonmotorized user
      ___ User observed, but was not in the conflict(s)
      ___ No information on the role

   b. Where specifically did the conflict occur on the Forest: _____

   c. What is the extent of the conflict(s) reported?
      ___ User reported a single occurrence of a conflict on the Forest
      ___ User reported widespread and/or repeated occurrences of conflicts on the Forest
      ___ No information on the extent

d. What was the effect of the conflict(s)?
___ Effect was on the recreation experience
___ Effect was on personal property and/or safety
___ Effect was on natural environment
___ No information on the effect

e. Did the user express a desire for and/or expectation of the Forest to take action(s) to resolve the conflict(s)?
___ Yes: Specify the action: _____
___ No: The user indicated they do not have a desire for and/or expectation of action(s)
___ No information on desire and/or expectation of action(s)

**Appropriate use of this form:** This form is not to be used as part of a formal survey of opinions of the public. The form should be used to guide and record unsolicited communications with the public about their satisfaction with motorized nonmotorized access on the Forest or a conflict between motorized and nonmotorized users. An unsolicited communication about the public's satisfaction and conflicts regarding motorized nonmotorized access is a communication on this subject that is not initiated by the Forest. Examples include:

- *The public initiates contact* with the Forest to talk about their satisfaction or a conflict regarding motorized nonmotorized use on the Forest. This could be via phone, email, postal service, a visit to a Chugach National Forest office, out on the Forest, or using the suggestion box at the Anchorage Sportsman's Show.
    - A skier stops in a district office to complain about all the snowmobile noise in their favorite area to ski on the Forest.
    - An OHV user writes a district office to request that more areas of the Forest be open to OHV use near their home.
    - The public reports their satisfaction or a conflict using the generic suggestion box at the Anchorage Sportsman's Show.
- During the course of a communication between the Chugach National Forest and the public about another subject *the public brings up* their satisfaction or a conflict regarding motorized or nonmotorized use on the Forest.
    - A Chugach National Forest Law Enforcement Officer while on duty makes contact with a group of snowmachiners in a Chugach National Forest parking lot. In the course of the contact a snowmachiner indicates they believe there are not enough large parking lots on the Forest that will accommodate multiple snowmachine trailers. They indicate they would like the Forest to build more of these parking lots.
    - A resources staff officer returns a call from the public regarding bears on their property adjacent the Forest. In the course of the contact the land owner also brings up that they noticed OHV trails in an area of the Forest. The area is open to OHV use for subsistence purposes, but the land owner does not like that the OHVs are in their words "tearing everything up out there." They tell the staff officer the area should be closed to all OHV use.

Only in the situation where the public brings up the subject of their satisfaction of, or conflicts about, motorized/nonmotorized access is it appropriate to use this form to guide the communication.

## *Attachment Q36-2. (EXAMPLE) Motorized/Nonmotorized User Reports Form*

**Instructions:** Use this form to guide and record any unsolicited communications with Forest users regarding their satisfaction with motorized and nonmotorized access, and conflicts between motorized and nonmotorized users, on the Forest (see the back of this form for further important guidance). Communications may be received in any form. Record the details of the communication except any personal information about the person (e.g. name, address, phone number). Even if you are asked to take down their name and number for someone to get back to them, do not record it here. Fill this report out either during the communication or immediately after so as not to lose information to memory. Submit the completed form (electronically or paper) immediately to your district/SO recreation planner. See Attachment Q36-2 for an example of this formed filled out.

**TYPE OF USE**

1. Which of the following best characterizes the type of recreation the user engages in most on the Forest?
   ___ Motorized
   X__ Nonmotorized
   ___ Both motorized and nonmotorized recreation
   ___ No information on type of recreation use

**SATISFACTION**

2. Did the user indicate their satisfaction with motorized/nonmotorized access on the Forest?
   X_ Yes
   ___ No

   If yes, for the following set of questions, indicate the response that most accurately represents the user's satisfaction and the season of access for which it applies. Enter a **W** for winter, **S** for summer, and **N** for no information on season. More than one season may be attributed to a single response and a single season may be attributed to more than one response.

   a. Which of the following characterizes the user's satisfaction with motorized and nonmotorized access on the Forest?

      ___ Satisfied with motorized access on the Forest
      W,S Unsatisfied with motorized access on the Forest
      ___ Satisfied with nonmotorized access on the Forest
      ___ Unsatisfied with nonmotorized access on the Forest

   b. Did the user express a desire for and/or expectation of the Forest to take action(s) to improve the user's satisfaction?

      W,S Yes. Specify the action: *Better signage throughout the Forest indicating the motorized access prescription.*
      ___ No: The user indicated they do not have a desire for and/or expectation of action(s)
      ___ No information on desire and/or expectation of action(s)

**CONFLICTS**

3. Did the user report a conflict(s) between motorized and nonmotorized users of the Forest?
   X_ Yes
   ___ No

   If yes, for the following set of questions, indicate the response that most accurately represents the conflict(s) and the season of access for which it applies. Enter a **W** for winter, **S** for summer, and **N** for no information on season. Again, more than one season may be attributed to a single response and a single season may be attributed to more than one response.

   a. Was the user the motorized or nonmotorized user in the conflict(s)?
      ___ Motorized
      W__Nonmotorized
      ___ User has been in conflicts as a motorized and as a nonmotorized user
      ___ User observed, but was not in the conflict(s)
      ___ No information on the role

      Where specifically did the conflict occur on the Forest: *Manitoba Mountain*

   b. What is the extent of the conflict(s) reported?
      ___ User reported a single occurrence of a conflict on the Forest
      W_ User reported widespread and/or repeated occurrences of conflicts on the Forest
      ___ No information on the extent

c. What was the effect of the conflict(s)?
W_ Effect was on the recreation experience
___ Effect was on personal property and/or safety
___ Effect was on natural environment
___ No information on the effect

d. Did the user express a desire for and/or expectation of the Forest to take action(s) to resolve the conflict(s)?
W_ Yes: Specify the action: *Increase law enforcement patrol Manitoba Mountain*
___ No: The user indicated they do not have a desire for and/or expectation of action(s)
___ No information on desire and/or expectation of action(s)

***Attachment Q36-3. Summary of the Annual Motorized/Non-motorized User Reports***

Following is a summary of reports received between October 15, 20__ and October 14, 20__ from Forest users about their satisfaction with motorized and non-motorized access and conflicts between motorized and non-motorized users on the Forest.

## GENERAL SUMMARY

Total number of reports for the year ___

The total number (and percentage) of reports received by Forest user type:

- o Motorized ___
- o Non-motorized ___
- o Both motorized and non-motorized recreation ___
- o No information on type of recreation use ___

## SATISFACTION

Total number of reports received regarding satisfaction ___

Total (and percentage) of satisfied users ___

Total (and percentage) of unsatisfied users ___

Total of satisfied and unsatisfied users by type and by season. Also summarizes the number of users who requested the Forest take action to improve their satisfaction and those who indicated no action was necessary.

**User Type: <u>All</u>**

| | Winter | Summer | Season Unknown |
|---|---|---|---|
| **Satisfied** | | | |
| **Unsatisfied** | | | |
| **Action Expected** | | | |
| **No Action Expected** | | | |

**User Type: <u>Motorized</u>**

| | Winter | Summer | Season Unknown |
|---|---|---|---|
| **Satisfied** | | | |
| **Unsatisfied** | | | |
| **Action Expected** | | | |
| **No Action Expected** | | | |

**User Type: Non-motorized**

| | Winter | Summer | Season Unknown |
|---|---|---|---|
| **Satisfied** | | | |
| **Unsatisfied** | | | |
| **Action Expected** | | | |
| **No Action Expected** | | | |

**User Type: Both Motorized and Non-motorized**

| | Winter | Summer | Season Unknown |
|---|---|---|---|
| **Satisfied** | | | |
| **Unsatisfied** | | | |
| **Action Expected** | | | |
| **No Action Expected** | | | |

**Short Narrative:** [*Include details about the specific actions requested and places where conflicts occurred.*]

**CONFLICTS**

Total number of reports of a conflict between motorized and non-motorized users on the Forest ___

Total number (and percentage) of reports of a conflict by season:

- o Winter ___
- o Summer ___

Total number (and percentage) of reports indicating the extent of the conflict was:

- o A single occurrence ___
- o Widespread and/or repeated ___

Total number (and percentage) of reports indicating the effect of the conflict was on:

- o The recreation experience ___
- o Personal Property ___
- o The natural environment ___

Total number of conflicts by the user's role in the conflict and by season that the user considered to be a single occurrence or widespread and/or repeated occurrence, the effect of the conflict, and whether the user requested the Forest take action to resolve the conflict.

**All Reports of Conflicts Combined**

| | Winter | Summer | Season Unknown |
|---|---|---|---|
| **Single Occurrence** | | | |
| **Widespread** | | | |
| **Affected Experience** | | | |
| **Affected Personal Property/Safety** | | | |
| **Natural Environment** | | | |
| **Action Expected** | | | |
| **No Action Expected** | | | |

**Reported by a Motorized User in the Conflict**

| | Winter | Summer | Season Unknown |
|---|---|---|---|
| **Single Occurrence** | | | |
| **Widespread** | | | |
| **Affected Experience** | | | |
| **Affected Personal Property/Safety** | | | |
| **Natural Environment** | | | |
| **Action Expected** | | | |
| **No Action Expected** | | | |

**Reported by a Non-motorized User in the Conflict**

| | Winter | Summer | Season Unknown |
|---|---|---|---|
| **Single Occurrence** | | | |
| **Widespread** | | | |
| **Affected Experience** | | | |
| **Affected Personal Property/Safety** | | | |
| **Natural Environment** | | | |
| **Action Expected** | | | |
| **No Action Expected** | | | |

**Short Narrative**: [*Include details about the specific places where conflicts occurred and the specific actions requested by the users.*]

## *38. What are the trends in the use of developed recreational facilities and how does it compare to capacity?*

**A. Monitoring Item: A. *Recreation Opportunities, Tourism, Access, and Facilities***

**B. MEIT Interpretation of General Monitoring Question:** Interpreted as stated.

**C. Business Need and Rationale:** The business need for this monitoring is summarized in the Revised Forest Plan summary of the current management situation. It states "Demand for recreation opportunities on the Chugach National Forest is now greater than ever. Increased tourism, an increased state population and the proximity to Anchorage have combined to make the Chugach the place where many people seek from road accessible to wild and remote recreation opportunities. Improved access to the Forest is expected to further accelerate recreation and tourism uses on the Forest" (chapter 2, p. 11).

This increase is most prominent in areas accessible by car from Anchorage. The Forest's overnight use developed recreation fee-site facilities (hereafter referred to as OUDs) have not expanded to accommodate the increased population and increases in tourism of the areas. Tourism statewide has grown at least 6 percent annually, according to many reports by organizations and businesses interested in the economic impacts of tourism. The population of Anchorage has grown at 15 percent (City-Data.com), while the Kenai Peninsula Borough has remained flat (Williams et al. 2010). OUDs capacity on the Forest has grown 3 percent during this period. Occupancy rates were calculated for our OUDs for years 2003 to 2006, based on data collected by the Chugach campground concessionaires and the cabin reservation system. Campgrounds have been averaging 85 percent occupancy during summer holidays and weekends and 46 percent on weekdays. Cabin occupancy was not broken out by weekend and weekday with an average forestwide occupancy rate of 63 percent during the main-use season. Cabins with high access costs have lower occupancy rates. INFRA data suggest the rate of increase is fairly flat, (Roenfanz, personal communication), but use is over optimum levels as defined by the forest plan final environmental impact statement (FEIS) (60 percent annual average occupancy; p. 3-307).

This monitoring directly contributes to the following Revised Forest Plan goal (p. 3-7):

- Improve knowledge and understanding of recreational activity and user satisfaction.

As well as the objective to:

- Develop information on recreational activities, patterns of use, and key recreational issues.

This monitoring will also inform management decisions regarding OUDs development on the forest and thus contribute toward the Chugach National Forest obtaining the following goal and desired condition:

> "Maintain current recreational capacity through the maintenance of existing recreational facilities and trails. Expand recreational capacity by developing new recreational facilities and trails in response to user

demands and where appropriate to management area objectives" (Revised Forest Plan; p. 3-9).

- Kenai – Improvement such as "expanded campgrounds, and new cabins will extend the ability of the Kenai Peninsula to accommodate increased summer recreation use without diminishing the area's natural quality" (p. 3-15).
- Copper River Delta – "Developed recreation facilities will have been improved in this area including the development of a recreation complex at Childs Glacier" (p. 3-19).

Expansion of OUDs in Prince William Sound is not a desired condition of the Revised Forest Plan.

**D. Category:** *Validation.* The FEIS projects use of cabins will increase from 7,055 visits in 2000 to 7,931 in 2010. Developed campsites will increase from 163,217 visits in 2000 to 200,985 in 2010 (FEIS p. 3-46). This is a 12 percent and 23 percent increase, respectively. The FEIS projects that capacity for cabin use will exceed demand by 2010. In addition, it indicates that the cabin use on the Kenai Peninsula is already at capacity. An additional 240 campsites would need to be on the Kenai Peninsula to meet demand in 2010 (FEIS pp. 3-355 through 3-356). The FEIS defined capacity for OUDS using a "people-at one time" (PAOT) number multiplied by the number of days the facility is open. For a single campsite, the PAOT is 5. A cabin PAOT is generally between 4 and 6, and can vary depending on the number of bunks.

**E. Protocol Status, Source, and Re-evaluation Schedule:** This protocol was developed by the Chugach National Forest and is considered final. The high-use periods used here may adjust over time for various reasons such as changes in hunting and fishing regulations. Re-evaluation of the definition of high-use periods should be done at least every 5 years. Knowledge of new campgrounds and their management (concessionaire or the Forest) should also be considered as the information becomes available. For example, the newly remodeled Childs Glacier campground will be managed by the Forest. Use data for this campground will eventually be entered into the INFRA database, and should be summarized as part of this protocol. Also note that data analysis may need to be done more frequently if the rate of change in percent occupancy of cabins or campground sites (hereafter referred to as campsites) increases or decreases. The rate is currently flat and at capacity (average near 60 percent) for all geographic areas except the Copper River Delta.

**F. Objective Statement:** Determine the trends in the use of overnight developed recreation fee-site facilities and how they compare to capacity.

**[F-1] Required by Law:** Not applicable

**[F-2] Statistical Rigor Rationale:** This is a census. This level of rigor is afforded because the data are already collected and available for free. No probabilistic statistics will be needed.

**[F-3] Data Precision, Reliability:** Class A

**[F-4] Confidence:** Not applicable; this is a census

**[F-5] Change Detection:** Not applicable; this is a census

**[F-6] Threshold:** Average of 60 percent occupancy over a 5-year period during the high-use season (as defined below).

**[F-7] Scope of Inference:** Forestwide and geographic area.

**G. Indicator and its Units of Measure:**

- Percent annual occupancy of campsites
- Percent annual occupancy of cabins

**H. Sampling Design:**

**[H-1] Target Population**: All OUDs (fee campground sites and cabins) on the Chugach National Forest.

**[H-2] Sampling Frame**: The same as the target population.

**[H-3] Sample Selection Methods**: Not applicable; this is a census

**[H-4] Sample Unit Description:** Not applicable

**[H-5] Detection and Observer Bias Controls:** Not applicable; this is a census

**[H-6] Sample Size Estimate and Estimation Methods:** This is a census. There are currently 778 campsites and 41 cabins on the Chugach National Forest. Note that the Childs Glacier campground is not included in this tally.

**[H-7] Temporal Details of Sampling:** Censusing will occur annually. For the purposes of this monitoring, the census of campground units is restricted to starting the Friday of Memorial Day weekend through the end of Labor Day weekend (high season). The season in which censusing occurs differs among cabins, since some are used primarily by hunters. Some cabins receive their highest use August 1 through December 31, others between September 20 and December 31, but the majority receives the highest use from the Friday of Memorial Day weekend through September 20. Attachment Q38-1 includes a list of all cabins and the sampling period assigned to them.

**I. Data Collection:**

**[I-1] Methods for Locating Sample Units:** Not applicable

**[I-2]Methods for Layout and Marking:** Not applicable

**[I-3] “Field” Sampling Methods:** Data are collected by the campground concessionaires and cabin reservation system. These data are entered annually into INFRA by the Chugach National Forest recreation program. Eventually, the Forest will collect use data for the Childs Glacier Campground, which will also be entered into INFRA by the Chugach National Forest recreation program.

**J. Quality Control and Assurance:** Data are originally collected by the reservation service and concessionaire. Therefore, quality control for the data they provide is

documented in the concessionaire permit and reservation service contract. Quality control and assurance for data collected by the Forest should be documented here once it is appropriate to do so.

**K. Data Form:** None at this time – the concessionaires and reservation service collect data.

**L. Data Storage:**

> **[L-1] Data Cleaning Methods:** The Chugach National Forest recreation program will check all data for obvious errors. A random spot check of 10 percent of the data will also be performed.
>
> **[L-2] Data Storage:** Data are stored and in INFRA. Analyses conducted on these data will be stored in the forest planning area of the J drive and on CD at the recreation planner's desk.

**M. Data Analysis:** Analyses that follow will be done for each geographic area and forestwide.

1) Percent annual occupancy of campground sites =

> (sum of the number of days each campground sites was occupied in a year during the high season ÷ sum of the number of days each campground site was open during the high season in the same year) x 100

2) Percent annual occupancy of cabins =

> (sum of the number of days each cabin was occupied in a year during its high season (refer to Attachment Q38-1) ÷ sum of the number of days each cabin was open during the high season in the same year) x100

The above percentages will be plotted for the 5-year period and beyond if the data are available. The rate of change will be calculated to determine whether there is a need to change the reporting frequency.

**N. Assumptions and Limitations:** It is assumed that recreation data being collected are fairly accurate. These analyses will not inform the Forest about demand for OUDs. Also, what is tracked here for cabins is paid occupancy as reflected in the National Reservation System data. There has been concern that some cabins are receiving "unpaid" use.

**O. Reporting Frequency:** The forest plan suggests an annual evaluation of these data. Our review of the use of campgrounds and cabins suggests this level of monitoring is not necessary because, although use has been at the threshold on all areas of the Forest except the Copper River Delta, this use has been relatively constant. These data will be analyzed every 5 years until such time the data indicate an increasing or decreasing overall trend.

**P. Responsibility:** Chugach National Forest Supervisor's Public Services Staff Officer.

**Q. List of Preparers:**

Mary Friberg, Inventory and Monitoring Coordinator, USDA Forest Service, Regional Office, Juneau, Alaska.

Steve Hennig, Landscape Architect, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

Alison Rein, Recreation Specialist, USDA Forest Service, Chugach National Forest, Glacier Ranger District, Girdwood.

**R. 10-Year Cost Forecast:** The forest plan projected the total 10-year cost: $20,000; 10-year cost forecast with Inflation: $12,152.

| | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Total** | **$5,628** | **$0** | **$0** | **$0** | **$0** | **$6,524** | **$0** | **$0** | **$0** | **$0** |

Cost ($)

**S. Literature Cited:**

City-Data.com. 2011. Census data for Alaska cities over 6,000 residents. Available online at http://www.city-data.com/city/Alaska.html accessed June 24, 2011.

Goldsmith, Scott. Proceedings of the Commonwealth North Forum, March 21, 2000.

Roenfanz, Hope. 2007, conversation. Program Specialist INFRA, USDA Forest Service, Chugach National Forest, Seward Ranger District. Moose Pass, Alaska.

Williams et al. 2010. Alaska Department of Labor & Workforce Development. Alaska Population Overview, 2009 Estimates. Available online at http://labor.alaska.gov/research/pop/estimates/pub/popover.pdf. Accessed June 24, 2011.

***Attachment Q38-1. Cabin sampling periods***

| COPPER RIVER DELTA | Sampling Period |
|---|---|
| **MARTIN LAKE CABIN** | **August 1 - December 31** |
| **MCKINLEY LAKE CABIN** | **Saturday prior to Memorial Day Weekend to September 20** |
| **MCKINLEY TRAIL CABIN** | |
| **POWER CREEK CABIN** | |
| **SOFTUK BAR CABIN** | |
| **TIEDEMAN SLOUGH CABIN** | |
| PRINCE WILLIAM SOUND | |
| **NELLIE MARTIN RIVER CABIN** | **August 1 to December 31** |
| **BEACH RIVER CABIN** | **September 20 to December 31** |
| **DOUBLE BAY CABIN** | |
| **HOOK POINT CABIN** | |
| **LOG JAM BAY CABIN** | |
| **PORT CHALMERS CABIN** | |
| **SAN JUAN BAY CABIN** | |
| **SHELTER BAY CABIN** | |
| **COGHILL LAKE CABIN** | **Saturday prior to Memorial Day Weekend to September 20** |
| **GREEN ISLAND CABIN** | |
| **HARRISON LAGOON CABIN** | |
| **JACK BAY CABIN** | |
| **PAULSON BAY CABIN** | |
| **PIGOT BAY CABIN** | |
| **SHRODE LAKE CABIN** | |
| **SOUTH CULROSS PASSAGE CABIN** | |
| KENAI PENINSULA | |
| **ASPEN FLATS CABIN** | **Saturday prior to Memorial Day Weekend to September 20** |
| **BARBER CABIN** | |
| **CARIBOU CREEK CABIN** | |
| **CRESCENT LAKE CABIN** | |
| **CRESCENT SADDLE CABIN** | |
| **CROW PASS CABIN** | |
| **DALE CLEMENS CABIN** | |
| **DEVIL'S PASS CABIN** | |
| **EAST CREEK CABIN** | |
| **FOX CREEK CABIN** | |
| **JUNEAU LAKE CABIN** | |
| **LOWER PARADISE LAKE CABIN** | |
| **ROMIG CABIN** | |
| **SWAN LAKE CABIN SEWARD** | |
| **TROUT LAKE CABIN** | |
| **UPPER PARADISE LAKE CABIN** | |
| **UPPER RUSSIAN LAKE CABIN** | |
| **WEST SWAN LAKE CABIN** | |

## *39. What are the trends in commercial recreation services on the Forest and how does it compare to capacity?*

**A. Monitoring Item: *Recreation Opportunities, Tourism, Access, and Facilities***

**B. MEIT Interpretation of General Monitoring Question:** Interpreted as stated.

**C. Business Need and Rationale:** The business need for this monitoring is summarized in the Chugach National Forest Plan Summary of the Current Management Situation where it states “Demand for recreation opportunities on the Chugach National Forest is now greater than ever. Increased tourism, an increased state population and the proximity to Anchorage have combined to make the Chugach the place where many people seek from road accessible to wild and remote recreation opportunities. Improved access to the Forest, particularly the new road to Whittier, is expected to further accelerate recreation and tourism uses on the Forest” (May 2002 Land and Resource Management Plan, R10-MB-480c; p. 2-11).

Commercial recreation use is perceived to be climbing and displacing non-commercial users. Anecdotal information indicates commercial group sizes and the number of groups in an area are causing noncommercial users to go elsewhere. There is concern by the outfitter/guide community about whether they will be able to expand their businesses over time or whether limits will be imposed by the forest. The forest seeks to maintain recreation opportunity settings without the need for imposed limits (Steve Hennig, *personal communication*).

This monitoring will directly meet the goal and objective of the forest plan to “Improve knowledge and understanding of recreational activity” by developing “information on recreational activities, patterns of use and key recreational issues” (p. 3-7) as they relate to commercial recreation services. This monitoring will allow managers to make more informed decisions on the management of commercial recreation forestwide and at the geographic area scale.

**D. Category:** *Effectiveness*. The forest plan calls for baseline and validation monitoring. The intent for this question to be validation monitoring is not clear because the specific monitoring questions identified in the Monitoring Strategy are baseline questions. Effectiveness monitoring is more appropriate at this time because commercial service levels and trends and their relationship to capacity are unknown. Validation work may be appropriate if the threshold is surpassed.

**E. Protocol Status, Source, and Re-evaluation Schedule:** As monitoring this protocol is considered final. However, a re-evaluation of whether these protocols are adequate will occur at 5-year intervals after implementation. If the threshold is obviously being surpassed, then it is likely these methods will be revamped to address validation questions regarding commercial recreation services on the Chugach National Forest.

**F. Objective Statement:** The objectives of this monitoring are to determine the number of people using commercial services to recreate on the Chugach National Forest and to determine whether that use exceeds the capacity set in the forest plan. In addition, general trends in the public use of commercial services to recreate on the forest are sought.

**[F-1] Required by Law:** No

**[F-2] Statistical Rigor Rationale:** Not applicable (this is a census)

**[F-3] Data Precision, Reliability:** Class A

**[F-4] Confidence:** Not applicable (this is a census)

**[F-5] Change Detection:** Not applicable (this is a census)

**[F-6] Threshold:** The threshold for commercial recreation services for the Forest and the three geographic areas is defined as meeting or exceeding the theoretic carrying capacity for that area over the period of Memorial Day through Labor Day for a minimum of two out of three consecutive years. This theoretic carrying capacity for the Chugach National Forest and each area is as follows:

i. Forestwide: 252,600 actual client days

ii. Kenai Peninsula: 94,300 actual client days

iii. Prince William Sound: 92,400 actual client days

iv. Copper River Delta: 65,900 actual client days

The season was restricted to Memorial Day through Labor Day, because this represents the primary use season when use is highest. Some specific activities occur outside this season, typically hunting and fishing, but this use is usually concentrated, and capacity issues should be handled on a case-by-case basis. See Attachment Q39-2 for further details on the methods used to calculate each theoretic carrying capacity.

Note that the carrying capacity for commercial recreation services on the Prince William Sound geographic area is currently being determined. This work should be complete in FY11 and the results will be substituted for the Prince William Sound threshold when it becomes available. There are no plans at this time to conduct capacity studies on the other geographic areas.

**[F-7] Scope of Inference:** The scope of inference for this monitoring is the Chugach National Forest as a whole, as well as each geographic area (Kenai Peninsula, Prince William Sound, and Copper River Delta). Inferences from this monitoring can only be made to the years, and time of year (Memorial Day to Labor Day) over which this monitoring occurs.

**G. Indicator and its Units of Measure:** The indicator and its units of measure are the total number of actual client days that recreationists spend on the Chugach National Forest through services provided by a Special Use Permittee between Memorial Day and Labor Day. Only Special Use Permittees providing transportation, packing, outfitting, guiding, leading, and instructor services to commercial recreationists for a fee will be used to calculate the indicator. An actual client day is a day or part of a day for each individual accompanied or provided services by an outfitter or guide. Where supply or drop-off service alone is performed, these are considered non-commercial users and not included in the actual client days. Any period of time, when clients (individually or in

groups) are on the Chugach National Forest and under the direction, care or tutelage of a guide or outfitter, shall be counted as part of the total actual client days. Commercial tours of the Begich Boggs Visitor Center are not included.

**H. Sampling Design:** This is a census.

**[H-1] Target Population:** Commercial recreationists forestwide during the current planning cycle.

**[H-2] Sampling Frame:** All Final Use Reports submitted to the Chugach National Forest by Special Use Permittees providing transportation, packing, outfitting, guiding, leading, and instructor services on the Forest.

**[H-3] Sample Selection Methods**: Not applicable (this is a census)

**[H-4] Sample Unit Description:** A Final Use Report to the Chugach National Forest by Special Use Permittees providing transportation, packing, outfitting, guiding, leading, and instructor services on the Forest. The Final Use Report must list the trip date(s), specific location, activity, number of guides, number of clients, and number of days on the Chugach National Forest. Each trip must be listed separately.

**[H-5] Detection and Observer Bias Controls:** Not applicable

**[H-6] Sample Size Estimate and Estimation Methods:** Not applicable

**[H-7] Temporal Details of Sampling**: Final Use Reports for the period of Memorial Day through Labor Day will be monitored on an annual basis. These reports are due no later than December 30 of each year.

**I. Data Collection:** The data will be collected from commercial recreation special use permit Final Use Reports provided by the permittees. These are housed at each of the three ranger districts. The ranger district special use permit staff will enter the data into the database.

**[I-1] Methods for Locating Sample Units:**

**[I-2]Methods for Layout and Marking:**

**[I-3] “Field” Sampling Methods:**

**J. Quality Control and Assurance:** The quality of these data depends on the accuracy and completeness of the Final Use Reports from the permittee.

**K. Data Form:** A form was created to collect data needed for monitoring and to help determine carrying capacity and if additional commercial activities should be permitted. The form is named (Commercial_Recreation_SUP_Data_Collection.mdb) and is included as Attachment Q39-1.

**L. Data Storage:**

**[L-1] Data Cleaning Methods:** Data are checked to ensure required fields are not left blank. Pulldown menus provide lists of business names, activities, seasons, landscape areas, etc., to ensure consistency in data entry.

**[L-2] Data Storage:** Initially data will be stored in an Access database stored in the Supervisor's Office. The Oracle database being created for a similar purpose for the Tongass National Forest may be used in the future if it is determined appropriate. The Oracle database will be stored at the National Information Technology Center in Kansas City.

**M. Data Analysis:** Actual client day information will be collected annually and analyzed every 3 years. Although thresholds have not been defined for separate activities, these calculations were also done for each activity type for informational purposes. Activities tracked are defined in the Flat Fee categories (FSH 2709.11, chapter 30). These calculations were performed every other year, starting with the year 2000. These calculations have been compared to the thresholds. The number of actual client days was determined for each Landscape Area for calendar years 2000, 2003, and 2006, and compared with the theoretic capacity. If deemed appropriate, after 6 years of data have been collected, regression analysis will be performed to determine trends.

**N. Assumptions and Limitations**: It is assumed that the data received from the permittee is complete and accurate. Methods to ensure this are limited. The theoretic capacity assumes a uniform distribution of recreation users across the forest. Local attractions, patterns and concentration areas (choke points) may require special consideration to maintain the desired recreation experience. It is also assumed that "persons at any one time" (PAOTS), as defined in the 1986 Recreation opportunity spectrum (ROS) Book (Red Book) has a one-to-one relationship with actual client days. See Attachment Q39-2 for further information on PAOTS.

**O. Reporting Frequency:** Data will be compiled annually and analyzed every 3 years.

**P. Responsibility:** Chugach National Forest Supervisor's Recreation, Lands and Minerals Staff Officer.

**Q. List of Preparers:**

Mary Friberg, Inventory and Monitoring Coordinator, USDA Forest Service, Regional Office, Juneau, Alaska.

Steve Hennig, Forest Landscape Architect, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

Karin Preston, GIS Database Coordinator, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

**R. 10-Year Cost Forecast:** Total 10-year estimated cost is $92,400; estimated annual cost in Revised Forest Plan (p. 5-16) is $6,000.

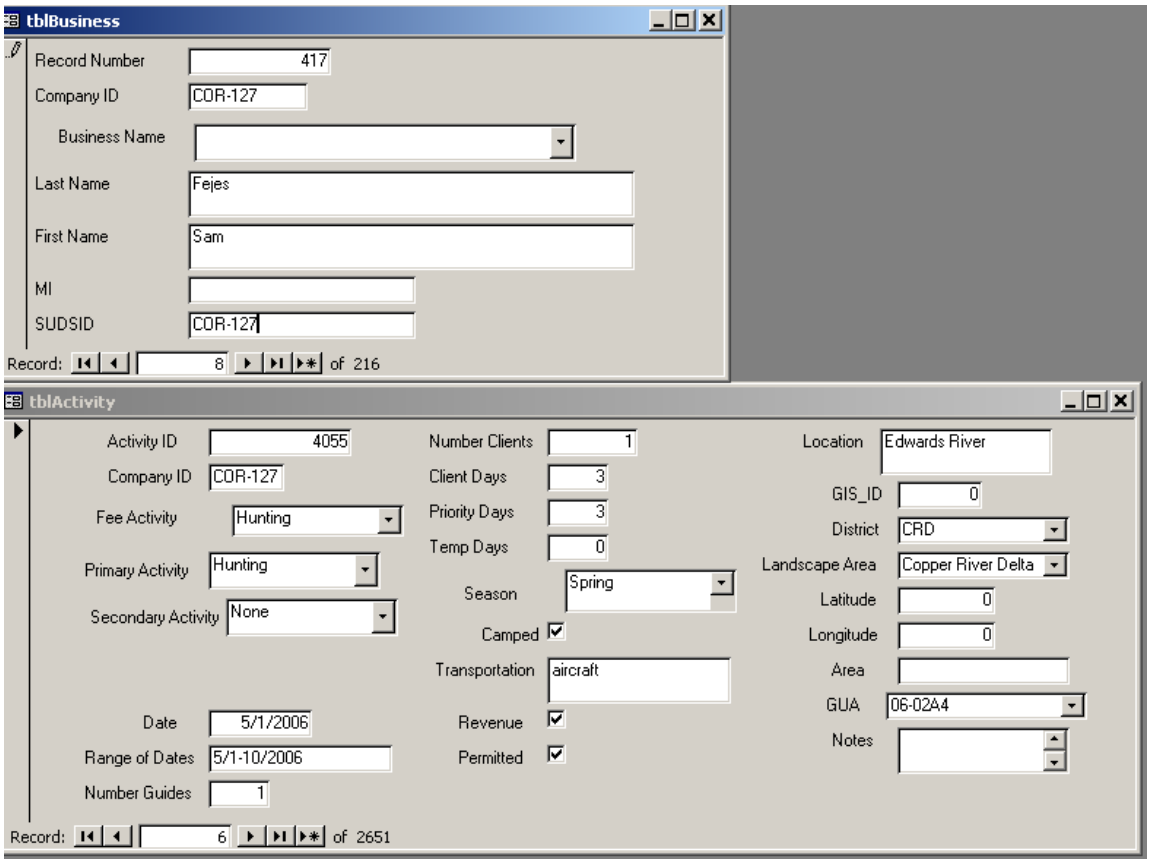
| | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Total** | **$6,800** | **$11,600** | **$7,200** | **$7,400** | **$12,700** | **$7,800** | **$8,000** | **$13,900** | **$8,400** | **$8,600** |

Cost in inflated dollars ($)

**S. Literature Cited:**

USDA Forest Service. 2002. *Chugach National Forest Revised Land and Resource Management Plan*. USDA Forest Service, Alaska Region R10-MB-480c. Alaska Region, Chugach National Forest, Anchorage, Alaska.

## *Attachment Q39-1. Commercial_Recreation_SUP_Data_Collection.mdb*




The database contains two forms. The tblBusiness form contains information about the permittee. The tblActivity form contains specific information about each individual activity conducted by the permittee. The two forms are linked by the CompanyID field.

## *Attachment Q39-2. Procedure for calculating theoretic capacities*

These capacities assume a uniform distribution of recreationists across the landscape area. The low ROS class capacity coefficients from the 1986 ROS Book (http://roadless.fs.fed.us/data/pdfdocs/rosguide.pdf p. 35) were used to determine the total "persons at any one time" (PAOTs) for each landscape area.

| | ROS Capacity Coefficients |
|---|---|
| **P/PII** | 0.002 |
| **SP** | 0.008 |
| **RN** | 0.083 |
| **R** | 0.83 |

This number was reduced according to the Outfitter/Guide Capacity Allocation percent from the May 2002 Land and Resource Management Plan, R10-MB-480c which varies from a minimum of 0 percent to a maximum of 60 percent, based on the prescription.

**Kenai Peninsula Landscape Area**. Areas suitable for recreation activities were required to be within a 0.5-mile buffer of a Forest Service campground, a 1.5-mile buffer of a Forest Service cabin, 0.75 mile either side of a road or trail, 0.5 mile either side of a major waterway or within 0.5 mile of the shore of a lake long enough (at least 1 mile) to land a small plane on. Areas within these areas that were ice, rock, or glacier were deemed to be unsuitable and were deleted. Also deleted were non-National Forest System lands (conveyed or private ownership) and slopes greater than 40 percent. The Roaded Natural ROS class was eliminated from the suitable acres because it was feared it would create a theoretic capacity that would skew the results in favor of road recreational activities. The remaining acres were combined with the ROS values and the prescriptions from the 2002 Land and Resource Management Plan. A report was prepared showing the suitable acres by ROS class and prescription. The suitable acres for each ROS class were multiplied by the ROS capacity coefficient for that class (http://roadless.fs.fed.us/data/pdfdocs/rosguide.pdf p. 35) to get the Total PAOTs. The outfitter and guide (O/G) clients per day were calculated by multiplying the Total PAOTs by the percent allocated to O/G use from the forest plan.

In a season approximately 100 days long (Memorial Day to Labor Day), the theoretic capacity for the Kenai Peninsula for O/G clients is approximately 94,300 actual client days.

| LRMP Prescription | ROS Class | Suitable Acres | Total PAOTs | percent O/G Allocation from Forest Plan | O/G Clients Per Day |
|---|---|---|---|---|---|
| Wild River | Semi-Primitive | 7,794 | 62.4 | 60.0 | 37.4 |
| Research Natural Area | Primitive | 1,206 | 2.4 | 0.0 | 0.0 |
| Backcountry | Semi-Primitive | 146,851 | 1,174.8 | 50.0 | 587.4 |
| Scenic River | Semi-Primitive | 9,487 | 75.9 | 50.0 | 37.9 |
| Brown Bear Core | Semi-Primitive | 26,526 | 212.2 | 50.0 | 106.1 |
| Fish & Wildlife Conservation | Semi-Primitive | 15,491 | 123.9 | 50.0 | 62.0 |
| Fish, Wildlife & Recreation | Semi-Primitive | 27,365 | 218.9 | 50.0 | 109.5 |
| Forest Restoration | Semi-Primitive | 4,698 | 37.6 | 0.0 | 0.0 |
| Recreation River | Semi-Primitive | 797 | 6.4 | 40.0 | 2.6 |
| Mining Claim | Rural | 5,135 | 4,262.1 | 0.0 | 0.0 |
| Transportation/Utility Corridor | Rural | 35 | 29.1 | 0.0 | 0.0 |
| **Total** | | **245,385** | **6,205.7** | | **942.8** |

**Prince William Sound Landscape Area.** Areas suitable for recreation activities were required to be below the 200-foot contour line, within a 1.5- mile buffer of a Forest Service cabin, 0.5 mile either side of a road or trail, 0.5 mile either side of a major waterway or within 0.5 mile of the shore of a lake long enough (at least 1 mile) to land a small plane on. Areas within these areas that were ice, rock, or glacier were deemed to be unsuitable and were deleted. Also deleted were non-National Forest System lands (conveyed or private ownership) and slopes greater than 40 percent. The remaining acres were combined with the ROS values and the current management prescriptions from the 2002 Land and Resource Management Plan. A report was prepared showing the suitable acres by ROS class and prescription. The suitable acres for each ROS Class were multiplied by the ROS Capacity coefficient for that class (http://roadless.fs.fed.us/data/pdfdocs/rosguide.pdf p. 35) to get the Total PAOTs. The O/G clients per day were calculated by multiplying the Total PAOTs by the percent allocated to O/G use from the forest plan.

In a season approximately 100 days long (Memorial Day to Labor Day) the theoretic capacity for the Prince William Sound for O/G clients is approximately 92,400 actual client days.

| LRMP Prescription | ROS Class | Suitable Acres | Total PAOTs | O/G percent | O/G Allocation |
|---|---|---|---|---|---|
| Research Natural Area | Primitive | 2,050 | 4.1 | 0.0 | 0.0 |
| Research Natural Area | Semi-Primitive | 54 | 0.4 | 0.0 | 0.0 |
| Fish, Wildlife & Recreation | Roaded Natural | 67 | 5.6 | 50.0 | 2.8 |
| Fish, Wildlife & Recreation | Semi-Primitive | 193 | 1.5 | 50.0 | 0.8 |
| Fish & Wildlife Conservation | Semi-Primitive | 59,894 | 479.2 | 50.0 | 239.6 |
| EVOS Acquired Lands | Semi-Primitive | 30,391 | 243.1 | 50.0 | 121.6 |
| Backcountry | Primitive | 32,390 | 64.8 | 50.0 | 32.4 |
| Backcountry | Roaded Natural | 43 | 3.5 | 50.0 | 1.8 |
| Backcountry | Semi-Primitive | 54,318 | 434.5 | 50.0 | 217.3 |
| Research Natural Area | Semi-Primitive | 1,696 | 13.6 | 0.0 | 0.0 |
| Wilderness Study Area | Primitive | 35,126 | 70.3 | 30.0 | 21.1 |
| Wilderness Study Area | Semi-Primitive | 119,459 | 955.7 | 30.0 | 286.7 |
| **Total** | | **335,680** | **2,276.3** | | **923.9** |

**Copper River Delta Landscape Area.** Areas suitable for recreation activities were required to be within a 1 mile buffer of a Forest Service cabin, 0.5 mile either side of a trail, 0.25 mile either side of a road, 0.5 mile either side of a major waterway or within 0.5 mile of the shore of a lake long enough (at least 1 mile) to land a small plane on. Areas within these areas that were ice, rock, or glacier were deemed to be unsuitable and were deleted. Also deleted were non-National Forest System lands (conveyed or private ownership) and slopes greater than 40 percent. The Roaded Natural ROS class was eliminated from the suitable acres because it was feared it would create theoretic capacity that would skew the results in favor of road recreational activities. The Roaded Natural ROS value for the Carbon Mountain and Katalla Roads was not eliminated because these roads have not been constructed yet. The remaining acres were combined with the ROS values and the prescriptions from the 2002 Land and Resource Management Plan. A report was prepared showing the suitable acres by ROS class and prescription. The suitable acres for each ROS Class were multiplied by the ROS Capacity coefficient for that class (http://roadless.fs.fed.us/data/pdfdocs/rosguide.pdf p. 35) to get the Total PAOTs. The O/G clients per day were calculated by multiplying the Total PAOTs by the percent allocated to O/G use from the forest plan.

In a season approximately 100 days long (Memorial Day to Labor Day), the theoretic capacity for Copper River Delta for O/G clients is approximately 65,900 actual client days.

| LRMP Prescription | ROS Class | Suitable Acres | Total PAOTs | O/G percent | O/G Allocation |
|---|---|---|---|---|---|
| Primitive | Primitive | 1,645 | 3.3 | 30.0 | 1.0 |
| 501(b)-1 | Primitive | 136,142 | 272.3 | 50.0 | 136.1 |
| 501(b)-1 | Roaded Natural | 1 | 0.1 | 50.0 | 0.1 |
| 501(b)-1 | Semi-Primitive | 1 | 0.0 | 50.0 | 0.0 |
| Backcountry | Semi-Primitive | 11,192 | 89.5 | 50.0 | 44.8 |
| 501(b)-2 | Primitive | 26,748 | 53.5 | 50.0 | 26.7 |
| 501(b)-2 | Roaded Natural | 97 | 8.0 | 50.0 | 4.0 |
| 501(b)-2 | Semi-Primitive | 53,771 | 430.2 | 50.0 | 215.1 |
| EVOS Acquired Lands | Semi-Primitive | 9,238 | 73.9 | 50.0 | 37.0 |
| Municipal Watershed | Semi-Primitive | 258 | 2.1 | 0.0 | 0.0 |
| 501(b)-3 | Semi-Primitive | 22 | 0.2 | 50.0 | 0.1 |
| 501(b)-3 | Roaded Natural | 4,673 | 387.9 | 50.0 | 193.9 |
| Transportation/Utility Corridor | Roaded Natural | 576 | 47.8 | 0.0 | 0.0 |
| Transportation/Utility Corridor | Semi-Primitive | 117 | 0.9 | 0.0 | 0.0 |
| **Total** | | **244,480** | **1,369.6** | | **658.8** |

## *Scenic Quality*

### *40. Are areas of the Forest being managed in accordance with the Scenery Integrity Objectives (SIO) in forestwide standards and guidelines?*

**A. Monitoring Item: *Scenic Quality***

**B. General Monitoring Question:** Are areas of the forest being managed in accordance with the scenic integrity objectives (SIO) in forestwide standards and guidelines?

**C. Business Need and Rationale:** The business need for this monitoring is identified in the forest plan goals and objectives where it is stated that the Forest will "maintain the outstanding scenic quality of the Chugach National Forest" and that this goal will be obtained by conducting "forest management activities consistent with Scenic Integrity Objectives" (p. 3-9). The Forestwide Recreation and Tourism Standards state that "Management activities will be designed to meet the scenic integrity objective (SIO) as mapped" and that "Within a watershed area, SIO acreage may be changed up to 20 percent within the range" prescribed in the Revised Forest Plan "without amending the Revised Forest Plan." "In no case may the effects of an activity exceed the level of scenic integrity of the lowest SIO in the range" (p. 3-35).

**D. Category:** Implementation

**E. Protocol Status, Source, and Re-evaluation Schedule:** This is a pilot protocol. It will be reviewed after the first year of implementation, finalized, and then re-evaluated every 5 years thereafter. This protocol relies upon data collected through the scenery management system. A reference for the scenery management system data collection methods will be supplied upon their completion.

**F. Objective Statement:** Determine to what extent the applicable forest plan direction and mitigation measures for SIO prescribed by NEPA decisions are implemented. This objective helps to fulfill the monitoring called for in question #1 and dovetails with that protocol.

> **[F-1] Required by law**: No, FSM 2820 directs the collection of the data upon which the protocol relies.
>
> **[F-2] Statistical Rigor Rationale:** Only very basic statistics will be used for data analysis. Because of the potential for undesired environmental impacts (significant or non-significant) that can be caused by not implementing decisions consistent with the forest plan or project-specified mitigation measures (significant or non-significant), it is expected that all projects conducted under an environmental impact statement (EIS) or environmental assessment (EA) will be monitored as part of this protocol.[39] Projects completed under a documented categorical exclusion (CE) will be sampled. The sample will be small in relation to the number of documented CEs published by the Chugach National Forest. However, all documented CEs and their implementation receive review during the NEPA process. In addition, projects completed under a documented CE are

[39] Should the Forest generate more than six EISs and EAs in a year, then a sample of these projects may be selected

"routine administrative, maintenance, and other actions [that] normally do not individually or cumulatively have a significant effect on the quality of the human environment" (FSH 1909.15 Chapter 30; 31.12). Therefore, a lower level of statistical rigor has been deemed acceptable.

**[F-3] Data Precision, Reliability**: Class B

**[F-4] Confidence:** We expect to have a high degree of confidence in the results from this monitoring. All EISs and EAs for which forest plan direction for SIOs is applicable and for which SIO mitigation measures were prescribed will be monitored. Although the sample of documented CEs is small (see protocol for question 1) in relationship to the number of documented CEs signed by the Forest, we expect the variability in compliance with the forest plan direction to be low. In addition, controls will be employed to minimize detection and observer bias.

**[F-5] Change Detection:** The goal of this monitoring is not to measure change. Although observations of change in the level of compliance with applicable forest plan direction may be made with this protocol, and may be of interest over time, no attempts will be made to measure change using statistics.

**[F-6] Threshold:** The threshold is surpassed when any of the following conditions occur within a 5-year window:

Mitigation Measures: Three or more projects do not fully implement the mitigation measures prescribed by the NEPA decision.

Lowest SIO: One or more project watersheds[40] in which, as a result of project implementation, the range in scenic integrity levels has been lowered below the lowest SIO in the range for the watershed.

Percent Change in SIO Acres: One or more project watersheds in which the acreage of SIOs has changed by greater than 20 percent from what was originally mapped in the forest plan.

Note that this protocol does not cover project-level monitoring. However, any project monitored under this protocol will be referred to the deciding official and appropriate staff officer for corrective action if the applicable forest plan direction and prescribed mitigation measures for SIOs are not fully implemented.

**[F-7] Scope of Inference:** Forestwide and district.

**G. Indicator and its Units of Measure:**

- Whether the prescribed mitigation measures were fully implemented on the project. Response options: yes or no
- The lowest existing scenic integrity level in the project watershed after project implementation

[40] A project watershed is the watershed within which the project is located.

- Total number of acres of the project watershed for which the SIO has been changed from that originally mapped for the watershed

**H. Sampling Design:** The general sample design for this monitoring is described in the protocol for question 1 “Are projects being implemented consistent with forest plan direction?" Additional information on the sample design specific to this protocol is below.

**[H-1] Target Population:** See the protocol for question 1.

**[H-2] Sampling Frame:** See the protocol for question 1.

**[H-3] Sample Selection Methods:** See the protocol for question 1. Note in NEPA analysis it is appropriate to consider the effects to SIOs whenever internal and/or external scoping produced a concern for potential effects to the scenery, as well as when an effect to the scenery is probable. This includes projects with substantial earth or vegetative disturbance or constructed features that are in sight of high-use areas (trails, recreation sites, highways, lakes, streams and/or the ocean). These types of projects will be given a higher weight during the sampling process to better ensure projects for which scenery is a factor are included in the sample. However, also note that it is possible the sample will include NEPA decisions for which forest plan direction for SIOs is not applicable and that did not prescribe SIO-specific mitigation measures. The protocol described here would not be applied to these projects.

**[H-4] Sample Unit Description:** Sampling units will be the individual projects completed within the last two years or that are ongoing for which a NEPA decision was made, excluding undocumented CEs, and for which forest plan direction for SIOs apply and/or the NEPA decision prescribed mitigation measures for SIOs.

**[H-5] Detection and Observer Bias Controls:** Detection and observer bias controls are applied at the time of data collection. This protocol relies on existing data collected as part of the scenery management system. A reference to the documentation of these controls will be supplied here once this aspect of the system is up and running.

**[H-6] Sample Size Estimate and Estimation Methods:** See the protocol for question 1. It is estimated that five to six projects will be monitored per year. Also note that because this protocol relies on existing data, it is possible a larger sample could be taken than that for question 1.

**[H-7] Temporal Details of Sampling:** The sample will be identified as part of the monitoring for question 1. This protocol relies on existing data so acquisition of the data can be made when they become available by the scenery management system. These data should have been collected after implementation of projects is complete (the exception is for projects that are ongoing). If these data are not available at the time of sample selection, then coordinate with the forest landscape architect and GIS coordinator to determine when these data will be available. It is recommended that these data be collected as soon as possible and that the forest landscape architect join the interdisciplinary team in the field for monitoring question #1 to complete this monitoring.

**I. Data Collection:**

**[I-1] Methods for Locating Sampling Units:** Not applicable

**[I-2] Methods for Layout and Marking:** Not applicable

**[I-3] "Field" Sampling Methods:**

Existing datasets used for this monitoring include:

- Scenery management program monitoring of mitigation measures for SIOs prescribed to projects.
- Forest plan scenic integrity objectives (FSM 2382.2(7)) map and database
- Existing scenic integrity level (FSM 2382.2(6)) map and database
- Existing scenic integrity level map and database frozen at the onset of the Revised Forest Plan (May 2002)
- Forest plan planning unit (watershed area) map

Mitigation measures prescribed in the NEPA decision for each project in the sample should be recorded using Attachment Q40-1.

**J. Quality Control and Assurance:**

A reference to the documentation of the quality control and assurance procedures for the base data used here will be supplied once this aspect of the scenery management system on the Chugach National Forest is up and running. As part of this protocol, a standardized form (Attachment Q40-1) will be used to record each evaluation. This form will help to better ensure accurate and full documentation of the information. The use of this form will provide for standardization over time and across the forest.

**K. Data Form:** See Attachment Q40-1.

**L. Data Storage:**

**[L-1] Data Cleaning Methods:** A reference to the documentation of the data cleaning methods for the base data used here will be supplied once this aspect of the scenery management system on the Forest is up and running. The completeness and accuracy of data recorded using Attachment Q40-1 will be reviewed shortly after each field season. These data will be reviewed by the forest landscape architect and the forest planner.

**[L-2] Data Storage**: A copy of the base scenery management system data used for this protocol, results of data interpretation (Attachment Q40-1), as well as the resulting analyses, will be stored by the forest planner with all other data associated with question 1 (see protocol for question 1). The forest landscape architect will also keep a copy of the data and the results of the SIO monitoring.

**M. Data Analysis:**

**Mitigation Measures:** These data should be obtained from the forest landscape architect. Based on these data, record whether each mitigation measure prescribed for each project was fully implemented or not. Record this using Attachment Q40-1.

**Lowest SIO:** At the onset of the forest plan, a single SIO was assigned to each watershed area (also referred to as a landscape planning unit) and was mapped. The watershed area in which each project is located and the SIO prescribed to those project watersheds in the forest plan should have been documented in the NEPA analysis. If this is not the case, determine the watershed within which each project is located using the forest plan watershed map and then intersect these watersheds with the forest plan scenic integrity objective map.

Compare the mapped SIO and the existing scenic integrity level (after project implementation) for each project watershed to determine whether the lowest SIO in the range allowed by the forest plan was met or exceeded or not (Compliance: yes or no) by each project. This will be recorded using Attachment Q40-1.

Note that for all these analyses it is imperative that the existing scenic integrity level map has been updated with the scenic integrity level(s) determined by post-project implementation monitoring conducted by the scenery management system.

**Percent Change in SIO Acres:** The forest plan standard for recreation and tourism directs that, "Within a watershed area, SIO acreage may be changed up to 20 percent within the range shown in Table 3-6 without amending the Forest Plan. This threshold is cumulative over the life of the Forest Plan" (p. 3-35). At the onset of the Revised Forest Plan, a single SIO was assigned to each watershed area (also referred to as a landscape planning unit) and was mapped. The range within which the SIO may be changed is defined by Management Area Prescription and can be found in table 3-6 on page 3-36 of the Revised Forest Plan. Therefore, to conduct this analysis, the total acreage of each project watershed will need to be determined (this can be done in a GIS) as well as the acres changed from the original SIO. The percent change can then be calculated as:

$$100 \text{ X } \left( \frac{\text{Total \# Acres Changed from Original SIO}}{\text{Total \# Acres in the Project Watershed}} \right)$$

The percent change in the original SIO should be recorded on Attachment Q40-1 as well as whether the standard was met (yes or no).

Finally, for each of the above analyses, the number of projects that do not meet each standard should be tallied annually and for each rolling 5-year window.

**N. Assumptions and Limitations**: Monitoring the implementation of projects under this protocol depends upon the accuracy and currency of the scenery management system monitoring and the existing scenic integrity level map and database.

**O. Reporting Frequency:** As specified in the forest plan, evaluations will be prepared once every 5 years. This evaluation will be consolidated with the report for question 1. Non-compliances will be reported to the deciding official upon their discovery. In addition, passing a threshold will be reported in the Annual Monitoring and Evaluation Report and brought to the forest leadership team soon thereafter.

**P. Responsibility:** Chugach National Forest Supervisor's Recreation, Lands, and Minerals Staff Officer.

**Q. List of preparers:**

Steve Hennig, Landscape Architect, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

Alison Rein, Recreation Specialist, USDA Forest Service, Chugach National Forest, Glacier Ranger District, Girdwood, Alaska.

And, with assistance from Mary Friberg, Inventory and Monitoring Coordinator, USDA Forest Service, Regional Office, Juneau, Alaska.

**R. 10-year cost forecast:**

| | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| People | $2,251 | $3246 | $2,388 | $2,460 | $2,534 | $2,610 | $2,700 | $2,800 | $2,900 | $3,000 |
| Travel | $0 | $0 | $0 | $0 | $0 | $0 | $ | $ | $ | $ |
| Other | $0 | $0 | $0 | $0 | $0 | $0 | $ | $ | $ | $ |
| **TOTAL** | **$2,251** | **$3,246** | **$2,388** | **$2,460** | **$2,534** | **$2,610** | **$2,700** | **$2,800** | **$2,900** | **$3,000** |

Total 10-year cost: $26,889

Annual cost estimates are based on 5 person-days per year at $400 per day plus a 3-percent inflation rate. This estimate includes time for data collection, interpretation, review, and storage on an annual basis. Two additional days of work are added in FY 2013 for evaluation and report writing for the 5-Year Monitoring and Evaluation Report. The estimated annual cost in the Revised Forest Plan (p. 5-16) is $5,000. Note that data collection through the scenery management system is not part of this protocol and; therefore, the cost for collecting these data has not been accounted for here.

**S. Literature Cited:**

USDA Forest Service. 2002. *Chugach National Forest Revised Land and Resource Management Plan*. USDA Forest Service, Alaska Region R10-MB-480c. Alaska Region, Chugach National Forest, Anchorage, Alaska.

## *Attachment Q40-1. Data form for Question 40 – Implementation monitoring for forest plan SIO direction*

NEPA Decision Document Name:

Date Implementation Completed:

Type of NEPA Decision Document (CE, EA, or EIS):

Watershed SIO:

Management Area Prescription Range in SIOs:

All forest plan standards for scenic integrity objectives are listed in the table below. Use this form to record whether the project was compliant with each standard. Provide documentation of implementation in the notes section.

| Forest Plan Direction for SIO | Compliant (yes/no) | Notes |
|---|---|---|
| "In no case may the effects of an activity exceed the level of scenic integrity of the lowest SIO in the range." | | |
| "Within a watershed area, SIO acreage may be changes up to 20 percent within the range shown in Table 3-6 without amending the Revised Forest Plan." | | |

Type in the specific language used in the NEPA document that prescribes a mitigation measure for SIOs. Record the page number(s) in the NEPA document where the mitigation measure can be found. Based on Scenery Management Monitoring, record whether each mitigation measure was implemented on the project (Yes or No). Provide documentation of the implementation in the notes section.

| SIO-Specific Mitigation Measures Prescribed in the NEPA Decision Document | NEPA Page Number(s) | Implemented (yes/no) | Notes |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

# *Fire Protection and Fuels Management*

## *41. Are human life, property, and facilities being protected from wildland fire hazards?*

**A. Monitoring Item: *Fire Protection and Fuels Management***

**B. General Monitoring Question:** Table 5-1 – What is the pattern of abundance of different fuel types on the Kenai Peninsula? MEIT Interpretation – Are human life, property, and facilities being protected from wildland fire hazards?

**C. Business Need and Rationale**: The National Fire Plan of 2000 and the Healthy Forest Restoration Act of 2003[41] provide administrative processes and procedures to reduce hazardous fuels. The focus is on areas that are near communities at risk, within the wildland-urban interface, where life, property and facilities are primarily located. Monitoring and assessment of hazardous fuels on the national forests is required under the Healthy Forests Restoration Act. Specifically, the Act calls for "a description of the changes in condition class, using the Fire Regime Condition Class Guidebook or successor guidance, specifically comparing end results to — (A) pretreatment conditions; (B) historical fire regimes; and (C) any applicable watershed or landscape goals or objectives in the resource management plan or other relevant direction." Additionally, fuel buildup has been identified by a former Chief of the Forest Service as one of the four major threats to environmental sustainability on the national forests.[42]

The threat of wildfire is a growing concern on the Kenai Mountains portion of the Chugach National Forest where bark beetles have caused extensive spruce tree mortality. Data are needed to help achieve the Revised Forest Plan goal to "Protect human life, property and facilities from wildland fire hazards" (p. 3-10). The four objectives listed under this goal are:

- On the Kenai Peninsula, implement the fire protection and management, fuels management, forest health and watershed restoration, and wildlife habitat management strategies described in the Kenai Peninsula Spruce Bark Beetle Management Strategies and Five-Year Action Schedule (*covers the FY2000 to FY2004 period so it is no longer a current objective*).
- Use management-ignited fire, prescribed natural fire, and mechanical treatments to achieve hazardous fuels reduction objectives for each management area.
- Maintain preparedness to respond with appropriate fire suppression to protect human life, property, and facilities from wildland fire.
- Accomplish activities to reduce hazardous fuels accumulations near communities or developed areas on the Kenai Peninsula.

[41] http://www.forestsandrangelands.gov/
[42] http://www.fs.fed.us/news/2003/speeches/09/change-debate.shtml

In addition, pages 3-42 through 3-44 of the Revised Forest Plan list standards and guidelines pertaining to fire, fuels, prescribed burning, and fuel treatment that are not repeated here.

**D. Category:** Effectiveness and implementation.

**E. Protocol Status, Source, and Re-evaluation Schedule:** This is a pilot protocol. The pilot will be evaluated in FY2012 after all methodologies have been implemented. Based on this evaluation, the protocol will be finalized. Once final, the protocol will be re-evaluated every five years. Four methodologies will be used:

**Implementation monitoring**

1. Review of project records: *Status* – pilot protocol developed by the Chugach National Forest. *Source* – this monitoring guide. Will be used to assess successes or failures in meeting fire and fuels goals, objectives, standards, and guidelines.

2. Database review: *Status* – pilot protocol developed by the Chugach National Forest. *Source* – this monitoring guide. Will be used to assess successes or failures in meeting fire and fuels goals, objectives, standards, and guidelines. Information to make these assessments will be extracted from the Forest Service Activity Tracking System (FACTS) and Alaska Interagency Coordination Center (AICC) databases[43] and through consultation with the Kenai Zone Fire Management Officer.

Effectiveness monitoring

3. Analysis of Fire Regime Condition Class (FRCC)[44] derived from Landscape Fire and Resource Management Planning Tools Project (LANDFIRE)[45] data. *Status* – nationally established and approved protocol for producing consistent and comprehensive maps and data describing vegetation, wildland fuel, and fire regimes across the United States based on satellite imagery. *Source* – Hann et al. 2008 and Rollins and Frame 2006. Department of Interior and USDA Forest Service wildland fire management programs and the Wildland Fire Leadership Council. FRCC composition will be compared between image dates for Kenai Peninsula geographic area and management area interpretations.

4. Forest Inventory and Analysis (FIA) grid inventory: *Status* – nationally established and approved protocol[46] quantifying the extent and condition of forest resources and analyzing how these resources are changing over time. *Source* – FIA National Office and PNW Research. The FIA data will provide an overall estimate of biomass of standing dead trees (snags) and down woody material biomass for Kenai Peninsula geographic area interpretations.

[43] FACTS - http://fsweb.ftcol.wo.fs.fed.us/frs/facts/index.shtml; AICC - http://fire.ak.blm.gov/
[44] http://frcc.gov
[45] http://www.landfire.gov/
[46] home page - http://fia.fs.fed.us/; protocols - http://fia.fs.fed.us/library/field-guides-methods-proc/; http://www.fs.fed.us/pnw/fia/publications/fieldmanuals.shtml

**F. Objective Statement:** The implementation monitoring is to determine if fire protection and fuels management activities on the Chugach National Forest are consistent with goals, objectives, standards and guidelines specified in the forest plan. The effectiveness monitoring interprets if changes in fire regime condition class, biomass of standing dead trees, and down woody material biomass on the Kenai Peninsula geographic area of the Chugach National Forest are of sufficient magnitude to be of concern to management.

**[F-1} Required by Law:** Yes. Monitoring and assessment of hazardous fuels on the national forests is required under the Healthy Forests Restoration Act of 2003.

**[F-2} Statistical Rigor Rationale:**

*Monitoring methods 1 and 2:* The review of project records and the database review should represent a “census” (100 percent) of fire and fuels projects occurring on the Chugach National Forest.

*Monitoring method 3*: The FRCC/LANDFIRE data will be collected across 100 percent of the Kenai Peninsula geographic area (basically a “census”).

*Monitoring method 4:* The statistical rigor of FIA data collection is high because the samples are from a systematic grid and are permanently marked (exact) locations.

**[F-3] Data Precision, Reliability:**

*Monitoring methods 1 and 2:* Class B for the review of project records and the database review.

*Monitoring methods 3 and 4:* Class A for the FRCC/LANDFIRE and FIA methods.

**[F-4] Confidence:**

*Monitoring methods 1 and 2:* For the review of project records and the database review the confidence level is 99 percent because all fire and fuel project activities are represented in the dataset but there may still be some errors in the data.

*Monitoring methods 3 and 4:* For the FRCC/LANDFIRE and FIA methods, the null hypotheses are that there is no change in fire regimes condition class, biomass of standing dead trees, and down woody material biomass, between monitoring dates. It is desirable to detect if the difference between dates exceeds 20 percent with a confidence level of 80 percent.

**[F-5] Change Detection:**

*Monitoring methods 1 and 2:* For the review of project records and the database review, all successes or failures in meeting fire and fuels goals, objectives, standards, and guidelines need to be documented.

*Monitoring methods 3 and 4:* For the FRCC/LANDFIRE and FIA methods, the probability of rejecting a false null hypothesis is set to 80 percent (statistical power = 1-*ß*).[47]

**[F-6] Threshold:**

*Monitoring methods 1 and 2:* For the review of project records and the database review, if more than 20 percent of the Kenai Peninsula management areas OR fire/fuels projects fail in meeting fire and fuels goals, objectives, standards, and guidelines, then a subjective evaluation would be triggered on whether or not more follow up (and perhaps management action) is needed.

*Monitoring methods 3 and 4*: For the FRCC/LANDFIRE and FIA monitoring, results having the greatest concern to management are those where the calculated P value from the significance test used is less than 0.20.

**[F-7] Scope of Inference:** The spatial scope is the Kenai Peninsula geographic area (the only portion of the forest where fire is a characteristic ecological process) with particular emphasis on the area within the wildland-urban interface. The temporal scale is annual to decadal.

**G. Indicator and its Units of Measure:**

*Monitoring methods 1 and 2:* For the review of project records and the database review, the indicators are the forest plan objectives, standards, and guidelines listed in Attachment Q41-1 of this protocol.

*Monitoring method 3:* For the FRCC monitoring, the primary indicator is fire regime condition class. Fire regime condition class is the degree of departure of current conditions from reference conditions (areas of FRCC class 3 would be of highest concern to management since they represent the greatest departure from reference conditions). The classes of FRCC are defined by biophysical land units (aka potential natural vegetation groups) and vegetation-fuel type (i.e., up to five successional states) as listed in Attachment Q41-2. Fire regime condition class is mapped by LANDFIRE using remote sensing.

*Monitoring method 4*: For the FIA data analysis, the specific variables to be analyzed are biomass of standing dead trees and down woody material biomass.

**H. Sampling Design:**

*Monitoring methods 1 and 2:* Review of project records and the database review do not involve sampling as they include 100 percent of the fire and fuels projects occurring on the Forest.

*Monitoring methods 3 and 4*: The sampling design for FRCC, LANDFIRE, and FIA are documented at the respective websites listed on pages 33 and 34.

[47] Where *ß* = the probability of Type II error (the failure to detect a difference when in truth there is one).

**[H-1] Target Population:** In all sampling, the target population is wildland fire hazard on the Kenai Peninsula geographic area with particular emphasis on the area within the wildland-urban interface.

**[H-2] Sampling Frame:**

*Monitoring methods 1 and 2:* Electronic and hard copy project files contain the data to be used in the review of project records and all data to be used in the database review are contained in the FACTS and AICC databases. These sources will be searched to determine if there are activities occurring that fail to meet forest plan objectives, standards, and guidelines listed in Attachment Q41-1 of this protocol.

*Monitoring method 3:* The FRCC/LANDFIRE data set is derived from LANDSAT[48] imagery and as such consists of all portions of LANDSAT scenes within the boundaries of the Kenai Peninsula geographic area of the Chugach National Forest.

*Monitoring method 4:* The FIA sample consists of all surveyed plots on the FIA grid within the Kenai Peninsula geographic area of the Chugach National Forest.

**[H-3] Sample Selection Methods:**

*Monitoring methods 1 and 2*: The review of project records and the database review include 100 percent of the fire and fuel project activities occurring on the forest.

*Monitoring method 3:* The satellite image data used in the FRCC/LANDFIRE analyses is a 100 percent sample.

*Monitoring method 4:* All sample plots for FIA are distributed systematically on a 4.8-km grid.

**[H-4] Sample Unit Description:**

*Monitoring methods 1 and 2:* The review of project records and the database review sample units are records documenting administratively tracked fire and fuels activities occurring on the forest.

*Monitoring method 3:* The LANDSAT data used by FRCC/LANDFIRE is collected in 30-meter pixels.

*Monitoring method 4:* Individual FIA grid points are a cluster of four sampling plots each of 7.3-meter radius.

**[H-5] Detection and Observer Bias Controls:**

*Monitoring methods 1 and 2:* The review of project records and database review do not include bias.

[48] http://landsat.usgs.gov/

*Monitoring method 3:* Satellite imagery is collected by automated sensors. Detection parameters are as defined in the sensor specifications. Accuracy assessment associated with FRCC derived from LANDFIRE data will indicate robustness of the classification. This assessment will be considered when evaluating changes in FRCC.

*Monitoring method 4:* There is potential for large variations in determining and measuring standing dead trees and down woody material attributes in FIA data collection. This bias can be controlled by calibrating estimation among observers prior to initiating field work.

**[H-6] Sample Size Estimate and Estimation Methods:**

*Monitoring methods 1 and 2:* The review of project records and database review include 100 percent of the administratively tracked fire and fuels activities occurring on the forest.

*Monitoring method 3:* The satellite image data is a 100 percent sample.

*Monitoring method 4:* Sample size is already established for the FIA plots based on the 4.8-km grid (approximately one plot per 6,000 acres) of which standing dead trees are measured on all forested plots and down woody material is measured on a 1/16th subsample of the forested plots (Woodall and Monleon 2008). The adequacy of this number of plots will be evaluated based on post hoc power and minimum detectable change analysis (pp. 262–264 of Elzinga et al. 1998). If this analysis shows low confidence in the results due to low power and high minimum detectable change size, it may be desirable to make changes in the monitoring design to increase power (e.g., increase sample size). In addition, the necessary sample size for detecting differences between two means when using the paired sampling units will be estimated using the method described on pages 354 through 357 of Elzinga et al. (1998).

**[H-7] Temporal Details of Sampling:**

*Monitoring methods 1 and 2*: The review of project records and database review will occur annually.

*Monitoring method 3:* The refreshment cycle of the FRCC/LANDFIRE mapping is anticipated on a 5- to 10-year time step.

*Monitoring method 4:* Ten percent of the FIA plots are sampled annually in a 10-year rotation.

**I. Data Collection:**

*Monitoring methods 1 and 2:* At the time of their use in this project, the data for the review of project records and database review will already have been input into the respective information system following the specific procedures for such entry. The Kenai Zone Fire Management Officer will also be consulted for additional clarification of fire management activities as necessary. No additional detail on data collection methods is necessary.

*Monitoring method 3:* The satellite image data collection methods are those used by LANDSAT (see link on previous page).

*Monitoring method 4*: FIA data collection methods are described in field guides posted on the Internet (see links on page 33 and Woodall and Monleon 2008).

**[I-1] Methods for Locating Sample Units:**

*Monitoring method 3:* LANDSAT imagery used in LANDFIRE is collected in 30-meter pixels in 170-km by 185-km scenes.

*Monitoring method 4:* The FIA sample is on a predetermined systematic 4.8-km grid.

**[I-2] Methods for Layout and Marking:**

*Monitoring method 3*: Layout and marking does not apply to the satellite image data.

*Monitoring method 4:* Layout and marking of FIA plots are as described in the field guides. Individual FIA grid points consist of a cluster of four systematically located sample plots each of 7.3-meter radius.

**[I-3] "Field" Sampling Methods:** See "Sample Selection Methods" (above).

*Monitoring method 3:* FRCC and LANDFIRE methods are as described on the websites listed earlier.

*Monitoring method 4:* FIA methods are as described on the Websites listed earlier. Additional detail on down woody materials sampling is provided by Woodall and Monleon (2008).

**J. Quality Control and Assurance:**

*Monitoring methods 1 and 2*: At the time of their use in this project, the data for the review of project records and database review will already have been input into the respective information system following the specific procedures for such entry. No additional quality control is planned.

*Monitoring method 3:* Most of the error will likely be in correctly classifying and mapping FRCC (fire regime condition class). LANDFIRE derives FRCC using computer models linked to remote sensing imagery and physical site attributes. Quality control of the satellite imagery is as provided by LANDSAT. Accuracy of classifying the imagery into FRCC is as established by LANDFIRE.

*Monitoring method 4:* Measurement of standing dead tree and down woody material attributes in FIA is vulnerable to error. These errors can be controlled by calibrating estimation among observers prior to initiating field work (and periodically during the field season).

**K. Data Form:**

*Monitoring methods 1 and 2:* The form for the review of project records and database review is attached as Attachment Q41-1.

*Monitoring method 3*: FRCC data is recorded on the Fire Regime and Condition Class Standard Landscape Method Field Form.[49] No form is needed for the satellite image data collection.

*Monitoring method 4:* PNW crews will collect the FIA data using their own forms.

**L. Data Storage:**

**[L-1] Data Cleaning Methods:**

*Monitoring method 1:* The review of project records information is in the form of hard copy and computer files collected by other projects and assumed to be already clean.

*Monitoring method 2:* The database review information is not collected by this project, but resides in the corporate and Forest databases that are assumed to be already clean.

*Monitoring method 3*: LANDFIRE processes the FRCC/LANDFIRE data following their standardized protocols.

*Monitoring method 4:* PNW processes the FIA data following their standardized protocols.

**[L-2] Data Storage:**

*Monitoring method 1:* Data used in the review of project records resides in hard copy and computer files on the Chugach National Forest.

*Monitoring method 2:* The database review information is in FACTS and AICC.

*Monitoring method 3:* The FRCC/LANDFIRE data is stored in the LANDFIRE database.

*Monitoring method 4:* The FIA data is stored in the FIA database.

**M. Data Analysis:**

*Monitoring methods 1 and 2*: In the review of project records and database review, Attachment Q41-1 is used to estimate the percentage accomplishment for the listed forest plan objectives, standards, and guidelines. Values less than 80 percent would trigger a subjective evaluation of whether more follow-up (and perhaps management action) is needed.

*Monitoring methods 3 and 4:* For the FRCC monitoring, acreage by fire regime condition class will be summarized Kenai-wide and by management area. For the FIA monitoring,

[49] http://frames.nbii.gov/documents/frcc/documents/FRCC_field_form.pdf

biomass of dead standing trees and downed woody biomass will be summarized Kenai-wide and by management area. The format to be used for summarizing and interpreting the results of the statistical analyses is as shown in the following table (modified from figure 11.24 of Elzinga et al. 1998). The statistical test to be used is a paired *t* test (p. 78–79 of Steele and Torrie 1960). This test is appropriate because it is expected that the data from the pairs of sampling units are highly correlated (repeat measurements from the same locations).

**Table Q41-1. Example of the format used to summarize results of the statistical analyses**

| Significance threshold = 0.10. Change threshold = 30%. Desired statistical power = 0.90[50.] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Sample Size** | **Sample Statistics** | | | | **Observed Change** | **Results of Statistical Test (P)** | **Calculated Power (1-ß) to Detect a 30% Change** | **Minimum Detectable Change Size with a Power of 0.9** |
| | **Year 1** | | **Year 2** | | | | | |
| | **mean** | **sd** | **mean** | **sd** | | | | |
| 50 | 3.12 | 11.16 | 1.30 | 2.92 | 1.82 (58 %) | 0.85 | 0.13 | 4.82 (155 %) |
| INTERPRETATION: In this example, it cannot be concluded that a change took place (cannot reject the null the null hypothesis. There is low confidence in the results due to low power and high minimum detectable change size. It may be desirable to take action as a precautionary step and make changes in the monitoring design to increase power. | | | | | | | | |

## N. Assumptions and Limitations:

*Monitoring methods 1 and 2:* The review of project records and database review are assumed to list all administratively tracked fire and fuels activities occurring on the Chugach National Forest. If an activity is missing in these datasets, that activity will be missed in the analysis and interpretations. Also, the data in the database review resides in the corporate databases that are assumed to be already clean. This may not be a valid assumption.

*Monitoring method 3:* FRCC does not equate to fire risk or fire hazard, but is the departure of current conditions from reference conditions. A landscape with a low departure from reference conditions can still pose a large fire hazard if the fire regime is one featuring intense, stand replacement fires when they do occur (which is the case with many of the forests on the Kenai Peninsula). It is assumed that the LANDFIRE data quality is sufficient for these landscape-scale analyses.

*Monitoring method 4*: The FIA plots are primarily drawn from forested locations and will not represent fuel characteristics of shrubland and herbaceous vegetation communities. Also, FIA plots are not being sampled within the 796,720-hectare wilderness study area, which encompasses 36 percent of the land area of the Chugach National Forest.

## O. Reporting Frequency:

*Monitoring methods 1 and 2:* Annually for the project database review.

[50] In the actual monitoring these values will be set to: Significance threshold = 0.20, change threshold = 20 percent, desired statistical power = 0.80.

*Monitoring methods 3 and 4:* Once every 5 years for FRCC/LANDFIRE and FIA monitoring (FY12 and FY17).

**P. Responsibility:** Chugach National Forest Ecologist in coordination with Kenai Zone Fire Management Officer.

**Q. List of Preparers:**

R.L. DeVelice, Ph.D., Forest Ecologist, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

**R. 10-Year Cost Forecast:**

*Monitoring methods 1 and 2:* The review of project records and the database review is an annual cost.

*Monitoring method 3*: The cost of FRCC/LANDFIRE data products is covered under a national multi-partner, multi-agency partnership and would not be funded by the Forest. The cost for interpreting the LANDFIRE data to answer this Chugach National Forest Plan monitoring question would be funded by the Forest (these interpretations are anticipated to occur once every 5 to 10 years depending on the LANDFIRE refreshment schedule).

*Monitoring method 4:* The cost of FIA data collection and entry into the FIA database is funded by PNW Research. The cost for interpreting the FIA data to answer this Chugach National Forest Plan monitoring question would be funded by the Forest (these interpretations would occur once every five years, i.e., in FY12 and FY17).

| | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| People | $7,955 | $2,730 | $2,815 | $2,900 | $2,985 | $9,225 | $3,165 | $3,260 | $3,360 | $3,460 |
| Travel | $1,060 | $0 | $0 | $0 | $0 | $1,230 | $0 | $0 | $670 | $695 |
| Other | $530 | $545 | $565 | $580 | $595 | $615 | $635 | $650 | $ | $ |
| **TOTAL** | **$9,545** | **$3,275** | **$3,380** | **$3,480** | **$3,580** | **$11,070** | **$3,800** | **$3,910** | **$4,030** | **$4,155** |

Total 10-year estimated cost: $50,225

Estimated annual cost in Revised Forest Plan (p. 5-17): $25,000

**S. Literature Cited:**

Elzinga, C.L., D.W. Salzer, and J.W. Willoughby. 1998. *Measuring and monitoring plant populations*. Bureau of Land Management Technical Reference 1730-1. Denver, Colorado. 477 pp.

Hann, W., A. Shlisky, D. Havlina, K. Schon, S. Barrett, T. DeMeo, K. Pohl, J. Menakis, D. Hamilton, J. Jones, M. Levesque, and C. Frame. 2008. *Interagency Fire Regime Condition Class Guidebook*. Version 1.3.0 [Homepage of the Interagency and The Nature Conservancy fire regime condition class website, USDA Forest Service, US Department of the Interior, The Nature Conservancy, and Systems for Environmental Management]. Website:

http://frames.nbii.gov/documents/frcc/documents/FRCC+Guidebook_2008.10.30.pdf

Rollins, M.G. and C.K. Frame, tech. eds. 2006. *The LANDFIRE Prototype Project: nationally consistent and locally relevant geospatial data for wildland fire management*. General Technical Report. RMRS-GTR-175. USDA Forest Service, Rocky Mountain Research Station. Fort Collins, Colorado. 416 pp. Website: http://www.fs.fed.us/rm/pubs/rmrs_gtr175.html

Steele, R.G.D. and J.H. Torrie. 1960. *Principles and procedures of statistics: with special reference to the biological sciences*. McGraw-Hill Book Company, Inc., New York. 481 pp.

Woodall, C. W. and V.J. Monleon. 2008. *Sampling protocol, estimation, and analysis procedures for the down woody materials indicator of the FIA program*. General Technical Report NRS-GTR-22. USDA Forest Service, Northern Research Station. Newtown Square, Pennsylvania. 68 pp. Website: http://www.fs.fed.us/pnw/fia/publications/pubpdf/gtr_nrs22.pdf

***Attachment Q41-1. Fire and fuels database review and review of project records checklist[51]***

| Reviewer(s)_____ | % | Database Reviewed | Date of Review |
|---|---|---|---|
| Reviews of the Fire Protection and Fuels Objectives: | | | |
| Percentage of 400 acres per year of prescribed burning for fuels management as called for in Forest Plan | % | FACTS | |
| Percentage of wildland fires extinguished before damaging human life, property, or facilities | % | AICC database/ consult FMO | |
| | | | |
| Review of Fire and Fuels Standards and Guidelines: | | | |
| Percentage of Forest for which protection level has been mapped (i.e., critical; full; modified; limited) | % | cnfprotect database | |
| Percentage of wildland fires that received appropriate suppression response given protection level | % | AICC database | |
| Percentage of wildlife fire suppression efforts where sensitive resources have been protected | % | AICC database/ consult FMO | |
| | | | |
| Review of Prescribed Burning Standards: | | | |
| Percentage of burn projects with complete burn plans | % | FACTS/ Project Records | |
| Percentage of burn projects with post-burn reports | % | FACTS/ Project Records | |
| Percentage of prescribed burns greater than 40 acres with ADEC permits | % | FACTS/ ADEC | |
| | | | |
| Review of Fuels Treatment Guidelines: | | | |
| Percentage of activity fuels treatments for which burn piles are not in sensitive locations | % | Project Records/ consult FMO | |
| Percentage of activity fuels treatments for which visible debris has been treated within year of vegetation management | % | Project Records/ consult FMO | |
| | | | |
| **Notes describing cases of non-compliance:** | | | |

[51] Values less than 80 percent would trigger a subjective evaluation of whether more follow-up (and perhaps management action) is needed. These cases of non-compliance are summarized in the notes section of the checklist.

***Attachment Q41-2 Potential natural vegetation groups and associated successional states (in parentheses) of the Kenai Peninsula geographic area[52]***

Forest

BSPS Black Spruce Southcentral (A, B, C, D, E)

CBTF Coastal Boreal Transition Forest (A, B, C, D, E)

KMHM Kenai Mountains Hemlock (A, B, C, D, E)

RISHK Riparian Spruce Hardwood Kenai (A, B, C, D, E)

Shrubland

PSHN Persistent Shrub North (A, B)

DSTN Dwarf Shrub Tundra (A, B, C)

Herbaceous

National ForestWL Non-Forested Wetland (A, B)

MEHM Mesic Herbaceous Meadow (A, B)

DHRM Dry Herbaceous Meadow (A, B)

[52] As defined by http://frames.nbii.gov/documents/frcc/documents/Alaska_BpS_Key.pdf (key) and http://frames.nbii.gov/portal/server.pt?open=512&objID=309&&PageID=1885&mode=2&in_hi_userid=2&cached=true (descriptions).

# *Wilderness*

## *42. Is the wilderness character of the Wilderness Study Area (WSA) and areas recommended for Wilderness being maintained?*

**A. Monitoring Item: *Wilderness***

**B. MEIT Interpretation of General Monitoring Question:** Is the wilderness character of the wilderness study area (WSA) and areas recommended for Wilderness being maintained?

**C. Business Need and Rationale:** The need for monitoring wilderness character in designated wilderness areas is national in scope, with direction found in the 1964 Wilderness Act (Public Law 88-577). Section 4(b) of the Wilderness Act states that "each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area." Forest Service policy (FSM 2320.2(4)) also directs managers to "protect and perpetuate wilderness character from the time of designation." A great deal of scholarly research has considered the meaning of "wilderness character," which is not defined in the Wilderness Act itself (Landres et al. 2005). Based on the definition of wilderness in the act, four qualities have been used as a way of distinguishing wilderness from other landscapes, and are used in interagency monitoring of wilderness character. These qualities are: **(1) untrammeled, (2) natural, (3) undeveloped, and (4) outstanding opportunities for solitude or a primitive and unconfined type of recreation** (Landres et al. 2005; Landres et al. 2008). We define these qualities below.

Nellie Juan – College Fiords WSA, covering most of western Prince William Sound and surrounding lands encompassing approximately 2.12 million acres, was established by Section 704 of the Alaska National Interest Lands Conservation Act (ANILCA; Public Law 96-487). The WSA is not designated wilderness, but Alaska Region policy (FSM 2320.3, Supplement No. R-10 2300-2008-2) directs the Chugach National Forest to manage the WSA in a manner that prevents degradation of wilderness qualities.

This direction is clearly defined in the 2002 Chugach National Forest Revised Land and Resource Management Plan (Revised Forest Plan) desired conditions, goals, objectives, and management prescriptions. The entire WSA falls under the Wilderness Study Area Management Area, which is "managed to maintain presently existing wilderness character and potential for inclusion into the National Wilderness Preservation System" (Revised Forest Plan, 4-12). The desired condition for special designations states that "[u]pon congressional designation, approximately 1,412,230 acres in Prince William Sound will have been established as Wilderness" (3-18). This acreage reflects the lands Chugach National Forest recommended Congress designate as Wilderness. Monitoring changes in wilderness character in the WSA is needed to ensure that the Chugach National Forest is managing the WSA in a way that maintains its suitability for designation and inclusion in the National Wilderness Preservation System. Furthermore, WSA monitoring will directly contribute to the forest plan goal to "Manage Wilderness Study Areas and recommended Wilderness consistent with the provisions of the Wilderness Act and ANILCA, pending congressional action," (3-11) and objective to "[m]anage use and monitor conditions in the Wilderness Study Area and Recommended Wilderness areas consistent with ROS objectives to maintain eligibility for Wilderness

designation" (3-11). It is important to assess trends both WSA-wide and in areas that were recommended to Congress to designate as part of the National Wilderness Preservation System (all of which are located within the WSA).

This WSA monitoring protocol is based on direction intended for monitoring designated wilderness areas because (1) the monitoring question is essentially the same as that used for designated wilderness areas (maintaining wilderness character), (2) Alaska Region management direction is similar for both designated wilderness and the WSA, and (3) a critical need exists for this monitoring so the Forest can be prepared to support congressional efforts to designate all or part of the WSA as wilderness.

**D. Category:** Implementation

**E. Protocol Status, Source, and Re-evaluation Schedule:** This protocol will be in pilot status for 2 years to validate the effectiveness of each of the monitoring strategies. Indicators and measures will be evaluated every 5 years to ensure monitoring data is providing a satisfactory picture of trends in wilderness character. This is in line with national change management for this protocol. Most of the indicators and methods are taken directly from the national protocol outlined in Technical Guide for Monitoring Selected Conditions Related to Wilderness Character (GTR WO-80, Landres et al. 2009, available at http://www.wilderness.net/index.cfm?fuse=toolboxes&sec=WC), which is intended to provide a nationally consistent approach to monitoring wilderness character throughout the Forest Service, and is also tied to the interagency strategy laid out in "Keeping it Wild" (Landres et al. 2008). The Technical Guide is meant to be a cost-effective way to consolidate and analyze data applicable to wilderness character that is already collected and stored by the Forest Service and other agencies. There is also an attempt to coordinate protocols with the Tongass National Forest, where appropriate, to provide a regional-level perspective of trends in wilderness character. Indicators and measures in the Technical Guide represent the minimum, or core, level of monitoring. The Chugach National Forest protocol deviates from the Technical Guide where agency data sources are either not applicable (i.e., data from Infra-WILD) or insufficient (i.e., air pollutant measures, National Visitor Use Monitoring data, etc.) for monitoring purposes. In these cases, supplemental indicators and measures have been developed. Attachment Q42-1 shows all indicators and measures for this protocol.

**F. Objective Statement:** This monitoring detects changes and trends in four qualities of wilderness character to determine if the Chugach National Forest is managing the WSA in a way that prevents degradation of wilderness character, in accordance with the Forest Plans "Wilderness Study Area Management Area" prescription. If monitoring indicates that the wilderness quality is being degraded, this may prompt the Forest to apply appropriate management actions to mitigate or eliminate degradation. The four qualities of wilderness character, taken from Landres et al. (2008), are as follows:

- **Untrammeled:** Wilderness is essentially unhindered and free from modern human control or manipulation.
- **Natural:** Wilderness ecological systems are substantially free from the effects of modern civilization.
- **Undeveloped:** Wilderness retains its primeval character and influence, and is essentially without permanent improvement or modern human occupation.

- **Solitude or Primitive and Unconfined Recreation:** Wilderness provides outstanding opportunities for solitude or primitive and unconfined recreation.

**[F-1] Required by Law:** No

**[F-2] Statistical Rigor Rationale:** Not applicable for the measures using "censusing" of information from Forest Service corporate databases and other sources (i.e., Whittier Tunnel counts) which includes almost all of the measures used in this protocol. For air quality measures using national data-collection programs, rigor is considered high.

**[F-3] Data Precision, Reliability:** Class A for database reviews. Class B for measures using data sources that need to be extrapolated (air quality, visitor statistics) or using specialist knowledge (extirpated species) as reliability, precision, and accuracy are decreased.

**[F-4] Confidence:** Database review with local agency data is high since all administratively tracked activities should be represented. Confidence varies for other measures, but when combined, is sufficient to determine broad changes to wilderness character, thus meeting the business need.

**[F-5] Change Detection:** Database reviews will detect all changes in administratively tracked activities. Other indicators and measures must be able to sufficiently detect changes to wilderness character qualities at a broad level (degrading, stable, improving).

**[F-6] Threshold:** This protocol is meant to show trends in wilderness character rather than whether a given threshold has been crossed. Trends in indicators and measures will be identified using the decision rules listed in the Technical Guide (2009; 33–43).

**[F-7] Scope of Inference:** The spatial scope is (1) the entire Wilderness Study Area and (2) all areas recommended as Wilderness in the forest plan, and the temporal scope is annual to 5 years.

**G. Indicator and its Units of Measure:** See Attachment Q42-1 for the table of indicators and measures.

**H. Sampling Design:** Database reviews and other census data do not involve sampling. Data for the entire WSA and for areas recommended as wilderness will be separated to track any variances in management actions. The Technical Guide provides additional information about data sources and methods.

**[H-1] Target Population:** Varies according to indicator and measure. In general, the target population includes all activities that impact wilderness character within the WSA in a given fiscal year.

**[H-2] Sampling Frame:** Sample units include: visitors; land use and special use permits; inholdings; management actions; fish, wildlife, and plant populations; recreation facilities; trails and roads; dams; mines; and air quality measures.

**[H-3] Sample Selection Methods:** Database reviews will include 100 percent of trackable activities conducted in the WSA. Air quality measures will be chosen based on proximity to the WSA, which varies for each measure. Informal surveys will be on an opportunistic basis as visitors are encountered by backcountry staff.

**[H-4] Sample Unit Description:** Not applicable.

**[H-5] Detection and Observer Bias Controls:** There is the possibility that data is not entered correctly into agency databases, or that activities are not accounted for, making the corporate database review less reliable. The broad level of change detection to meet the business need mitigates these reliability issues.

**[H-6] Sample Size Estimate and Estimation Methods:** All activities tracked and documented in agency databases will be identified and counted.

**[H-7] Temporal Details of Sampling:** Database information will be collected annually and analyzed every five years.

**I. Data Collection:** Data will be collected from applicable Forest Service databases, other agency data sources (air quality, extirpated species, invasive species, and Whittier Tunnel and harbormaster counts).

**[I-1] Methods for Locating Sample Units:** Corporate database review will cover all activities and features in the WSA. By covering the entire WSA, changes in activities and features in recommended wilderness will also be detected. Air quality sample units were chosen based on proximity to the WSA.

**[I-2]Methods for Layout and Marking:** Not applicable.

**[I-3] "Field" Sampling Methods:** For monitoring included in the Forest Service Technical Guide, sampling methods will follow applicable guidance. Data for air quality (see Technical Guide for specific measures), extirpated and invasive species (http://aknhp.uaa.alaska.edu/Default.htm) and Whittier Tunnel use (http://www.dot.state.ak.us/creg/whittiertunnel/index.shtml) will be taken from the pertinent websites, and the Whittier and Valdez harbormasters will be contacted for boat launch information (Fay et al. 2010). To supplement visitor counts, backcountry rangers will also conduct informal surveys using a standardized form, as they encounter visitors in Whittier and in the WSA.

**J. Quality Control and Assurance:** Data collection most vulnerable to error is when the individual consolidating data does not know how to use the databases or how to extrapolate the information. This potential for error will be controlled by following guidance in the Technical Guide and this protocol, and by working with appropriate resource specialists when collecting and analyzing the data.

**K. Data Form:** Data for the WSA cannot be entered into Infra-WILD until it is designated as Wilderness. Thus, a separate form will be developed. An effort will be made to allow for easy data migration if data needs to be transferred to Infra-WILD. The form used for collecting applicable information from databases will be developed in the first year of implementing this protocol. The spreadsheet will include a summary of the annual

collection of data, raw data collected that year, and a tab showing the trends for each quality, question, indicator, and measure.

**L. Data Storage:**

**[L-1] Data Cleaning Methods:** Data stored in agency databases are assumed to be clean. Data from other sources will be reviewed by field staff and specialists to ensure forms are complete and accurate.

**[L-2] Data Storage:** All monitoring data will be stored on the O Drive (at O:\NFS\Chugach\Program\2300Recreation\2320Wilderness). A tab in the spreadsheet will be reserved for data from recommended wilderness. The spreadsheet will resemble the format of Infra-WILD, to the extent possible, so data can be transferred smoothly to Infra-WILD in the event that the WSA is designated as wilderness.

**M. Data Analysis:** Data will be analyzed every 5 years to assess trends in each quality of wilderness character. Data from special studies that relate to wilderness character, which may include lichen analysis, climate change studies, and stratified random boat transects, will be integrated when studies are complete. Trends (degrading, stable, improving) for each measure, indicator, monitoring question, and quality will be determined following guidance in chapter 3 of the Technical Guide. The report will be sent to the regional office to include in regionwide wilderness reports.

To attempt to establish trends dating back to creation of the WSA, applicable data collected since 1980 will be compiled to the extent possible. This will take place in FY13, and the information will be included in the first 5-year analysis, scheduled for FY16.

**N. Assumptions and Limitations:** The assumption for database reviews is that this data is clean and that the level of accuracy and completeness is consistent. It is also assumed that bias will be mitigated by using a consistent approach to monitoring. Another assumption is that wilderness character is not being degraded in remote areas of the WSA, so monitoring focuses on only a small portion of the area, primarily the shorelines. Finally, as FSM 2320 is revised, it is assumed that Forest Service policy regarding wilderness monitoring will reflect the direction described in the Technical Guide.

There are numerous limitations for wilderness character monitoring. The Technical Guide, as well as Landres et al. (2008 and 2005), describes these well. In general, it is acknowledged that by reducing the complex concept of wilderness character into only four qualities, a full sense of the WSA's character cannot be achieved. Instead, these indicators are meant to provide a way to raise "red flags" to alert managers of broad-level changes. There will be many activities that are not recorded through this monitoring, such as other agency and private activities in areas outside of Forest Service jurisdiction (state/private land, marine waters, etc.), that nonetheless may have a significant impact on wilderness character. The complexity of jurisdictions and land ownership makes monitoring a challenge. Existing data sources are also a limitation, particularly for air quality monitoring; the need to extrapolate data from several hundred miles away is a major limitation on the accuracy of this data.

Potential special studies, outside the scope of this monitoring protocol but intimately linked to wilderness character, would provide important additional data to improve monitoring quality. These studies include a lichen tissue analysis for air quality and, possibly, climate change (Dillman 2010), boat transects to validate proxy information for solitude opportunities (PWS Framework), campsite condition monitoring for the Undeveloped quality (Cole and Carlson 2006; Monz and Twardock 2010), informal and formal surveys to assess solitude and primitive recreation opportunities, and measuring impacts of climate change on selected ecosystems attributes in the WSA.

**O. Reporting Frequency:** Data will be compiled annually, and analyzed every 5 years. A local report showing trends in wilderness character for the WSA will be completed every 5 years. Currently, there is no requirement for higher reporting for a WSA, but the report will be shared with the Regional Office.

**P. Responsibility:** Field staff on the Glacier Ranger District (10 days per year), with assistance from the forest recreation planner (4 days), will be responsible for collecting and consolidating data on an annual basis. The Chugach National Forest recreation planner and Glacier Ranger District backcountry staff will be responsible for analyzing the data and writing the local report every 5 years (additional 10 days each) with support from specialists (additional 2 days each). The forestwide Infra data steward (5 days), along with a GIS specialist (5 days), ecologist (2 days), fish biologist (2 days), lands specialist (1 day), and hydrologist (2 days) will assist with testing and implementing this protocol. FY12 costs are higher as more specialist time is needed to refine and test this protocol. FY13 costs reflect additional time needed to gather historical data for the WSA, to be conducted by the forest recreation planner and lead backcountry ranger (additional 10 days each). FY14–15 costs reflect core monitoring costs, including 1 day for each resource specialist and 2 days for the GIS specialist. FY16 and 21 are higher because those years include additional time for the 5-year analysis (additional 7 days for the recreation planner and 10 days for the lead backcountry ranger). The Forest will seek opportunities to include other agencies, private citizens, including volunteers, youth, and Alaska Native tribes and corporations, into supplemental WSA monitoring.

**Q. List of Preparers:**

Paul Clark, Recreation Planner, USDA Forest Service, Chugach National Forest, Anchorage, Alaska.

**R. 10-Year Cost Forecast:** The cost forecast includes only core monitoring. Supplemental monitoring activities that could allow the Chugach National Forest to more accurately monitor trends in wilderness character are not included in this protocol. Costs include 3 percent annual inflation. Cost estimate in Revised Forest Plan: $10,000 per year.

Core monitoring

| | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| People | $13,845 | $12,550 | $8,150 | $8,400 | $14,585 | $8,900 | $9,200 | $9,450 | $9,700 | $16,415 |
| Travel | $0 | $250 | $0 | $0 | $200 | $0 | $0 | $0 | $0 | $300 |
| Other | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **TOTAL** | **$13,845** | **$12,800** | **$8,150** | **$8,400** | **$14,785** | **$8,900** | **$9,200** | **$9,450** | **$9,700** | **$16,715** |

**S. Literature Cited:**

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Landres, Peter; Steve Boutcher; Liese Dean; Troy Hall; Tamara Blett; Terry Carlson; Ann Mebane; Carol Hardy; Susan Rinehart; Linda Merigliano; David N. Cole; Andy Leach; Pam Wright; and Deb Bumpus. 2009. *Technical guide for monitoring selected conditions related to wilderness character*. Gen. Tech. Rep. WO-80. U.S. Department of Agriculture, Forest Service, Washington Office. 295 p. Retrieved 10/16/2010 from the Wilderness.net website at http://www.wilderness.net/index.cfm?fuse=toolboxes&sec=WC.

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Monz, C.A. and P. Twardock. 2010. A classification of backcountry campsites in Prince William Sound, Alaska, USA. *Journal of Environmental Management*, doi:10.1016/j.jenvman.2010.02.030.

USDA Forest Service. 2002. *Revised Land and Resource Management Plan, Chugach National Forest*. USDA Forest Service, Chugach National Forest, R10-MB-480c.

USDA Forest Service. Draft. *Sustainable Human Use Management in Prince William Sound [PWS Framework]*. Chugach National Forest, Anchorage, Alaska.

## *Attachment Q42-1. Wilderness Character Monitoring Matrix*

| Quality | Question | Indicator | Measure | Data Source / Frequency (data gathered/ analysis) | Protocol source |
|---|---|---|---|---|---|
| **UNTRAMMELED** | Management actions: What are the trends in actions that control or manipulate the "earth and its community of life" inside wilderness? | Actions authorized by the Forest Service | Vegetation; Fish, wildlife, insects, and disease; soil and water; and fire actions | Specialist reports, SOPA, NEPA decisions, ADF&G Annual / 5 years | FS Technical Guide (pp. 52–63) |
| | | | Number of lakes stocked / | Specialist reports, SOPA, NEPA decisions, ADF&G Annual / 5 years | FS Technical Guide (pp. 66–69) |
| **NATURAL** | What are the trends of human threats to natural conditions? | Pollutants that degrade air quality and air-quality-related values | Ozone and concentration of sulfur and nitrogen in wet deposition | CASTNET data from Mount Rainier NP; NADP data from Denali National Park Annual / 5 years (Supplement: Lichen tissue analysis | FS Technical Guide (pp. 75–100) |
| | | Developments that degrade the free-flowing condition of rivers and streams | Number of dams inside the WSA / Number of fish weirs | Infra-DAMS, GIS, ADF&G Annual / 5 years | FS Technical Guide (pp. 100–102) |
| | | Nonindigenous species that alter the composition of natural plant and animal species | Percent of land cover | NRIS, Ecologist reports | FS Technical Guide (pp. 105–113) |
| | What are the trends in selected biophysical conditions and processes sensitive to human threats? | Visual air quality | Average sum of anthropogenic fine nitrate and sulfate Average deciview | Interagency Monitoring of Protected Visual Environments (IMPROVE) data from Tuxedni, AK site Annual / 5 years | FS Technical Guide (pp. 118–126) |
| | | Indigenous ecosystems, plant communities, and plant and animal species that have been extirpated | Number of known indigenous plant and animal species that have been extirpated | NRIS, Natural Heritage Database, Forest files 5 years / 5 years | FS Technical Guide (pp. 127–132) |

| Quality | Question | Indicator | Measure | Data Source / Frequency (data gathered/ analysis) | Protocol source |
|---|---|---|---|---|---|
| **UNDEVELOPED** | What are the trends in physical evidence of modern human occupation or modification? | Physical evidence of development | Index of authorized physical development | Infra, SUDS<br>Annual / 5 years<br>Supplement: campsite monitoring | FS Technical Guide (pp. 140–168) |
| | | | Known unauthorized physical development | Law enforcement reports, field staff reports | Landres et al. (2008) (Keeping it Wild) (pp. 52–53) |
| | What are the trends in the use of motorized equipment and mechanical transport? | Motorized equipment and mechanical transport use authorizations | Index of administrative and non-emergency use; index of emergency use | Regional wilderness manager, NEPA, Min requirement analyses, District reports<br>Annual / 5 years | FS Technical Guide (pp. 168−179) |
| | What are the trends in inholdings? | Inholdings | Acres of inholdings | Lands status maps, Automated Lands Project (ALP) database<br>5 years / 5 years | FS Technical Guide (pp. 179–180) |
| Outstanding opportunities for solitude or a primitive and unconfined type of recreation | What are the trends in outstanding opportunities for solitude | Remote, trailless wilderness | Acres of WSA away from access and travel routes | Infra, GIS layers<br>5 years / 5 years | FS Technical Guide (pp. 187–190) |
| | | Wilderness visitation | Number and location of parties visiting the WSA during the primary use season | Whittier Tunnel numbers, harbormaster information, Ferry O/G permits, water taxis, cabin rentals, informal surveys<br>Supplement: stratified random transects<br>Annual / 5 years | FS Technical Guide (pp. 191–196), Fay et al. (2010) |
| | What are the trends in outstanding opportunities for primitive recreation | Recreation facilities | Recreation facilities index | Infra<br>5 years / 5 years | FS Technical Guide (pp. 208–210) |
| | | Trail development level | Number of class 3-5 trail miles | Infra<br>5 years / 5 years | FS Technical Guide (pp. 211–214) |

| Quality | Question | Indicator | Measure | Data Source / Frequency (data gathered/ analysis) | Protocol source |
|---|---|---|---|---|---|
| | What are the trends in outstanding opportunities for unconfined recreation | Management restrictions on visitor behavior | Index of restrictions on visitor behavior | Forest orders, Forest Plan direction and amendments, SUDS | FS Technical Guide (pp. 214–220) |

## *Research Natural Areas*

### *43. Are proposed and established Research Natural Areas (RNA) being maintained in a manner consistent with the purposes for which the area was established?*

**A. Monitoring Item: *Research Natural Areas***

**B. MEIT Interpretation of General Monitoring Question**: Are proposed and established Research Natural Areas (RNA) being maintained in a state unmodified by human activity?

**C. Business Need and Rationale:** RNAs form a long-term network of ecological reserves administratively designated for non-manipulative research, monitoring, education, and for the maintenance of natural diversity. RNAs serve as baseline reference areas for measuring long-term ecological change. RNA management focuses on allowing natural physical and biological processes to prevail without human intervention. On the Chugach National Forest, probably the largest human-caused disturbance to RNAs is recreational activity. Implementation monitoring is needed to ensure that the RNAs are being maintained according to standards and guidelines and the RNA Management Area Prescription specified for in the Revised Forest Plan (pp. 4-30 through 4-33) as follows:

**Standards**

1. Allow soil/watershed restoration projects and wildlife and fish habitat manipulation for the protection of threatened, endangered or sensitive species or where it is necessary to perpetuate or restore natural conditions for which the RNA was established.

2. Allow natural fires to burn to accomplish the objectives of the specific research natural area.

3. Use management-prescribed fire as necessary to accomplish RNA objectives.

4. Allow non-vehicular recreation, except when it interferes with the purpose of the RNA.

5. Prohibit the construction of new trails unless they contribute to the objectives or to the protection of the RNA.

6. No competitive group events are allowed.

7. Administrative facilities are not allowed. Temporary facilities may be permitted to support approved research projects.

**Guidelines**

1. Treatment measures may be taken on exotic plants and animals to minimize their impacts on ecological processes.

2. RNAs may be withdrawn, subject to the establishment of valid existing rights, from mineral entry for locatable minerals.

3. Mineral activities may be limited, modified or restricted to maintain, to the extent possible, the natural values of the area.

4. Close or obliterate existing roads, except where they provide necessary access for scientific or educational purposes.

5. Existing trails may remain unless they are not consistent with the purpose of the RNA.

6. Administrative and non-recreational motorized access (e.g., helicopter landings) may be allowed if such activities do not interfere with the objectives for which the RNA was established.

7. If no other reasonable access exists, provide such access, including roads for conducting mineral operations under a mining plan of operations. Aircraft access is allowed for minerals exploration and will be coordinated with the responsible line officer to minimize impacts to the natural character of the area.

8. If no other reasonable access exists elsewhere, provide reasonable access to private lands.

**Activities Not Allowed Under the RNA Prescription**

1. Vegetation Management

2. Commercial Timber Harvest

3. Commercial Special Forest Products Harvest

4. Personal Use Timber Harvest

5. Personal Use Special Forest Products Harvest

6. Mineral Activities – Salable

7. Recreational Gold Panning

8. Day-use Facilities

9. Forest Service Recreational Cabins

10. Campgrounds

11. Hardened Dispersed Camping Sites

12. Viewing Sites

13. Marine Transfer Facilities

14. Boat Docks and Ramps

15. Mode Changes: Parking Lots at Trailheads, Ferry Terminals, etc.

16. New Forest Service Built Roads

17. Electronic Sites

18. Utility Systems

19. SUP Destination Lodges

20. SUP "Hut-to-Hut" Type Recreation Cabins

21. SUP Recreation Equipment Storage/Cache

**D. Category:** Implementation.

**E. Protocol Status, Source, and Re-evaluation Schedule:** This will be a final protocol. Two methodologies will be used: (1) database review, and (2) visitor effects monitoring. The sources of the database review information are the corporate FACTS, INFRA, TIM, and SUDS databases, and data from the forest's schedule of proposed actions and fire occurrence. The visitor effects monitoring methodology will be a modification of that described by Cole (1989) and Monz (1998). The protocol depends on accurate information in national as well as Chugach National Forest databases. Re-evaluation of the protocol will occur every 5 years.

**F. Objective Statement:** This monitoring guide documents the ways that each of the RNAs on the Chugach National Forest are being managed in a manner consistent with standards and guidelines and the RNA Management Area Prescription specified in the Revised Forest Plan.

**[F-1] Required by Law:** Inferred; 36 CFR 219.25 states that in planning RNAs the forest "shall make provision for the identification of examples of important forest, shrubland, grassland, alpine, aquatic, and geologic types that have special or unique characteristics of scientific interest and importance that are needed to complete the national network of RNAs.

**[F-2] Statistical Rigor Rationale:** NA for the database review since information in the databases should represent a "census" of administratively tracked activities proposed and occurring on the Forest. The statistical rigor of the visitor effects monitoring is medium since, rather than random or systematic sampling, the data are collected from those portions of each RNA where the greatest human activity is known or suspected (perceived) to occur.

**[F-3] Data Precision, Reliability:** Class A for the database review. Class B for the visitor effects monitoring.

**[F-4] Confidence:** For the database review the confidence level is 99 percent because all administratively tracked activities are represented in the dataset, but there may still be some errors in the data. For the visitor effects monitoring the confidence level is 75 percent (following Cole 1989).

**[F-5] Change Detection:** Under the database review, all changes in the presence or absence of an administratively tracked activity within the RNA

network need to be documented. The visitor effects monitoring must detect evidence of human-caused damages within the RNA network. These changes would then be interpreted in regard to the extent they interfere with the purposes for which the affected RNAs were established (as described in the establishment record for the respective RNAs).

**[F-6] Threshold:** For the database review, the occurrence of any activity not allowed within an RNA would require immediate management action to bring the area into compliance. For the visitor effects monitoring, the occurrence of any evidence of human-caused damage to an RNA would trigger an evaluation to determine if the damage is of a magnitude to impede natural processes. The greater the aggregate size of the affected area and the more intense the damage, the greater will be the likelihood that natural processes could be impacted and that management action is called for. Following visitor effects monitoring every 5 years, a report summarizing the size and intensity of human-caused disturbances within the RNAs will be provided to the forest supervisor. The forest supervisor will decide if management action is warranted.

**[F-7] Scope of Inference:** The spatial scope is the network of five RNAs on the Chugach National Forest and the temporal scale is annual to decadal. The data will be summarized by individual RNA and across the forestwide RNA network.

**G. Indicator and its Units of Measure:** For the database review, the indicator is presence or absence of the respective activity (listed above under “Business Need and Rationale”) in the RNA in question. Attachment Q43-1 provides the checklist to be used for recording these determinations. For the visitor effects monitoring, the indicators to be estimated at each human activity site samples are (as listed in Monz 1998): size of impacted area ($m^2$), condition class (1-5 rating), vegetative ground cover on site (percent), vegetative cover off site (percent), mineral soil exposure (percent), tree damage (1-3 rating), root exposure (1-3 rating), number of tree stumps (count), number of trails (count), number of fire sites (count), and litter or trash presence (1-3 rating). Attachment Q43-2 provides the form to be used for recording these estimates.

**H. Sampling Design:** The database review does not involve sampling, as it includes 100 percent of the administratively tracked activities proposed and occurring on Chugach National Forest. The visitor effects monitoring is conducted on a sample of those portions of each RNA where the greatest human activity is known or suspected to occur (see “Sample Selection Methods”).

**[H-1] Target Population:** Human-caused disturbances within RNAs on the Chugach National Forest.

**[H-2] Sampling Frame:** All data to be used in the database review are contained in the Chugach National Forest Schedule of Proposed Actions, and the corporate FACTS, TIM, INFRA, and SUDS databases. These databases will be searched to determine if any existing or proposed activities are occurring in the RNAs, and if so, if these activities are allowed (as listed above under “Business Need and Rationale”). Attachment Q43-1 provides the checklist to be used for recording these determinations. Sample units for the visitor effects monitoring are human activity indicators (as listed above under “Indicator and its Units of Measure”) in those portions of each RNA where the greatest human activity is known or

suspected (perceived) to occur. Attachment Q43-2 provides the form to be used for recording the disturbance estimates.

**[H-3] Sample Selection Methods:** The database review includes 100 percent of the administratively tracked activities proposed and occurring in RNAs on the Chugach National Forest. The visitor effects monitoring will survey all sites of human-caused disturbance larger than 10 $m^2$ in those portions of each RNA where the greatest human activity is known or suspected to occur. Beaches are the area of greatest known or suspected human activity for RNAs accessible by water (i.e., all but Wolverine Glacier RNA). The entire shoreline of these RNAs will be examined from boat. All visible occurrences of human-caused disturbance with an estimated aggregate size larger than 10 $m^2$ will be surveyed on the ground. If a visit to a disturbance location reveals that the disturbance was not caused by humans, data for that location would not be collected. Stops will also be made at sites perceived to be likely camping spots (based on topography and setting), but for which site disturbance is not visible from the water. In addition to shoreline surveys, 100 percent of Copper Sands RNA will be viewed from aerial over flights to document any off-road vehicle trails within the area. Wolverine Glacier RNA will also be surveyed from the air to document any visible human-caused disturbance (particularly in the vicinity of the cabin on the divide between Wolverine Glacier and Upper Paradise Lake). If human-caused disturbances are detected or suspected from the air, then these detection sites will be surveyed on the ground.

**[H-4] Sample Unit Description**: The database review sample units are database records documenting administratively tracked activities. The visitor effects monitoring sample units are human-caused disturbance sites larger than 10 $m^2$.

**[H-5] Detection and Observer Bias Controls:** The database review does not include bias. The visitor effects monitoring can have measurement errors for the ratings and ground cover estimates. This bias will be controlled by calibrating observers across a range of values for the measurement variables prior to conducting the field work.

**[H-6] Sample Size Estimate and Estimation Methods:** The database review includes 100 percent of the administratively tracked activities proposed and occurring in RNAs on the Chugach National Forest. The visitor effects monitoring will survey 100 percent of the sites of human-caused disturbance larger than 10 $m^2$ in those portions of each RNA where the greatest human activity is known or suspected to occur.

**[H-7] Temporal Details of Sampling:** Although the Revised Forest Plan (p. 5-17) suggests data collection and reporting only once every 10 years, that frequency may be inadequate to document and appropriately respond to human-caused disturbances affecting the RNAs. Under this protocol, the database review will occur quarterly for data in schedule of proposed actions and annually for data in FACTS, TIM, INFRA, and SUDS. The visitor effects monitoring will occur once every 5 years across the RNA network during the months of June, July, and August.

**I. Data Collection:** The following data collection method details apply only to the visitor effects monitoring. At the time of their use in this project, the data in the database review will already have been input into the respective database following the specific procedures for such entry.

**[I-1] Methods for Locating Sample Units:** The visitor effects monitoring will survey all sites of human-caused disturbance larger than 10 $m^2$ in those portions of each RNA where the greatest human activity is known or suspected to occur. To reduce costs, these site visits will be coordinated with other projects visiting the areas (these reduced costs have been incorporated into the "10-Year Cost Forecast"). Beaches are the area of greatest known or suspected human activity for RNAs accessible by water (i.e., all but Wolverine Glacier RNA). The entire shoreline of these RNAs will be examined from boat (using binoculars) and all visible occurrences of human-caused disturbance larger than 10 $m^2$ will be documented with a mapping grade GPS (ca. 1-meter accuracy) and surveyed on the ground. In addition to shoreline surveys, 100 percent of Copper Sands RNA will be viewed from aerial over flights to document any off-highway vehicles trails within the area. Wolverine Glacier RNA will also be surveyed from the air to document any visible human-caused disturbance (particularly in the vicinity of the cabin on the divide between Wolverine Glacier and Upper Paradise Lake). Within constraints of safety, the aerial over flights will be at a low enough altitude and speed to discern disturbances of 10 $m^2$ and larger. If human-caused disturbances are detected or suspected from the air, then these detection sites will be surveyed on the ground and documented with a mapping-grade GPS.

**[I-2] Methods for Layout and Marking:** In the visitor effects monitoring, when a site of human-caused disturbance larger than 10 $m^2$ is found, the center and the boundary of the site will be digitally documented with a mapping-grade GPS. No permanent marking will be necessary.

**[I-3] "Field" Sampling Methods:** At each sample site, the following variables (Monz 1998) will be estimated within the GPS-documented perimeter of the site:

1. *Size of impacted area ($m^2$)* – the area within the perimeter delimited by the disturbance boundary with the mapping-grade GPS.

2. *Condition class (1-5 rating)* – modified from Cole 1989 to the following: Class 1 – ground vegetation flattened but not permanently injured. Minimal physical change; Class 2 – ground vegetation worn away around center of activity; Class 3 – ground vegetation lost over most of the site, but humus and litter still present in all but a few areas; Class 4 – bare mineral soil widespread. If trees present, their roots exposed on surface; and Class 5 – soil erosion obvious. If trees present, they are reduced in vigor or dead.

3. *Vegetative ground cover on site (percent, midpoint of each of six classes)* – modified from Cole 1989, to the following: 1=0-5%; 2=6-25%; 3=26-50%; 4=51-75%; 5=76-95%; 6=96-100%.

4. *Vegetative cover off site (percent, midpoint of each of six classes)* – as described by Cole 1989, vegetative ground cover on an environmentally

similar, but unimpacted area off the site: 1=0-5%; 2=6-25%; 3=26-50%; 4=51-75%; 5=76-95%; 6=96-100%.

5. *Mineral soil exposure (percent, midpoint of each of six classes)* – as described by Cole 1989, the percent of the site that is bare mineral soil: 1=0-5%; 2=6-25%; 3=26-50%; 4=51-75%; 5=76-95%; 6=96-100%.

6. *Tree damage (1-3 rating)* – as described by Monz 1998: Class1 – little/none; Class 2 – moderate; and Class 3 – severe.

7. *Root exposure (1-3 rating)* – as described by Monz 1998: Class1 – little/none; Class 2 – moderate; and Class 3 – severe.

8. *Number of cut tree stumps (count)* – the number of tree stumps within the site perimeter.

9. *Number of trails (count)* – the number of human-made trails within the site perimeter (regardless of how worn they are).

10. *Number of fire sites (count)* – the number of human-made fire locations within the site perimeter.

11. *Litter/trash presence (1-3 rating)* – as described by Monz 1998: Class 1 – little/none; Class 2 – moderate; and Class 3 – severe.

These data will be collected in electronic field data recorders loaded with the data form. In general, the total amount of time spent documenting a site will be from 15 to 30 minutes.

**J. Quality Control and Assurance:** The data collections most vulnerable to error are the ratings and ground cover estimates in visitor effects monitoring. This error will be controlled by calibrating observers across a range of disturbance conditions prior to conducting the field work.

**K. Data Form:** The form used for the database review is attached as Attachment Q43-1. The data form for the visitor effects monitoring (Attachment Q43-2) is modified from that shown in figure 16 of Cole 1989 to include just those variables listed under “Indicator and Units of Measure” (above).

**L. Data Storage:**

**[L-1] Data Cleaning Methods:** The database review information is not collected by this project, but resides in the corporate and Forest databases that are assumed to already be clean. Data collected in the visitor effects monitoring will be initially stored in electronic field data recorders which will check for errors on data entry (e.g., out of bounds answers not allowed; illogical answers flagged as possible errors). Missing data will not be allowed (all visitor effects monitoring variables must be recorded for a valid record).

**[L-2] Data Storage:** Data used in the database review information are in the corporate FACTS, INFRA, TIM, and SUDS databases, on the Chugach National Forest Internet in the case of Schedule of Proposed Actions, and in the Chugach

National Forest GIS database in the case of fire occurrence data. Data collected in the visitor effects monitoring will be stored in a Chugach National Forest customized database maintained by the forest ecologist.

**M. Data Analysis:** For the database review, the databases listed under “Data Storage” are searched for the presence (in the RNA in question) of activities listed under “Business Need and Rationale.” The schedule of proposed actions database is reviewed quarterly; all others are reviewed annually. The occurrence of any activity not allowed within RNAs would require immediate management action to bring the area into compliance. For the visitor effects monitoring, the estimates from “Field Sampling Methods” (above) will be summarized for each RNA. In addition, a relative cover loss variable (Monz 1998) will be derived. The summary statistics for all sample variables will be number of sites, average, median, minimum, and maximum. The occurrence of any evidence of human-caused damage to an RNA triggers an evaluation to determine if the damage is of a magnitude that impedes natural processes. The greater the aggregate size of the affected area and the more intense the damage, the greater will be the likelihood that natural processes could be impacted and that management action is called for.

**N. Assumptions and Limitations:** The database review information is assumed to list all administratively tracked activities proposed and occurring within the RNA network. If an activity is missing from these databases, that activity will be missed in the analysis and interpretations (unless observed in the visitor effects monitoring). Also, the data in the database review resides in the corporate and Forest databases that are assumed to already be clean. That may not be a valid assumption. Data collection in the visitor effects monitoring is on those portions of each RNA where the greatest human activity is known or suspected (perceived) to occur. For those RNAs accessible by water, beaches are assumed to the area of greatest known or suspected human activity and are the focus of sampling. Restricting sampling to beach areas (and human disturbance areas visible from over flights in Copper Sands and Wolverine Glacier RNA) may miss some important sites of human activity.

**O. Reporting Frequency:** Annually for the database review. Once every 5 years for the visitor effects monitoring.

**P. Responsibility:** Chugach National Forest Ecologist in coordination with Planning Staff Officer.

**Q. List of Preparers:**

R.L. DeVelice, Ph.D., Forest Ecologist, USDA Forest Service, Chugach National Forest, Anchorage, Alaska

B.A. Schrader, Ph.D., Regional Ecologist, USDA Forest Service, Regional Office, Juneau, Alaska.

**R. 10-Year Cost Forecast:** Total 10-year estimated cost is $37,202; annual cost (FY13 dollars) for the database review work is $1,159; annual costs (FY12 dollars) for visitor effects monitoring (FY12 and FY17) is $12,318. Estimated annual cost in the Revised Forest Plan (p. 5-17) is $2,000.

| | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| People | $7,879 | $1,159 | $1,194 | $1,230 | $1,267 | $9,133 | $1,344 | $1,384 | $1,426 | $1,469 |
| Travel | $3,939 | $0 | $0 | $0 | $0 | $4,567 | $0 | $0 | $0 | $0 |
| Other | $563 | $0 | $0 | $0 | $0 | $652 | $0 | $0 | $0 | $0 |
| **TOTAL** | **$12,381** | **$1,159** | **$1,194** | **$1,230** | **$1,267** | **$14,353** | **$1,344** | **$1,384** | **$1,426** | **$1,469** |

Cost in inflated dollars ($)

## S. Literature Cited:

Cole, D.N. 1989. *Wilderness Campsite Monitoring Methods: A Sourcebook*. USDA Forest Service, Intermountain Forest and Range Experiment Station, General Technical Report INT-259. Ogden, Utah. 57 pp.

Monz, C.A. 1998. Monitoring Recreation Resource Impacts in Two Coastal Areas of Western North America: An Initial Assessment. Pages 117-122 in *Personal, Societal, and Ecological Values of Wilderness: Sixth World Wilderness Congress Proceedings,* on Research, Management, and Allocation, Volume I (A.E. Watson, G.H. Aplet, and J.C. Hendee, Comps.). USDA Forest Service Proceedings RMRS-P-4, Ogden, Utah.

## *Attachment Q43-1. RNA Database Review Checklist*

| RNA Name_____<br>Reviewer(s)_____ | Yes [1]/ No | Database Reviewed | Date of Review |
|---|---|---|---|
| **Conduct Quarterly Reviews of the Following Standards:** | | | |
| S1 – if needed, is restoration NOT occurring? | | SOPA | |
| S1 – is prohibited restoration occurring? | | SOPA | |
| S3 – if needed, is prescribed fire NOT occurring? | | SOPA | |
| S5 – have prohibited trails been constructed? | | SOPA | |
| S7 – are prohibited administrative facilities present? | | SOPA | |
| | | | |
| **Conduct Annual Reviews of the Following Standards:** | | | |
| S1 – if needed, is restoration NOT occurring? | | FACTS | |
| S1 – is prohibited restoration occurring? | | FACTS | |
| S3 – if needed, is prescribed fire NOT occurring? | | FACTS | |
| S5 – have prohibited trails been constructed? | | INFRA | |
| S7 – are prohibited administrative facilities present? | | INFRA | |
| S6 – have competitive group events occurred? | | SUDS | |
| S2 – are natural fires being suppressed? | | Fire | |
| | | | |
| **Conduct Annual Reviews of the Following Guidelines:** | | | |
| G1 – if present, have exotic plants and animals NOT been controlled? | | FACTS | |
| G4 – do unnecessary roads exist? | | IN FRA | |
| G5 – do undesirable trails exist? | | INFRA | |
| G8 – is unauthorized access to private lands occurring? | | INFRA | |
| G2 – is mineral entry occurring? | | 31_minerals | |
| G3 – is mineral entry occurring in excess of restrictions? | | 31_minerals | |
| G7 – is unauthorized mineral operations access occurring? | | 31_minerals | |
| G6 – is unauthorized administrative motorized access occurring? | | dispatch records | |
| | | | |
| **Conduct Annual Reviews of the Following Prohibited Activities:** | | | |
| A1 – is unauthorized vegetation management occurring? | | FACTS | |
| A2 – is commercial timber harvest occurring? | | FACTS | |
| A3 – is commercial special forest products harvest occurring? | | FACTS | |
| A4 – is personal use timber harvest occurring? | | FACTS | |
| A5 – is personal use special forest products harvest occurring? | | FACTS | |
| A6 – are salable mineral activities occurring? | | FACTS | |
| A2 – is commercial timber harvest occurring? | | TIM | |
| A3 – is commercial special forest products harvest occurring? | | TIM | |
| A4 – is personal use timber harvest occurring? | | TIM | |
| A5 – is personal use special forest products harvest occurring? | | TIM | |
| A8 – are day-use facilities present? | | INFRA | |
| A9 – are Forest Service recreational cabins present? | | INFRA | |
| A10 – are campgrounds present? | | INFRA | |
| A11 – are hardened dispersed camping sites present? | | INFRA | |
| A12 – are viewing sites present? | | INFRA | |
| A13 – are marine transfer facilities present? | | INFRA | |
| A14 – are boat docks and ramps present? | | INFRA | |
| A15 – are mode change structures present? | | INFRA | |
| A16 – are new Forest Service built roads present? | | INFRA | |
| A17 – are electronic sites present? | | INFRA | |
| A18 – are utility systems present? | | INFRA | |
| A19 – are SUP destination lodges present? | | INFRA | |
| A20 – are SUP recreation cabins present? | | INFRA | |
| A7 – is recreational gold panning occurring? | | SUDS | |
| A21 – are SUP storage caches present? | | SUDS | |

| |
|---|
| **Notes justifying any "Yes" calls (i.e., deviations from Standards, Guidelines, or Activities Not Allowed):** |
| [1] **In all cases, a "Yes" indicates an undesirable situation. "Yes" calls in this checklist would trigger a subjective evaluation of whether or not more follow up (and perhaps management action) is needed. The SOPA reviews occur quarterly, and all other reviews occur annually. Data for all of the variables listed must be recorded for a valid record.** |
| |

## *Attachment Q43-2. RNA Visitor Effects Monitoring Form*

**RNA Name: _____**

**Site Number: _____ Photo #s: _____**

**Observers: _____**

**Location of Site Center (use mapping grade GPS):**

**UTM Zone _____ Easting _____ Northing _____**

***Size of impacted area*** **($m^2$ use mapping grade GPS): _____**

***Condition class*** **(circle appropriate class):**

**Class 1 – ground vegetation flattened but not permanently injured. Minimal physical change**

**Class 2 – ground vegetation worn away around center of activity**

**Class 3 – ground vegetation lost over most of the site, but humus and litter still present in all but a few areas**

**Class 4 – bare mineral soil widespread. If trees present, their roots exposed on surface**

**Class 5 – soil erosion obvious. If trees present, they are reduced in vigor or dead.**

***Vegetative ground cover on site*** **(circle appropriate cover class):**

**1=0-5% 2=6-25% 3=26-50% 4=51-75% 5=76-95% 6=96-100%**

***Vegetative cover off site*** **(circle appropriate cover class):**

**1=0-5% 2=6-25% 3=26-50% 4=51-75% 5=76-95% 6=96-100%**

***Mineral soil exposure*** **(circle appropriate cover class):**

**1=0-5% 2=6-25% 3=26-50% 4=51-75% 5=76-95% 6=96-100%.**

***Tree damage*** **(circle appropriate class):**

**Class1 – little/none Class 2 – moderate Class 3 – severe**

***Root exposure*** **(circle appropriate class):**

**Class1 – little/none Class 2 – moderate Class 3 – severe**

***Number of cut tree stumps*** **(the number of tree stumps within the site perimeter): _____**

***Number of trails*** **(the number of human made trails within the site perimeter): _____**

***Total length of trail within site perimeter*** **(meters): _____**

***Number of fire sites*** **(the number of human made fire locations within the site perimeter):**

**_____**

***Litter/trash presence*** **(circle appropriate class):**

**Class1 – little/none Class 2 – moderate Class 3 – severe**

## *Air Resources*

### *46. What is the potential that winter snowmachine use and its associated activities are causing violations of Alaska State air quality standards in areas of the Chugach National Forest where winter motorized use is the highest?*

**A. Monitoring Item: *Air Resources***

**B. MEIT Interpretation of General Monitoring Question:** Interpreted as stated.

**C. Business Need and Rationale:**

*General:* This protocol is based on a pilot study conducted on the Chugach National Forest during the winter of 2006–2007 to monitor the effects of winter motorized uses on air quality. The intent of this monitoring program is to qualitatively describe air quality conditions and quantify levels of carbon monoxide (CO) and fine particulates (PM2.5). The pilot study evaluated the potential that these pollutants are exceeding Alaska State air quality standards as a result of winter motorized uses at the Turnagain Pass motorized parking area, one of the most heavily used areas on the Chugach National Forest for winter motorized recreation. This pilot study initiated a long-range strategy to monitor the effects of winter motorized use on air quality on the Chugach National Forest.

*Forest Plan Appeal:* The Revised Chugach National Forest Land and Resource Management Plan (USDA Forest Service, Chugach National Forest 2002a) (Revised Forest Plan) does not include a monitoring question related to air resources. An appeal to the Revised Forest Plan suggested that the Forest Service has not adequately quantified and assessed the impacts of winter motorized use on air quality. The pilot study was developed with the appropriate level of monitoring to address the Forest Service Chief's response to this appeal (USDA Forest Service 2004), in which the Chief agreed with the Regional Forester's decision in the Revised Forest Plan Record of Decision (USDA Forest Service, Chugach National Forest 2002c) to conduct more detailed air quality analyses "so emissions can be more accurately quantified, reasonably forecasted, and local impacts assessed." In this response, the Chief determined the need to do the following:

- "Cooperate with the State to identify air quality changes over time and detect changes in air quality related to human activities on the Forest,"
- "Collect reliable qualitative air quality information to assure compliance with EPA's air quality standards," and
- Conduct monitoring to "conform to State air quality implementation plans."

*The Forest Plan:* The forest plan final environmental impact statement (FEIS) states that the largest source of air pollution on the Chugach National Forest is from airborne dust, particularly from natural sources (USDA Forest Service, Chugach National Forest 2002b). Other sources of air pollutants include vehicle emissions, smoke from campfires, and smoke from wildfires and prescribed fires. The FEIS further states that snowmobile use on the Forest is dispersed and is not expected to have negative effects on air

quality, although it does identify the fact that carbon monoxide and other pollutants may potentially increase in localized areas where high concentrations of snowmobiles assemble, such as Turnagain Pass and the Lost Lake area.

In the Revised Forest Plan Record of Decision (USDA Forest Service, Chugach National Forest 2002c), the Regional Forester stated that the activities described in the forest plan are not likely to degrade air quality or violate State implementation plans. The Regional Forester also stated that more detailed analyses will be conducted at subsequent levels of planning to more accurately quantify and forecast emissions and asses the local impacts. No air quality studies quantifying levels of pollutants from snowmachine emissions were previously conducted on the Chugach National Forest.

This pilot protocol addresses the following Forest Plan air quality goals and objectives (USDA Forest Service, Chugach National Forest 2002a) as they relate to winter motorized use:

**Goal:** Conserve air quality-related values over Chugach National Forest lands.

**Objective:** Meet state standards for visible and particulate air quality.

*The Clean Air Act:* The Clean Air Act of 1990 sets the National Ambient Air Quality Standards (NAAQS) (U.S. Environmental Protection Agency (EPA) 1990). These standards include six criteria pollutants: carbon monoxide, lead, nitrogen dioxide, suspended particulates, ozone, and sulfur oxides. Individual states are responsible for carrying out the regulations in the Clean Air Act, which includes enforcing state air quality standards and developing state implementation plans to clean up polluted areas. State standards must be no less stringent than the national EPA standards and are generally similar to the national standards. Air quality for the State of Alaska is regulated by the Alaska Department of Environmental Conservation air quality control standards (18 AAC 50) (Alaska Department of Environmental Conservation 2005) (Table Q46-1).

**Table Q46-1. Alaska State air quality standards (18 AAC 50)**

| Pollutant | Primary Standard | Averaging Times |
|---|---|---|
| Carbon Monoxide | 9 ppm | 8-hour average |
| | 35 ppm | 1-hour average |
| Lead | 1.5 µg/$m^3$ | Quarterly arithmetic mean |
| Nitrogen Dioxide | 100 µg/$m^3$ | Annual arithmetic mean |
| Particulate matter (PM10) | 150 µg/$m^3$ | 24-hour average |
| Particulate matter (PM2.5) *(EPA standard)* | 15.0 µg/$m^3$ | Annual arithmetic mean |
| | 35 µg/$m^3$ | 24-hour average |
| Ozone | 0.12 ppm | 1-hour average |
| Sulfur Oxides | 0.03 ppm | Annual arithmetic mean |
| | 0.14 ppm | 24-hour average |
| | 0.50 ppm | 3-hour average |

*Motorized Use and Air Quality:* The winter motorized season on the Chugach National Forest begins on December 1 and ends on April 30, as snow conditions allow. One of the most popular areas for winter motorized recreation on the forest is the Turnagain Pass area because of its high elevation, abundant snow, and proximity to Anchorage. Motorized use at Turnagain Pass can be permitted as early as the Wednesday before Thanksgiving if snow conditions allow (USDA Forest Service, Chugach National Forest 2002a).

Snowmachine emissions have been shown to cause increased levels of carbon monoxide, nitrogen oxide, and particulates in the air (Ray 2005 and Bishop et al. 2006). The types and amounts of these pollutants can vary with factors such as the manufacturer, the type of engine, temperature, and elevation. Four-stroke engines have been shown to have lower emissions than 2-stroke engines (Bishop et al. 2006). These emissions can be sources of concern for public health and safety, and clean air is an important part of the experience for visitors to the Chugach National Forest in terms of visual clarity as well as health.

Air pollution as a result of snowmachine use has been monitored in Yellowstone National Park since 1998 (Ray 2005). At the West Yellowstone entrance between 1998 and 2002, the maximum 8-hour carbon monoxide levels averaged between 5 ppm and 9 ppm. These levels nearly exceeded the 8-hour NAAQS standard (9 ppm), with roughly 400 snowmachines entering the park each day and a high percentage of 2-stroke engines. Air quality impairment can be worse on days with stagnant air conditions and temperature inversions. As a result of adaptive management leading to decreased numbers of snowmachines and clean engine technology requirements, levels of carbon monoxide and particulates have decreased considerably over the last 4 years. During the 2004–2005 season, between 130 and 190 snowmachines used the West Yellowstone entrance each day, and the maximum 8-hour carbon monoxide levels reached only 1 ppm (Ray 2005).

Past snowmachine use at Turnagain Pass has averaged around 50 users per day on weekends and 10 users per day on weekdays (Skustad 2001). Furthermore, weather conditions at Turnagain Pass are often such that the air is not stagnant. Based on these use levels and climatic factors, the forest plan FEIS concluded that levels of pollutants on the Chugach National Forest are likely to be minor and below the Federal air quality standards (USDA Forest Service, Chugach National Forest 2002b).

**D. Category:** The monitoring item can be described as effectiveness monitoring, addressing how the direction of the forest plan is meeting its goals and objectives for air quality.

**E. Protocol Status, Source, and Re-evaluation Schedule:** This is a pilot protocol. No nationally established Forest Service air quality monitoring protocols currently exist for quantifying the air quality effects of winter motorized recreation. This pilot protocol was designed by the Chugach National Forest to meet the needs of this monitoring question, with assistance from the Alaska Department of Environmental Conservation.

Results of the 2007 pilot study showed that winter motorized uses at Turnagain Pass have a low potential to violate State air quality standards. This study recommends that additional monitoring occur every 3 to 5 years. The pilot protocol should be re-evaluated after each monitoring year.

**F. Objective Statement:** This pilot protocol has the following objectives:

1) Quantifiably determine the potential that Alaska State air quality standards for carbon monoxide and fine particulates are being exceeded as a result of winter motorized use in high winter motorized use areas on the Chugach National Forest. Because of the remote nature and the unknown air quality conditions for these sites, this protocol will quantify levels and determine the sources of these pollutants on a number of days during the winter motorized season when the use is the highest. Air quality data will be analyzed in relation to climatic observations and motorized use levels observed during the day to account for natural and human-related variations in the air quality conditions.

2) Provide information leading to the future development of an adaptive, long-range air quality monitoring program on the Chugach National Forest to investigate the influence of winter motorized use on air quality.

This type of monitoring will not meet the stringent requirements of the State Implementation Plan for air quality monitoring. However, it will allow a determination of the level of need, which will drive the development of an appropriate monitoring program. To meet the Chief's objectives stated in the 2004 forest plan appeal response (USDA Forest Service 2004), this pilot protocol will involve assistance from the State of Alaska Department of Environmental Conservation to obtain monitoring equipment, develop sampling procedures, and collect sufficient data to accurately quantify air pollution as identified in the objective statement.

**[F-1] Required by Law:** The Chugach National Forest is required to ensure that management activities do not contribute to violations of the air quality standards regulated by the Alaska Department of Environmental Conservation (Alaska Department of Environmental Conservation 2005), as specified by the U.S. Environmental Protection Agency and the Clean Air Act (U.S. Environmental Protection Agency 1990).

**[F-2] Statistical Rigor Rationale:** This pilot protocol is designed to determine the potential for winter motorized use on the Chugach National Forest to cause air quality standards to be exceeded, and not to make statistical inferences about air quality across the forest. Therefore, a non-statistical approach is employed. The determination of this potential will be based on quantitative data and professional judgment.

**[F-3] Data Precision, Reliability**: The data will be Class A quantitative data that is repeatable, using instrumentation that will be calibrated to known concentrations of pollutants.

**[F-4] Confidence:** Confidence levels of this monitoring are dependent upon the standard errors associated with the equipment used to measure air quality parameters (see Quality Control and Assurance).

**[F-5] Change Detection:** See F-6.

**[F-6] Threshold:** Threshold levels of carbon monoxide and fine particulates that would trigger changes in the monitoring approach and a management review are shown in Table Q46-2. The threshold that defines the high potential to exceed the State standard is based on the air quality standards established by the State of Alaska (Alaska Department of Environmental Conservation 2005).

**Table Q46-2. Action thresholds for carbon monoxide (CO) and fine particulates (PM2.5)**

| Potential for exceeding State air quality standards/ Description of conditions | 1-Hour Average CO Concen-tration | 8-Hour Average CO Concen-tration | 24-Hour Average PM2.5 Concen-tration * | Action Needed |
|---|---|---|---|---|
| LOW: Background or low levels of pollutants | 0-25 ppm | 0-6 ppm | 0-25 µg/$m^3$ | Continue monitoring the same sites with remeasurement occurring every 3 to 5 years. |
| MODERATE: Some impairment of air quality, levels at or below State standards | 25-35 ppm | 6-9 ppm | 25-35 µg/$m^3$ | Consider remeasurement of same sites on an annual basis. |
| HIGH: Levels of air pollutants exceed State standards | >35 ppm | >9 ppm | >35 µg/$m^3$ | Consider increasing the frequency of monitoring and the number of sites monitored. Review of monitoring results by management to determine need for change in policy. |
| * The 24-hour average PM2.5 concentration is inferred based on data from an 8-hour sampling period. | | | | |

**[F-7] Scope of Inference**: This pilot protocol will quantify air quality conditions during the "worst case scenario" that occurs during the peak of motorized use in one of the most heavily used areas on the Forest (Turnagain Pass). It is likely, but not certain, that the air quality as a result of winter motorized uses throughout the rest of the Forest will be as impaired or less impaired than at this site. The temporal scope of reference is the winter months corresponding to the winter motorized use season (December 1 to April 30).

### G. Indicator and its Units of Measure:

*Primary Indicators and Units of Measure*: This pilot protocol will monitor carbon monoxide (CO) and fine particulates (PM2.5) in relation to winter motorized use. At the Turnagain Pass area, snowmachine use is likely to cause some degree of increase in the levels of carbon monoxide, nitrogen oxides, and particulates in the air. Because the only standard for nitrogen oxide is an annual arithmetic mean, winter seasonal snowmachine use is less likely to violate this standard. Carbon monoxide, with an 8-hour standard, and fine particulates, with a 24-hour standard, are likely the best indicators to assess whether winter motorized uses are causing a violation of air quality standards.

- 1-hour average CO concentration (ppm)
- 8-hour average CO concentration (ppm)
- 24-hour average PM2.5 concentration (µg/m3)

*Climatic Indicators and Units of Measure:* The variable climatic conditions at Turnagain Pass can affect the air quality conditions. The Turnagain Pass area has characteristics of the maritime climate of Prince William Sound and the interior climate of the Kenai Peninsula. This area has peak snowpacks averaging over 100 inches at the 1,800-foot elevation (USDA Natural Resources Conservation Service 2007), occasional winter rains, and winds generally from the northeast or southwest, parallel to the direction of the valley. The following weather variables will be collected as secondary indicators:

- Air temperature (degrees F)
- Relative humidity (percent)
- Wind speed (mph)
- Wind direction (direction)
- Barometric pressure (mm Hg)
- Weather conditions (description)

*Human-Use Indicators and Units of Measure:* This pilot protocol will compare air quality conditions to the amount of winter motorized use in these areas. Motorized activities associated with snowmachine use include vehicle use. The following secondary indicators are used to quantify the amount of human use on each day of sampling:

- Snowmachines visible (number)
- Trucks in parking lot (number)
- Cars, SUVs, and vans in parking lot (number)
- Trailers in parking lot (number)
- RVs and semi-trucks in parking lot (number)
- Traffic rate on Seward Highway (vehicles per minute)

**H. Sampling Design:** Air quality monitoring will be conducted at the times of the heaviest winter motorized use, over a range of climatic conditions. The intent is to collect data that represent the maximum air quality impairment related to winter motorized uses.

**[H-1] Target Population:** The target population is the air quality conditions of carbon monoxide and fine particulates at peak times of winter motorized use at Turnagain Pass.

**[H-2] Sampling Frame:** Four sites at Turnagain Pass will be sampled for carbon monoxide, including one control site. One of these sites at Turnagain Pass will be sampled for fine particulates (PM2.5). Each site will be sampled on eight different

days over the course of the winter season. The four carbon monoxide sampling sites represent the range of conditions around the Turnagain Pass western parking lot. The one particulate sampling site represents impaired air quality conditions at the Turnagain Pass western parking lot.

**[H-3] Sample Selection Methods:** The method of site selection was not probabilistic. The Turnagain Pass area represents the highest degree of air quality impairment on the Forest resulting from winter motorized uses. The parking lot is where the most concentrated winter motorized uses occur, including emissions resulting from "cold-starts," idling snowmachines, and idling vehicles. The four monitoring sites at Turnagain Pass were chosen to adequately quantify variability in air quality conditions around the site that may be the result of the following factors:

- Elevation: During inversions, pollutants can be trapped in low-lying areas.
- Weather: Wind can cause pollutants to drift in various directions.
- Distance from the source: Air pollutants will diminish with distance from the area of most concentrated use.

**[H-4] Sample Unit Description**: The Turnagain Pass area, near mile 70 of the Seward Highway can be used as an indicator of maximum carbon monoxide and particulates concentrations resulting from winter motorized activities on the Chugach National Forest. Its 1,000-foot elevation allows for a long winter motorized season. The Forest Service allows winter motorized use only on the west side of the Seward Highway. The topography consists of a terrace on which the highway and parking lot lay, a flat valley floor to the west of the parking lot, and steep hills and mountain slopes rising to the west of the valley.

To show local variability in levels of air pollution at the Turnagain Pass area, several sites will be sampled at three locations on the west side of the highway (where motorized use is allowed) and one site on the east side of the highway (designated non-motorized area) (Figure Q46-1). Because the objective of this protocol is not to sample the individual sources of pollutants, such as an idling truck or a running snowmachine, samples will not be taken in the parking lot, but in the general vicinity of where these activities are taking place. These samples will be representative of the air quality in the area, and the locations will provide a representative sample of air quality conditions during a variety of weather and wind conditions. The sensors are set up to sample the air about 6 feet above the snow surface, or the general air that users would encounter at the site. Air quality will be sampled at the following sites:

1. SITE #1: Turnagain Pass west-side (motorized) parking area. This site is about 10 feet west of the plowed edge of the parking lot, on the snow berm a few feet above the parking lot level and between the two restrooms. Both carbon monoxide and particulates will be sampled at this site. Because only one particulate sensor is available, particulates will always be measured only at this site because it is in a central location and it is the closest site to the most concentrated motorized uses.

2. SITE #2: Turnagain Pass west-side (motorized), northwest of the parking area. This site is in the valley floor approximately 200 feet west of the northwest corner of the parking lot, on a small terrace just south of the creek about 20 feet below the level of the parking lot. Carbon monoxide will be sampled at this site.

3. SITE #3: Turnagain Pass west-side (motorized), southwest of the parking area. This site is on a terrace bench approximately 150 feet west of the southwest corner of the parking lot about 10 feet below the level of the parking lot. The site is on the edge of the bench so that it is visible from above and below. Carbon monoxide will be sampled at this site.

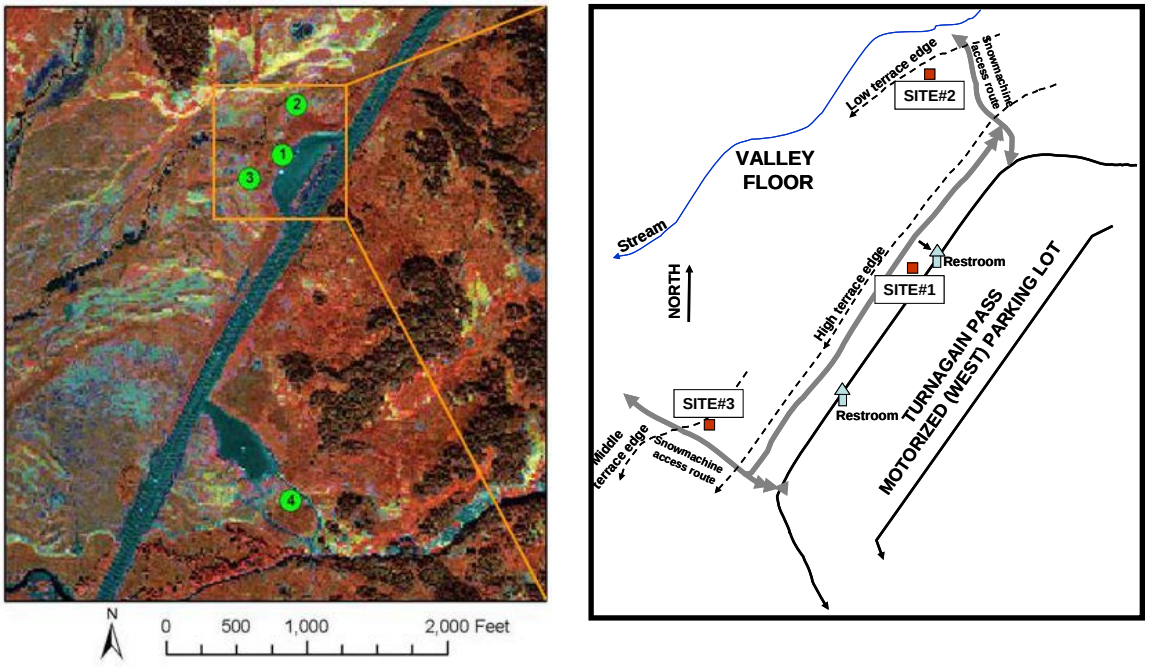


**Figure Q46-1. Turnagain Pass parking area sampling sites (left) and west Turnagain Pass detail drawing (right)**

4. SITE #4: Turnagain Pass east-side (non-motorized) parking area. This site is next to the 'Avalanche Danger' sign located along the trail, about 500 feet east of the east end of the parking lot. Carbon monoxide will be sampled at this site.

**[H-5] Detection and Observer Bias Controls:** Sources of bias include sample locations (see H-3 and H-4) and sample dates. Although the intent is to sample the range of conditions including the air quality conditions under the "worst case scenario," scheduling constraints may not always allow this. Sample dates will be chosen based on the best available knowledge of anticipated use levels.

**[H-6] Sample Size Estimate and Estimation Methods:** Air quality monitoring at Turnagain Pass will occur on a total of eight sample days over the course of the winter season to characterize the air quality conditions during a variety of

weather conditions and motorized use levels. These eight sample days will characterize high-use conditions and low-use conditions, including a control sample to characterize the background conditions.

**[H-7] Temporal Details of Sampling:** The eight sample days, occurring between December 1 and April 30, will measure air quality during high-use days to show the highest potential for carbon monoxide and fine particulates pollution at these locations. Sampling will occur during approximately 8-hour periods spanning the time of most concentrated motorized use on each sample day. The following schedule, dependent on motorized access closures, weather conditions, and other factors, will be used for sampling:

- Six days during moderate or heavy use (weekend days or weekdays during holiday times) between December 1 and April 30
- One day during low use (weekdays or low-use weekend days) between December 1 and April 30
- One day during no motorized use (non-motorized season, weekday, or night)

**I. Data Collection**:

**[I-1] Methods for Locating Sample Units:** See H-3 and H-4.

**[I-2]Methods for Layout and Marking:** See I-3.

**[I-3] "Field" Sampling Methods:** The following parameters will be measured or recorded at each site:

Carbon Monoxide: Carbon monoxide concentrations will be measured using Drager PACIII hand-held monitors equipped with carbon monoxide (XS CO) sensors, or an equivalent sensor. These lightweight, portable samplers with data-logging capabilities allow continuous sampling to occur at multiple locations, allowing sampling personnel to measure the spatial and temporal variations in carbon monoxide levels over the course of the sampling period. Drager PACIII monitors have been used to successfully characterize carbon monoxide levels in other studies, including a winter carbon monoxide saturation study in Anchorage, Alaska (Morris and Taylor 1998). The PACIII monitors continuously detect carbon monoxide levels at concentrations between 0 and 2,000 ppm at temperatures of minus 40 degrees F to 120 degrees F. Sample resolution is 1 ppm. The monitors use 9-volt lithium batteries.

The monitors will be left at the sample sites to collect 8 hours of continuous data, and they will be configured to record an average carbon monoxide concentration every 15 minutes in the datalogger.

One monitor will be placed at each of the four sample sites. One additional monitor will be placed at one of the sites as a duplicate for quality control. The sample site that is duplicated will rotate to a different site on each sample day. One monitor will be kept as a spare and used as necessary. For consistency, each site will be assigned a specific monitor.

The PACIII monitors will be placed in insulating cases. The insulators will not cover the air inlet area and will be placed on posts so that the monitors are about 6 feet above the snow surface, at the level at which a person would breathe. The mounting posts will include a cover held several inches above the sampler to keep snow and rain off the air inlet area but still allow air saturation of the monitors from all directions. The monitors will be surrounded by orange snow fence, and a small informational sign will be posted at each site.

The time at which sampling at the site begins and ends will be recorded for each site (see Attachment Q46-2). The battery voltage at the beginning and end of the sampling period will also be recorded. Battery voltage for the monitors must be greater than 7.0 volts to ensure valid data. Any visible sources of carbon monoxide at or near the site will be recorded.

Particulates: Fine particulates (PM2.5) will be sampled using a portable Met-One EBAM particulate sampler configured to sample fine particulates or an equivalent fine particulate sampler.

The EBAM sampler uses a rechargeable battery kept in a cooler with a lamp to keep it warm. The sampler will continuously record PM2.5 concentration and temperature. The sampler will be calibrated prior to use for this project. The sampler will be configured to take measurements continuously over an 8-hour period and calculate 15-minute and 1-hour averages.

- A leak test, temperature check, pressure check, and flow check must be conducted at the beginning and end of each sample day to ensure valid data. The instrument must be calibrated prior to use if needed, and these check and calibration data will be recorded (Attachment Q46- 4). The sampler will be surrounded by orange snow fence, and a small informational sign will be posted at the monitoring location. Any visible sources of particulates at or near the site will be recorded.

Secondary Indicators*:* On each sample day, weather conditions and motorized use levels will be recorded during a morning observation period (between 9:00 a.m. and 10:00 a.m.), a mid-day observation period (between 12:00 p.m. and 2:00 p.m.), and an afternoon observation period (between 4:00 p.m. and 5:00 p.m.).This will characterize the general weather and use conditions for each of the two main parking lots at Turnagain Pass (west-side motorized and east-side non-motorized) during the day. Measurements and observations will include the following:

*Weather:* Air temperature, relative humidity, wind speed, and wind direction will be recorded using a hand-held Kestrel 4000 weather instrument or equivalent Attachment Q46-1) held 6 feet above the ground. Qualitative weather descriptions include precipitation, sky conditions, and description of any visible haze layers from natural or human sources. Barometric pressure will be recorded by the EBAM sampler.

*Quantitative Use Parameters:* The amount of motorized use will be quantified, including the number of snowmachines visible at the time of sampling, the number of snowmachine trailers in the parking lot, and the number of each type of vehicle in the parking lot during each observation period. These values will be used as indicators of the amount of motorized use at each location. The

estimated average traffic rate, in vehicles per minute going both directions on the Seward Highway, will be measured as an additional indicator of motorized use in the area.

*Photographs:* Photographs will be taken on each sampling day, showing the air conditions at the site. In particular, any visible air pollution should be photo-documented. These should be in digital format, with the photo numbers recorded.

*General Observations*: Observations should be recorded of any specific human sources of air pollution, natural sources of air pollution, or any other factors that could influence the measured parameters.

**J. Quality Control and Assurance:** Air quality monitoring will be conducted by the forest air quality specialist. Oversight and training on use of the carbon monoxide and particulate samplers will be provided by the Alaska Department of Environmental Conservation. Additional Forest Service monitoring personnel will be trained in the operation of the sampling equipment by Alaska Department of Environmental Conservation personnel or the forest air quality specialist.

Carbon Monoxide Monitors: The PACIII carbon monoxide monitors will be calibrated prior to the first day of monitoring and will undergo a post-sampling quality control check and calibration and after every two sample days. See Attachment Q46-3 for calibration instructions and the data form. Calibration can be conducted in cooperation with Alaska Department of Environmental Conservation and the Municipality of Anchorage using calibration gases. Batteries will be replaced so that voltage readings are always greater than 7.0 volts. New carbon monoxide sensors will be used in these monitors, as the sensors expire after 30 months of being opened.

Carbon monoxide error limits for post-sampling quality control and calibration were established for the PACIII monitors during past carbon monoxide monitoring conducted by the Municipality of Anchorage (Morris and Taylor, 1998). These limits, established for three concentrations of carbon monoxide and extrapolated as shown in Figure Q46-2, include the following:

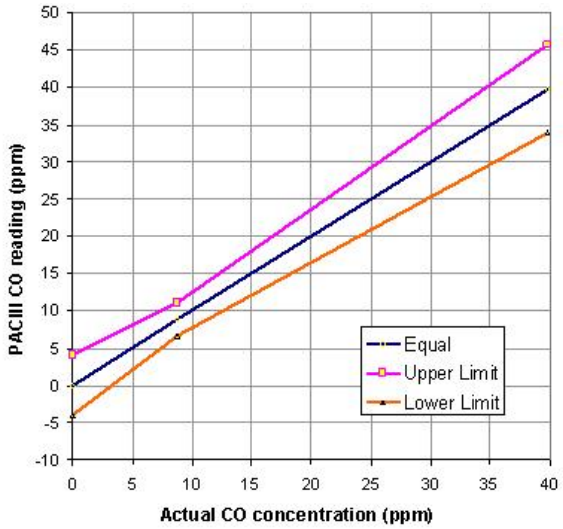


**Figure Q46-2. Quality control limits for PACIII carbon monoxide monitors**

*Zero:* Readings must be within 4 ppm of the known concentration (0 ppm).

*Span:* Readings must be within 15 percent of the known span concentration. The span concentration used during this study is 39.8 ppm.

*Precision:* Readings must be within 25 percent of the known precision concentration. The precision concentration used during this study is 8.81 ppm.

The 8-hour average carbon monoxide concentrations from the duplicated carbon monoxide monitors during each monitoring day should be within these established quality control limits. Each monitor will be assigned to the same site for consistency, and the duplicate monitor will rotate between sites.

In a carbon monoxide study in Anchorage, Alaska, the Municipality of Anchorage Environmental Services Division correlated the PACIII monitors with EPA-compliant reference method TECO 48 carbon monoxide monitors of the Anchorage air quality network (Morris and Taylor 1998). Data show that the PACIII monitors reported slightly higher carbon monoxide readings than the reference monitors, and at carbon monoxide concentrations below 2 ppm, the PACIII monitors sometimes read zero or below. Morris and Taylor (1998) applied a correction factor using the regression equation developed in this correlation. After this correction, 95 percent of the PACIII data fell within 2 ppm of the reference concentration. This regression equation will also be applied to the data obtained in this air quality pilot study in order to compare carbon monoxide data to the State standards.

Particulate Sampler: The Met-One EBAM sampler is reported to meet the EPA requirements for Class III PM2.5 designation (Attachment Q46- 4), with an accuracy of 2.5 µg in a 24-hour period. The flow accuracy is reported to be within 3 percent of the reading. Trent (2006) found that the EBAM sampler accurately estimated smoke particulate concentrations within 1 percent of the concentrations measured with the federal reference method sampler.

The EBAM particulate sensor will be calibrated for temperature, pressure, and flow rate before and after each use (Attachment Q46- 4). If the unit is repeatedly used at the same location, re-calibration may not be required. Calibration must occur if the unit is moved to another sample location. The temperature, pressure, and flow values on the EBAM unit should be recorded and compared to the values on the DeltaCal calibration unit before and after each sample day. The battery voltage must read greater than 10.6 volts.

**K. Data Form:** The following data collection forms are attached to this section:

Attachment Q46-1: Air quality monitoring weather and use data form for 2007 air quality study.

Attachment Q46-2: 2007 Air quality monitoring CO monitor data form

Attachment Q46-3: Carbon monoxide monitor calibration form

Attachment Q46- 4: 2007 Air quality monitoring EBAM data and calibration form

**L. Data Storage**:

**[L-1] Data Cleaning Methods:** Data cleaning will be conducted to remove data errors and data that do not meet the quality control requirements.

**[L-2] Data Storage:** Data will be stored on the Chugach National Forest in electronic format and in a monitoring report. Data will be input into the Forest Service NRIS Air database if available.

**M. Data Analysis:** This pilot protocol will analyze the following:

1. **Carbon monoxide:** The carbon monoxide monitors record an average value every 15 minutes. These values will be averaged over the course of the 8-hour sampling period to derive 1-hour averages and an 8-hour average that will be compared to the State standards and the action levels shown in Table Q46-1 and Table Q46-2.

2. **Particulates:** EBAM particulate sampler records an average value every 15 minutes. These values will be averaged over the course of the 8-hour sampling period. It is assumed that the 24-hour average PM2.5 concentration would be less than the measured 8-hour average PM2.5 concentration sampled during the daytime hours when motorized use is present at the site. The PM2.5 concentration during the overnight hours could be approximated by extrapolating data from the morning or other periods when motorized use levels are the lowest. The inferred 24-hour average PM2.5 concentration will be compared to the State standards and the action levels shown in Table Q46-1 and Table Q46-2.

3. **Standards:** Measured air quality parameters will be compared to the State air quality standards (Table Q46-1) and the thresholds for low, moderate, and high potentials for exceeding these standards (Table Q46-2). Data analysis will show the number of sample days that achieve the low, moderate, or high potentials for carbon monoxide and fine particulates to exceed the State standards.

4. **Motorized use correlation:** Quantitative trends between measured air quality parameters and the number of motorized users will be analyzed.

5. **Effects of weather:** Relationships between measured air quality parameters and temperature, wind speed, wind direction, and barometric pressure will be qualitatively analyzed to determine under what conditions air quality is likely to be the most impaired given a known level of motorized use.

6. **Actions needed:** Management actions will be suggested based on the action levels shown in Table Q46-2. If a low potential for exceeding State air quality standards is found, then additional monitoring similar to this pilot protocol should be implemented every 3 to 5 years. If a moderate potential for exceeding State air quality standards is found, then additional monitoring may be required on an annual basis. If a high potential for exceeding State air quality standards is found, then a new monitoring strategy may need to be developed, including additional monitoring sites and more frequent monitoring. In this case, results will be presented to management to determine the need for a change in policy.

**N. Assumptions and Limitations:** The following assumptions and limitation exist for this air quality monitoring protocol:

*Sampling Equipment:* This monitoring protocol assumes that the instruments used to measure air quality parameters will accurately quantify the levels of the measured pollutants. To meet the requirements for air quality monitoring under the Alaska State air quality implementation plan, EPA-approved Federal reference method or equivalent method monitors must be used under a strict quality control and quality assurance protocol. Any data that are not collected in this way cannot be used to determine attainment or non-attainment of air quality standards. However, data from non-EPA-approved instruments may be used to analyze the *potential* for attainment or non-attainment of these standards. This is a suitable approach when the magnitude of air quality impairment is unknown.

*Time:* This pilot protocol does not conduct continuous monitoring beyond an 8-hour period on each sample day. This protocol assumes that the greatest period of air quality impairment associated with winter motorized uses occurs during the daytime hours when motorized uses are the highest, and that overnight levels of particulates will be less than those during the day.

*Sample Sites:* This protocol assumes that the selected sample sites are representative of the general air conditions at the monitoring location. Only four sites are sampled at Turnagain Pass, providing limited information on the distribution of air pollutants. The locations in which sampling will occur have particular characteristics of environmental, climatic, and topographic conditions. Therefore, air quality conditions at these locations cannot necessarily be extrapolated to other locations, given the same amount of motorized use.

*Weather:* Although monitoring will sample a range of weather conditions, it will not represent the air quality conditions that may occur during all weather conditions. In particular, wind speed and direction can have a large effect on air pollutant concentrations.

**O. Reporting Frequency:** A comprehensive report will be prepared following each monitoring event, including the raw data, associated data, and data analysis.

**P. Responsibility:** Chugach National Forest Supervisor’s Resources Staff Officer is responsible for this protocol. The Forest air quality specialist will manage this project with assistance from the Alaska Department of Environmental Conservation.

**Q. List of Preparers:**

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**R. 10-Year Cost Forecast:** The cost of implementing this project over the next 10 years was determined based on the 3- to 5-year monitoring interval recommended after the 2007 pilot study. The following table shows anticipated annual costs through fiscal year 2021, based on an annual inflation rate of 3 percent. The total 10-year cost estimate is $49,200. If results from any monitoring year indicate that a moderate or high potential exists for violating the State air quality standards, this schedule may be modified to reflect more frequent monitoring and higher cost.

| | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 | FY21 |
|---|---|---|---|---|---|---|---|---|---|---|
| People | $12,000 | $0 | $0 | $0 | $13,500 | $0 | $0 | $0 | $15,200 | $0 |
| Travel | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Other | $2,500 | $0 | $0 | $0 | $2,800 | $0 | $0 | $0 | $3,200 | $0 |
| **TOTAL** | **$14,500** | **$0** | **$0** | **$0** | **$16,300** | **$0** | **$0** | **$0** | **$18,400** | **$0** |

Cost in inflated dollars ($)

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***Attachment Q46-1. Air quality monitoring weather and use data form for 2007 air quality study***

| **Chugach National Forest 2007 Air Quality Monitoring Pilot Project Weather and Use Data Form (version 1/8/07)** | | | |
|---|---|---|---|
| **Location** | | | |
| **Sampler(s)** | | | |
| **Date / Day of week** | | | |
| **Time** | | | |
| **Air Temperature** | Degrees F | | |
| **Relative Humidity** | Percent | | |
| **Wind Speed** | mph | | |
| **Wind Direction** | Direction | | |
| **Barometric pressure** | in Hg | | |
| **Sky Conditions** | CLR-PC-MC-OC-FOG | | |
| **Precipitation** | NO-LR-HR-LS-HS | | |
| **General weather observations**<br><br>*- weather changes*<br>*- inversions*<br>*- cloud layers* | | | |
| **Parking Lot Name** | | | |
| **Number of snowmachines visible** | | | |
| **Parking Lot Counts** | **Total number of vehicles** | | |
| | **Cars/SUV's/Vans** | | |
| | **Trucks** | | |
| | **Trailers** | | |
| | **RV's and Semi-trucks** | | |
| **Traffic rate on Seward Highway** | # per minute | | |
| **Photographs taken** | photo # | | |
| **General use observations**<br><br>*- Visible haze*<br>*- Sources of air pollution*<br>*- Use patterns*<br>*- Other factors* | | | |

**Instructions for the 2007 Air Quality Monitoring Weather and Use Data Form**

General weather and use conditions are recorded on this form between 9:00 and 10:00 a.m. (morning), 12:00 and 2:00 p.m. (mid-day), and 4:00 and 5:00 p.m. (afternoon) on each sample day. Conditions observed at additional times can also be recorded if desired (use additional sheets).

Measure the following parameters at each parking lot using a Kestrel hand-held weather instrument:

- **Air Temperature:** Record the air temperature, to the nearest degree F.
- **Relative Humidity:** Record the relative humidity, to the nearest percent.
- **Wind Speed:** Record the average wind speed, to the nearest mph.
- **Wind Direction:** Record the average wind direction (direction the wind is coming from).
- **Barometric Pressure:** Barometric pressure will be recorded by the EBAM sampler.

Record the following qualitative weather descriptions:

- **Sky Conditions:** Record the general sky condition at the time of sampling as Clear (CLR), Partly Cloudy (PC), Mostly Cloudy (MC), Overcast (O), or Foggy (FOG).
- **Precipitation:** Record the general precipitation conditions at the time of sampling as None (NO), Light Rain (LR), Heavy Rain (HR), Light Snow (LS), or Heavy Snow (HS).
- **General Weather Observations:** Include general weather observations such as changes in weather conditions observed, inversions, cloud layers, etc.

Record the following qualitative descriptions of human uses:

- **Parking lot name:** Turnagain Pass East or Turnagain Pass West.
- **Number of snowmachines visible:** Count the average number of snowmachines that are visible from the parking lot, including those in use and not in use.
- **Parking lot counts:** Conduct separate parking lot counts at the east and west parking lots.
    - Total number of vehicles in the parking lot
    - Total number of cars, SUVs, Vans, and pickup trucks with toppers in the parking lot (vehicles without open beds)
    - Total number of trucks or vehicles with open beds in the parking lot
    - Total number of trailers in the parking lot
    - Total numbers of RVs and semi-trucks in the parking lot
- **Traffic Rate on the Seward Highway:** Estimate the average traffic rate on the Seward Highway in both directions, in number of vehicles that pass by in 1 minute.
- **Photographs taken:** Take digital photos of each location and record the photo numbers corresponding to each location, date, and time.
- **General Use Observations:** Record general observations of use, including any visible haze or pollution, any apparent sources of visible pollution, or the presence of any factors that are causing a marked increase in air pollution.

***Attachment Q46-2. 2007 Air quality monitoring CO monitor data form.***

| **Chugach National Forest 2007 Air Quality Monitoring Pilot Project - CO Monitoring Data Form (ver 1/8/07)** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Location** | | | | | | | | | |
| **Sampler(s)** | | | | | | | | | |
| **Date/Day of week** | | | | | | | | | |
| **Site** | **Site Description** | **Sensor(s) used (list)** | **Sampling start time** | **Battery voltage at start** | **Sampling stop time** | **Battery voltage at end** | **Notes/Observations** *(sources of air pollution, problems, issues, weather effects on sensors, etc)* | **Download Date** | **File Name** |
| **Site #1** | | | | | | | | | |
| **Site #2** | | | | | | | | | |
| **Site #3** | | | | | | | | | |
| **Site #4** | | | | | | | | | |

**Instructions for the 2007 Air Quality Monitoring CO Monitor Data Form**

This form will be filled out for the PACIII monitors at the beginning and end of each sample day. Four sites are sampled at each location. For each site, record the following:

- **Site description:** Record a short description of the site location (e.g., north of parking lot).
- **Sensors used:** Record the identification number of each CO monitor that is placed at each site and the identification number of the duplicate CO monitor under the appropriate site.
- **Sampling start time:** Record the time at which the sampling began at each site (the time at which the monitor was set up, and continuous monitoring began).
- **Battery voltage at start:** Record the battery voltage of each PACIII monitor when sampling began. This should be greater than 7.0 volts.
- **Sampling stop time:** Record the time at which the sampling ended at each site (the time at which the sampler was taken down).
- **Battery voltage at end:** Record the battery voltage of each PACIII monitor when sampling is stopped. This should be greater than 7.0 volts.
- **Notes/Observations:** Record any pertinent observations related to each site. This includes sources of air pollution that affect the site, problems or issues related to the monitors, or weather conditions that affect each site.
- **Download Date:** Record the date that the data were downloaded.
- **File name:** Record the file name corresponding to that sensor at that site, using the format: Monitor number (##) Underscore (_) month (mm) day (dd) (e.g., 07_1229.txt)

## *Attachment Q46-3. Carbon monoxide monitor calibration form*

| **CNF 2007 Air Quality Monitoring Pilot Project: CO Monitor Calibration Form and Checklist (version 1/12/07)** | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Calibration Location** | | | | | | | **Date** | | | | | | | | | | | |
| **Sampler(s)** | | | | | | | | | | | | | | | | | | |
| Pac III Monitor Number | | | | | | | | | | | | | | | | | | |
| Battery change date | | | | | | | | | | | | | | | | | | |
| Filter change date | | | | | | | | | | | | | | | | | | |
| Initial battery voltage | | | | | | | | | | | | | | | | | | |
| Set Date and Time (√) | | | | | | | | | | | | | | | | | | |
| Set calibration conc (ppm) | | | | | | | | | | | | | | | | | | |
| Set to 10-second average (√) | | | | | | | | | | | | | | | | | | |
| **POST-RUN QC (Time)** | | | | | | | | | | | | | | | | | | |
| zero = 0 (QC +-4)<br>span = 39.8 (QC +-15%)<br>precision = 8.81 (QC +-25%) | Pre-cision | Zero | Span | Pre-cision | Zero | Span | Pre-cision | Zero | Span | Pre-cision | Zero | Span | Pre-cision | Zero | Span | Pre-cision | Zero | Span |
| Known | | | | | | | | | | | | | | | | | | |
| Measured | | | | | | | | | | | | | | | | | | |
| QC control limits (√) | | | | | | | | | | | | | | | | | | |
| **CALIBRATION (Time)** | | | | | | | | | | | | | | | | | | |
| zero = 0 (QC +-4)<br>span = 39.8 (QC +-15%)<br>precision = 8.81 (QC +-25%) | Zero | Span | Pre-cision | Zero | Span | Pre-cision | Zero | Span | Pre-cision | Zero | Span | Pre-cision | Zero | Span | Pre-cision | Zero | Span | Pre-cision |
| Known | | | | | | | | | | | | | | | | | | |
| Measured | | | | | | | | | | | | | | | | | | |
| QC control limits (√) | | | | | | | | | | | | | | | | | | |
| Final battery voltage | | | | | | | | | | | | | | | | | | |
| Set to 15-minute average (√) | | | | | | | | | | | | | | | | | | |
| Turn off monitor (√) | | | | | | | | | | | | | | | | | | |
| **Comments** | | | | | | | | | | | | | | | | | | |

**PACIII CO Monitor Calibration Instructions**

Post-sampling quality control check and calibration for the PACIII monitors can be conducted at the Municipality of Anchorage Department of Health and Human Services Air Lab (contact Larry Taylor) after every other sample run. Use the calibration form (Attachment Q46-3) as a checklist and to record calibration information.

1) Record the date of the last battery and filter changes on the calibration data form.

2) Check the voltage reading on the PACIII monitors (press Enter until it displays) and record on the calibration form. Battery voltage should always be greater than 7.0 volts.

3) Make sure the date and time are set correctly.

4) In the calibration menu, set the calibration concentration to 40 ppm (this is for the span calibration), and record this number on the calibration form.

5) In the configure menu, configure the PACIII monitor to take 10-second average readings, and make sure that the datalogger is on.

6) First, conduct a post-run Quality Control check. Record the time of this check.

   - Apply precision (8.81 ppm CO), Zero (0 ppm CO), and Span (39.8 ppm CO) gas mixtures to each PACIII monitor and record the value that the sensor reads after the reading stabilizes. Check whether each of these readings is within the Quality Control limits.

     - Precision gas should read 8.81 ppm ± 25% (between 6.6 and 11.0 ppm)

     - Zero gas should read 0 ppm ± 4 (between -4 and 4 ppm)

     - Span gas should read 39.8 ppm ± 15% (between 33.8 and 45.8 ppm)

7) Second, calibrate the PACIII monitors if the post-run QC indicates that the sensors are not reading correctly, or more frequently if desired.

   - Go to the zero calibration screen under the Calibrate menu. Apply pure air for zero calibration to each of the PACIII monitors. After the reading stabilizes, press enter. Record the reading on the calibration form. Make sure the PACIII accepts it.

   - Go to the span calibration screen under the Calibrate menu. Apply 39.8 ppm CO mixture to each of the PACIII monitors. After the reading stabilizes, press enter. Record the reading on the calibration form. Make sure that the PACIII accepts it.

   - Exit out of the menus. Apply the 8.81 ppm CO mixture to each of the PACIII monitors. After the reading stabilizes, record the reading on the calibration form.

- Check the known and measured readings against the quality control limits.

8) Record the battery voltage following calibration on the calibration form.

9) Configure the PACIII monitors to take 15-minute averages.

10) Turn off the PACIII monitors.

11) Record any notes about problems or issues with the calibration run.

12) Close valves and regulators for the calibration gases.

**PACIII CO Monitor Configuration Instructions**

The following are basic instructions for configuring the PACIII Monitors to measure CO concentrations in the field. For more information, see the Drager PACIII manual.

- To turn on, press and hold the large button
- To turn off, press and hold the two small buttons until the screen goes blank.
- The monitor will display the current CO concentration.
- Turn on the monitors at least 30 minutes prior to sampling in order to warm up the sensors.
- To enter the menu, press and hold the large button for several seconds.
- To scroll, press the up or down buttons, and to select, press the large enter button.

Ensure that the following settings have been configured under the **Configure** menu:

- Go to the main menu, and press *configure*
- For the password, enter *Accept* (0000)

- **Configure - Instrument**
  - In the *Configure* menu, scroll down and press Instrument
  - Click *Date/Time* - To change the date and time, press *enter*, change the numbers with the up, down, and enter keys, and press *Accept*.
  - OK mode: Should be turned to *Off*
  - Security Beep: Should be turned to *Off*
  - Switch Off: Should be turned to *Allow*

- **Configure - Alarms**
  - In the *Configure* menu, scroll down and press Alarm

- A1: Set Point to *0000*
- Latching: *Off*
- Acknowledgable: *All*
- A2: Set Point to *0000*
- Latching: *Off*
- Acknowledgable: *All*

**Configure - Datalogger**

- In the Configure menu, scroll down and press *Datalogger*
- On/Off: *On*
- Period: *15min*
- Overwrite: *Yes*

To change the battery, unscrew the Phillips screws, and install the new battery. The monitor will take about 30 minutes to reset itself. **Note:** the monitor will lose all data in the datalogger when the battery is replaced, the date/time and configuration must be reset, and the instrument must be re-calibrated.

**PACIII CO Monitor Data Download Instructions**

Data from the PACIII instruments will be downloaded using Drager GasVision software. Data are transferred using the interface box, which should be connected to the COM port of the computer. The PACIII should be turned off and placed in the interface box, then GasVision should be opened.

- Select the Communications Port by clicking *Options*, clicking *Setup Interface*, and choosing the *COM1* port.
- To transfer the data, click on *Data Logger*, click *Transfer*, and select *PACIII*
- Data will be uploaded. Click *OK* to see a table and graph of the data.
- Click Save As to save the data to a text file. GasVision only allows 8 characters in the name. Use the following file naming convention: Monitor number (##) Underscore (_) month (mm) day (dd) (Example: For DEC7 sampled on 12/29/06: Name = 07_1229.txt)

## *Attachment Q46- 4. Air quality monitoring EBAM data and calibration form*

| Chugach National Forest 2007 Air Quality Monitoring Pilot Project<br>E-BAM Calibration Form and Checklist (version 1/8/07) | | | |
|---|---|---|---|
| **Location** | | | |
| **Site** | | | |
| **Sampler(s)** | | | |
| **Date/Day of week** | | | |
| **TASK** | **(√)** | **PARAMETER** | **VALUE** |
| Set up unit | | Time: | |
| Battery Voltage - Start | | Voltage: | |
| **Pre-sample check and calibration** — Leak Check | | Flow Rate: | |
| **Pre-sample check and calibration** — Temperature Check | | DeltaCal: | |
| | | E-BAM: | |
| | | Within 1 degree C? | |
| | | Calibrated? | |
| **Pre-sample check and calibration** — Pressure Check | | DeltaCal: | |
| | | E-BAM: | |
| | | Within 2 mm Hg? | |
| | | Calibrated? | |
| **Pre-sample check and calibration** — Flow Check | | DeltaCal: | |
| | | E-BAM: | |
| | | In range? (16.37 to 17.03 L/min)? | |
| | | Calibrated? | |
| **Pre-sample check and calibration** — Begin sampling | | Time: | |
| **Post-sample check and calibration** — Stop sampling | | Time: | |
| **Post-sample check and calibration** — Leak Check | | Flow Rate: | |
| **Post-sample check and calibration** — Temperature Check | | DeltaCal: | |
| | | E-BAM: | |
| | | Within 1 degree C? | |
| | | Calibrated? | |
| **Post-sample check and calibration** — Pressure Check | | DeltaCal: | |
| | | E-BAM: | |
| | | Within 2 mm Hg? | |
| | | Calibrated? | |
| **Post-sample check and calibration** — Flow Check | | DeltaCal: | |
| | | E-BAM: | |
| | | In range? (16.37 to 17.03 L/min)? | |
| | | Calibrated? | |
| Battery Voltage - End | | Voltage: | |
| Take-apart unit | | Time: | |
| Data Download | | Date: | |
| | | File Name: | |
| **Comments** | | | |

**Setup, Calibration, and Operation Instructions for EBAM Particulate Monitor**

- For more information, see the EBAM manual.
- Prior to use, the battery should be charged for at least 24 hours. The battery should be charged prior to each day of use.
- Turn on the DeltaCal unit to let it equilibrate prior to calibration.
- If it is snowing or raining during setup, use a tarp to cover the unit during calibration.
- The temperature/pressure/flow check should be conducted and recorded at the beginning and end of each sample day.

**Setup**

1) Unfold and set up the tripod, and install lock pins. Secure the tripod legs in the snow, or bolt the tripod legs to a plywood board if needed for stability through the ¼ inch holes.
2) Place the EBAM unit on the tripod – slide the slot in the back of the cabinet over the tab on the tripod, and screw in the ¼-inch bolt at the bottom of the cabinet.
3) Place the 9-inch “down tube” into the EBAM inlet tube, and hand tighten the large black lock screw at the top of the EBAM unit.
4) Attach the cross-tube onto the down tube with the Allen screws, and attach the temperature unit to the end of the cross tube.
5) Attach the PM2.5 sample unit to the top of the down tube.
6) Attach the ground wire to one of the bolts on the tripod legs or a rebar stake driven into the snow.
7) Attach the power supply and temperature sensor wires to the base of the EBAM unit.
8) Turn on the lamp in the cooler to keep the battery warm.
9) When the EBAM turns on, take out the shipping plate when prompted.
10) The EBAM will automatically begin a self-test.

**Leak Check**

1) Press *menu*, and select *Field Calibration*.
2) Stop EBAM operation.
3) Remove the PM2.5 sample unit.
4) Install the leak test Valve with the valve open (*note*: the gasket may not fit if it is very cold).

5) Scroll to and select *Pump Test*.

6) Toggle to *Leak Test*, and the EBAM will start operating.

7) Allow the flow to increase to about 10 L/min, then close the Leak Test Valve.

8) Wait until the flow rate drops to below 1.5 L/min (or less than 0.5 L/min) and stabilizes. **Record** this flow rate.

9) Open the leak test valve **slowly**.

10) Press *exit* to return to the Field Calibration menu.

11) Remove the leak test valve and replace the PM2.5 sample unit.

**Temperature-Pressure-Flow Check:**

1) Press menu, and select *Field Calibration*.

2) Stop EBAM operation.

3) Remove the PM2.5 sample unit.

4) The DeltaCal monitor should be already turned on and calibrated to local conditions. The flow rate should read Under Range.

5) Install the DeltaCal sensor on the EBAM unit.

6) Under the Field Calibration menu, select *Temperature*. Scroll to *LOW* if doing test in cold conditions, or scroll to *HIGH* if doing test in warm temperatures.

7) Let the unit equilibrate to the ambient temperature. **Record** the temperatures on the DeltaCal and the EBAM. No calibration is necessary if they are within 1 degree C of each other.

8) If calibration is needed, enter the ambient temperature from the DeltaCal unit as the reference temperature in the EBAM (using the arrows) and select *Calibrate*.

9) Press Escape to go to the Field Calibration menu, and select *Pressure*.

10) Record the pressure on the DeltaCal and EBAM units. No recalibration is necessary if these two readings are within 2 mm of each other.

11) If calibration is needed, enter the pressure reading from the DeltaCal unit as the reference temperature in the EBAM and select *Calibrate*.

12) Press Escape to go to the Field Calibration menu, and select *Flow*.

13) Scroll until it reads *SETPOINT* and 16.71 L/Min. The pump will turn on and flow will begin to regulate.

14) Allow the flow to equilibrate. **Record** the flow rates on the DeltaCal and the EBAM. No re-calibration is necessary if the two flow rates are within 2 percent of each other (16.37 to 17.03 L/min).

15) If recalibration is needed, enter the flow rate from the DeltaCal as the reference flow rate on the EBAM and press *Calibrate*.

16) Press *exit* to return to the Field Calibration Menu.

17) Remove the DeltaCal sensor and replace the PM2.5 sample unit.

18) Press escape twice to exit the menus. When the display indicates *Start Operations*, press *Yes*, and the EBAM will begin operation.

**Take-apart**

1) In the menu, select *shutdown/shipping*.

2) Insert the metal plate over the tape, with the tab in the slot on the left.

3) After the EBAM lowers the sensor head, unplug the power device.

4) Turn off the lamp in the battery cooler.

**Data Download**

1) Attach the data cable from EBAM unit to COM port on computer.

2) The EBAM unit should be turned on (power supplied).

3) Open HyperTerminal (Programs  Accessories  Communications)

4) Enter a name (e.g., EBAM), and in the *Connect To* window, select the COM port.

5) For Port Settings, use:

   - Bits per second: 9600
   - Data bits: 8
   - Parity: none
   - Top bits: 1
   - Flow control: none

6) In the HyperTerminal window, press *enter* until a star appears.

7) Press the number 2, and all data from the EBAM will download. This can take a while. Data include 15-minute average, hourly average, flow, and ambient temp.

# Glossary

**5th- or 6th-code watershed** – Watersheds across the nation are classified in a nested hydrologic unit hierarchy consisting of regions, subregions, basins, subbasins, watersheds and subwatersheds. Regions are the largest unit. Regions are composed of subregions; subregions are composed of basins, and so on. A 5th-code watershed is a subdivision of subbasin and is the unit labeled as Watershed. A watershed is the 5th-level (code), 10-digit unit of the hydrologic unit hierarchy. Fifth-code watersheds range in size from 40,000 to 250,000 acres. A 6th-code watershed is the unit labeled as subwatershed, a subdivision of a watershed. A subwatershed is the 6th-level (code), 12-digit unit and smallest of the hydrologic unit hierarchy. Subwatersheds generally range in size from 10,000 to 40,000 acres.

**Alaska National Interest Lands Conservation Act (ANILCA)** – Federal law that Congress passed in 1980 to provide for the creation or revision of 15 National Park Service properties, and set aside other public lands for the United States Forest Service and United States Fish and Wildlife Service. In all, the act provided for the designation of 79.53 million acres (124,281 square miles; 321,900 km²) of public lands, fully a third of which was set aside as wilderness area.

**Best management practices (BMPs)** – A practice or usually a combination of practices that are determined to be the most effective and practicable means (including technological, economical, and institutional considerations) of controlling point and nonpoint source pollutants at levels compatible with environmental quality goals.

**Clean Air Act** – Defines the Environmental Protection Agency's responsibilities for protecting and improving the Nation's air quality and the stratospheric ozone layer. The last major change in the law, the Clean Air Act Amendments of 1990, was enacted by Congress in 1990.

**Clean Water Act** – The Clean Water Act establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. The Federal Water Pollution Control Act, enacted in 1948, was the basis of the Clean Water Act, but it was significantly reorganized and expanded in 1972, and with amendments in 1977, it became the Clean Water Act.

**Consultation** – Consultation with other Federal or State agencies is required by two different Acts whenever there may be a potentially adverse effect on threatened or endangered wildlife, fish or plant species or on historic or cultural resources. For wildlife, fish, and plant species, the Endangered Species Act requires that Section 7 consultation with the U.S. Fish and Wildlife Service be conducted whenever Federal agencies actions may have an impact on a threatened, endangered, or proposed (for listing) species of wildlife, fish or plants. For historical and cultural resources, Section 206 of the National Historic Preservation Act requires that a Federal agency consult with the State Historic Preservation Officer (SHPO). Programmatic agreements are in place with SHPO describing the process for Section 206 consultation.

**Deciding official** – The Forest Service employee who has the authority to select and carry out a specific planning action.

**Decommissioning** –Activities that result in the stabilization and restoration of unneeded roads to a more natural state (36 CFR § 212.1).

**Design criteria –** Measures that evaluate the statistical rigor of the sampling design and field protocols developed for the monitoring item in relation to the risk associated with the resource proposed for monitoring.

**Desired conditions** – Description of forest landscape condition goals. These conditions may currently exist or may be achieved sometime in the future. Desired conditions may be based on ecological or social objectives, or both.

**Dispersed recreation** – Recreational activities conducted outside of developed sites such as developed campgrounds or picnic areas.

**Eligible sites** – A cultural site is considered eligible for the National Register if it meets the National Register Criteria for Evaluation. Evaluation of a site's eligibility involves considering the property's age, significance, and its integrity.

**Endangered Species Act** – Requires Federal agencies, in consultation with the U.S. Fish and Wildlife Service and/or the National Oceanic and Atmospheric Administration Fisheries Service, to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat of such species.

**FACTS** (Forest Service Activity Tracking System) – An activity tracking system for all levels of the Forest Service. It supports timber sales in conjunction with TIM Contracts and Permits; tracks and monitors NEPA decisions; tracks KV trust fund plans at the timber sale level, reporting at the National level; and, it generates national, regional, forest, and/or district reports.

**FIA** – The Forest Inventory and Analysis (FIA) Program of the U.S. Forest Service provides the information needed to assess America's forests. As the Nation's continuous forest census, the FIA program projects how forests are likely to appear 10 to 50 years from now. This enables us to evaluate whether current forest management practices are sustainable in the long run. FIA reports on status and trends in forest area and location; in the species, size, and health of trees; in total tree growth, mortality, and removals by harvest; in wood production and utilization rates by various products; and in forest land ownership.

**Focal species** – A multi-species approach in which the ecological requirements of a suite of species are used to define or evaluate the range of habitat conditions required by many other species. The species thought to be most sensitive to, or having the most stringent ecological requirements for the particular factor, is usually identified as the focal species.

**Forest road or trail** – A road or trail wholly or partly within or adjacent to and serving the National Forest System that the Forest Service determines is necessary for the protection, administration, and utilization of the National Forest System and the use and development of its resources (36 CFR § 212.1).

**Healthy Forests Restoration Act of 2003** – Helps expedite high-priority fuel-reduction and forest restoration projects in forests and rangelands to reduce fire danger and return forests and rangelands to a healthier state.

**Herbaceous vegetation** – Class of vegetation dominated by nonwoody plants known as herbs (graminoids, forbs, and ferns).

**INFRA** (Infrastructure Database) – The Forest Service uses this database application to manage information on national resources, such as buildings, trails, roads, wilderness areas, and water systems.

**Interdisciplinary team** – A team of specialists from different disciplines such as hydrology, soils science, wildlife and fish biology, archaeology, engineering, etc. convened to conduct and prepare an environmental analysis.

**Intermittent** – (Pertaining to streams, lakes, or springs) recurrent; showing water only part of the time.

**Invasive species** – Non-native species of plants or animals that tend to flourish and displace native species of plants or animals.

**Jurisdiction** – Agency authority to approve, veto, or finance all or part of the proposal (40 CFR 1508.15). The territory or facilities over which authority is exercised.

**LANDFIRE** (Landscape Fire and Resource Management Planning Tools) – An interagency vegetation, fire, and fuel characteristics mapping program, sponsored by the United States Department of the Interior (DOI) and the United States Department of Agriculture, Forest Service. LANDFIRE produces a comprehensive, consistent, scientifically credible suite of spatial data layers for the entire United States. The program is a long-range initiative to periodically update LANDFIRE data to sustain the value of the original project investment and to ensure the timeliness, quality, and improvement of data products into the future.

**LANDSAT** – The LANDSAT Program is a series of Earth-observing remote-sensing satellite missions jointly managed by NASA and the U.S. Geological Survey. Since 1972, LANDSAT satellites have collected information about Earth from space. LANDSAT satellites have taken specialized digital photographs of Earth's continents and surrounding coastal regions, enabling people to study many aspects of our planet and to evaluate the dynamic changes caused by both natural processes and human practices.

**LEIMARS** (Law Enforcement and Investigations Attainment Reporting System) – Database created by the USDA Forest Service as a digital repository for reporting crime incidents. LEIMARS is the only available source of crime statistics for national forests and grasslands in the United States.

**Maintenance level (Operation maintenance level) –** Maintenance levels define the level of service provided by, and maintenance required for, a specific road. Maintenance levels must be consistent with road management objectives and maintenance criteria. Maintenance levels 1-5 (operational and objective) are described in the following paragraphs (FSH 7709.59, 62.32):

1. LEVEL 1. These are roads that have been placed in storage between intermittent uses. The period of storage must exceed 1 year. Basic custodial maintenance is performed to prevent damage to adjacent resources and to perpetuate the road for future resource management needs. Emphasis is normally given to maintaining drainage facilities and runoff patterns. Planned road deterioration may occur at this level. Appropriate traffic management strategies are “prohibit” and “eliminate” all traffic. These roads are not shown on motor vehicle use maps.

   Roads receiving level 1 maintenance may be of any type, class, or construction standard, and may be managed at any other maintenance level during the time they are open for traffic. However, while being maintained at level 1, they are closed to vehicular traffic but may be available and suitable for nonmotorized uses.

2. LEVEL 2. Assigned to roads open for use by high-clearance vehicles. Passenger car traffic, user comfort, and user convenience are not considerations. Warning signs and traffic control devices are not provided with the exception that some signing, such as W-18-1 “No Traffic Signs,” may be posted at intersections. Motorists should have no expectations of being alerted to potential hazards while driving these roads. Traffic is normally minor, usually consisting of one or a combination of administrative, permitted, dispersed recreation, or other specialized uses. Log haul may occur at this level. Appropriate traffic management strategies are either to:

   a. Discourage or prohibit passenger cars, or

   b. Accept or discourage high clearance vehicles.

3. LEVEL 3. Assigned to roads open and maintained for travel by a prudent driver in a standard passenger car. User comfort and convenience are not considered priorities. The Manual on Uniform Traffic Control Devices is applicable. Warning signs and traffic control devices are provided to alert motorists of situations that may violate expectations.

   Roads in this maintenance level are typically low-speed with single lanes and turnouts. Appropriate traffic management strategies are either “encourage” or ‘accept.” “Discourage” or “prohibit” strategies may be employed for certain classes of vehicles or users.

4. LEVEL 4. Assigned to roads that provide a moderate degree of user comfort and convenience at moderate travel speeds. Most roads are double lane and aggregate surfaced. However, some roads may be single lane. Some roads may be paved and/or dust abated. Manual on Uniform Traffic Control Devices is applicable. The most appropriate traffic management strategy is “encourage.” However, the “prohibit” strategy may apply to specific classes of vehicles or users at certain times.

5. LEVEL 5. Assigned to roads that provide a high degree of user comfort and convenience. These roads are normally double lane, paved facilities. Some may be aggregate surfaced and dust abated. Manual on Uniform Traffic

Control Devices is applicable. The appropriate traffic management strategy is "encourage."

**Management indicator species (MIS)** – Wildlife, fish, or plant species that represent other species that use the same or similar habitat. These species are used to help determine if management activities may have an effect on the group of species within that habitat.

**Merit criteria –** Measures that evaluate the monitoring item according to how well it addresses the Revised Forest Plan as well as regional and national information needs.

**Mesic** – Of, pertaining to, or adapted to an environment having a balanced supply of moisture.

**Migratory bird species** – Bird species that overwinter in areas that differ from their nesting and breeding habitats. These birds migrate from their wintering habitat to their summer habitat and back annually.

**Mitigation** – An action taken to make effects less severe or to eliminate adverse effects.

**MODIS** (Moderate Resolution Imaging Spectroradiometer) – A key instrument aboard the Terra (EOS AM) and Aqua (EOS PM) satellites. Terra's orbit around the Earth is timed so that it passes from north to south across the equator in the morning, while Aqua passes south to north over the equator in the afternoon. Terra MODIS and Aqua MODIS are viewing the entire Earth's surface every 1 to 2 days, acquiring data in 36 spectral bands, or groups of wavelengths (see MODIS Technical Specifications). These data will improve our understanding of global dynamics and processes occurring on the land, in the oceans, and in the lower atmosphere.

**Monitoring** – The collection of information over time, generally on a sample basis by measuring change in an indicator or variable, to determine the effects of resource management treatments in the long term.

**Motor vehicle use map** – A map reflecting designated roads, trails, and areas on an administrative unit or a Ranger District of the National Forest System (36 CFR § 212.1).

**Motor vehicle** – Any vehicle which is self-propelled, other than: (1) a vehicle operated on rails; and (2) any wheelchair or mobility device, including one that is battery-powered, that is designed solely for use by a mobility-impaired person for locomotion, and that is suitable for use in an indoor pedestrian area (36 CFR § 212.1).

**National Environmental Policy Act (NEPA) –** In 1969, NEPA was one of the first laws ever written that establishes a broad national framework for protecting our environment. NEPA's basic policy is to assure that all branches of government give proper consideration to the environment prior to undertaking any major Federal action that could significantly affect the environment.

**National Forest Management Act of 1976** (16 U.S.C. §§ 1600-1614, August 17, 1974, as amended 1976, 1978, 1980, 1981, 1983, 1985, 1988 and 1990**)** – The National Forest Management Act reorganized, expanded and otherwise amended the Forest and Rangeland Renewable Resources Planning Act of 1974, which called for the management of renewable resources on national forest lands. The National Forest

Management Act requires the Secretary of Agriculture to assess forest lands, develop a management program based on multiple-use, sustained-yield principles, and implement a resource management plan for each unit of the National Forest System. It is the primary statute governing the administration of national forests.

**National Forest System (NFS)** – As defined in the Forest Rangeland Renewable Resources Planning Act, the "National Forest System" includes all National Forest System lands reserved or withdrawn from the public domain of the United States, all National Forest System lands acquired through purchase, exchange, donation, or other means, the National Grasslands and land utilization projects administered under title III of the Bankhead-Jones Farm Tennant Act (50 Stat. 525, 7 U.S.C. 1010–1012), and other lands, waters or interests therein which are administered by the Forest Service or are designated for administration through the Forest Service as a part of the system (36 CFR § 212.1).

**National Forest System road** – A forest road other than a road which has been authorized by a legally documented right-of-way held by a State, county, or other local public road authority (36 CFR § 212.1).

**National Forest System trail** – A forest trail other than a trail which has been authorized by a legally documented right-of-way held by a State, county, or other local public road authority (36 CFR § 212.1).

**National Historic Preservation Act of 1966** – Establishes a national preservation program and a system of procedural protections which encourage the identification and protection of cultural and historic resources of national, state, tribal and local significance.

**NRIS-TESP –** The Forest Service Natural Resources Manager Natural Resources Information System provides information and support for a variety of database, data collection, and analysis products. The Threatened, Endangered, and Sensitive Plants (TESP), and Invasive Species database system supports national data collection standards for combined TESP and invasive species surveys, TESP element-occurrences, and Invasive Species Inventories

**Nonindigenous** – Nonnative; not originating in or characteristic of a particular region or country.

**Nonmotorized** – Motor vehicle use is not permitted.

**Nonnative** – See nonindigenous.

**Notice of availability (NOA)** – A term used to describe that a Draft Environmental Impact Statement (DEIS) is available for review and the start of the comment period on the DEIS. NOAs are published in the Federal Register. The date of publication in the Federal Register begins the comment period for the DEIS.

**Notice of intent (NOI)** – A term used to describe that an agency is intending to prepare and consider an environmental impact statement. NOIs are published in the Federal Register. The date of publication in the Federal Register begins the comment period for scoping on the proposed action.

**Off-highway vehicle (OHV)** – Any motor vehicle designed for or capable of cross-country travel on or immediately over land, water, sand, snow, ice, marsh, swampland, or other natural terrain (36 CFR § 212.1).

**Over-snow vehicle (OSV) –** Motor vehicle that is designed for use over snow and that runs on a track or tracks and/or a ski or skis, while in use over snow.

**Perennial** – Present at all seasons of the year.

**Planning, Appeals, and Litigation System (PALS)** – A database listing NEPA decisions that have been signed. The PALS database does not keep track of implementation or report when or if a project has been completed. However, the database does provide contact information for the "primary project manager" and "secondary project manager," which can be used to determine whether the project has been implemented or not.

**Proposed action** – A proposal made by the Forest Service to authorize, recommend, or implement an action to meet a specific purpose and need.

**Protocol** – Predefined written procedural method in the design and implementation of monitoring or experiments. Protocols ensure successful replication of results. Detailed protocols also facilitate the assessment of results through peer review. The goal of the protocol description and format is to provide sufficient (but not excessive) information so that a person other than the author can understand and implement the methods.

**Record of decision (ROD)** – A concise public record of the responsible official's decision to implement an action when an environmental impact statement has been prepared.

**Recreation opportunity spectrum (ROS)** – A land classification system which categorized National Forest System land into six classes, each class being defined by its setting and by the probably recreation experiences and activities it affords. The six classes in the spectrum are: primitive; semiprimitive, nonmotorized; semiprimitive motorized; roaded natural; rural; and urban.

**Research natural areas (RNA)** – An area in as near a natural condition as possible which exemplifies typical or unique vegetation and associated biotic, soil, geologic and aquatic features. This area is set aside to preserve a representative sample of an ecological community primarily for scientific and educational purposes; commercial and general public use is not allowed.

**Riparian** – Of, pertaining to, or situated or dwelling on the bank of a river or other body of water.

**Road** – A motor vehicle route over 50 inches wide, unless identified and managed as a trail (36 CFR § 212.1).

**Route** – A road or trail (FSM 2353.05).

**Sampling Design –** A formal statement of how the sample will be selected so that the sample's attributes accurately represent the population.

**Scope of Inference –** The spatial and temporal scales over which the monitoring results are applicable.

**Scoping** – An early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action. Public comments on the proposed action are sought during the scoping process.

**Section 7 consultation** – A requirement of the Endangered Species Act. Section 7 consultation with the U.S. Fish and Wildlife Service is required whenever a Federal agency's actions may have an impact on a threatened, endangered or proposed for listing species of wildlife, fish or plant.

**Sensitive species** – Those plant and animal species identified by a regional forester for which population viability is a concern, as evidenced by:

a. Significant current or predicted downward trends in population numbers or density.
b. Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

**Significant issue** – An issue is defined as a point of disagreement, debate, or dispute with a proposed action, based on some anticipated effect. It is not significant if: it is outside the scope of the proposed action; is already decided by law, regulations, forest plan, or other higher level decision; is irrelevant to the decision to be made; or is conjectural and not supported by scientific (or factual) evidence.

**Spatial scale** – Area from which a sample is taken.

**Statistical rigor** – Degree of mathematical precision or accuracy; designated as high, medium, low, or not applicable.

**Threshold** – A pre-determined level of change that triggers management action. This includes the source and/or methods for establishing the threshold values.

**Turbidity** – Measurement of the suspended solids in a liquid.

**Watershed** – The region or area drained by a river, stream, etc.; drainage area.

**Wetlands** – As defined by Executive Order 11990, areas that are inundated by surface or ground water with a frequency sufficient to support and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

**Wilderness** – Per the 1964 Wilderness Act, a wilderness is undeveloped Federal land retaining its primeval character and influence without permanent improvements or human habitation. No motorized activities are permitted in wilderness areas.

**Wilderness study areas (WSA)** – A wilderness study area contains undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, and managed to preserve its natural conditions.

WSAs are not included in the National Wilderness Preservation System until the United States Congress passes wilderness legislation.

# Appendix A: List of Authors and Supporting Specialists

### The Monitoring and Evaluation Interdisciplinary Team

(titles reflect position at time of contribution)

Martin Bray ~ Wildlife Biologist
Robert L. DeVelice ~ Forest Ecologist (ecosystem specialist)
Mary Friberg ~ Regional Inventory and Monitoring Coordinator
Michael Goldstein ~ Regional Wildlife Ecologist
Grant Harris ~ Forest Wildlife Ecologist (fauna specialist)
Steve Hennig ~ Recreation Specialist
Gregory D. Hayward ~ Wildlife Ecologist
Connie Hubbard ~ Inventory and Monitoring Coordinator
Jeremy M Karchut ~ Forest Archaeologist
Sharon Randall ~ Forest Planner
Patrick Reed ~ Regional Social Scientist

### Contributors from TEAMS Enterprise

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Blaze Baker ~ Botanist
Sandy Caveney ~ Forester (Fuels) and Recreation
Patricia Goude – Writer-Editor
Stephanie Gripne ~ Economist
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Colleen (Chaz) O'Brien ~ Landscape Architect/Recreation
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Shannon Smith ~ Archeologist
Jan Spencer ~ Landscape Architect/Recreation/Planning

### Contributors from Chugach National Forest

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Robert (Max) Dean ~ Archeologist
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