Big Islands Landscape Assessment
Cordova Ranger District
Chugach National Forest

June 20, 2005

2003 satellite image of Green, Montague, Hinchinbrook, and Hawkins Islands.

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Executive Summary

The Big Islands Landscape Assessment is an ecosystem analysis at the landscape scale that involves both information gathering and analysis. The purpose is to document and develop an understanding of the processes and interactions occurring on Montague, Green, Hinchinbrook, and Hawkins Islands in Prince William Sound, Alaska, about 372,850 acres of land and fresh water as displayed in Figure 1.1. It does not include the saltwater within the analysis boundary.

This report focuses on the issues and key questions identified for the area and describes its biological, physical, and social features. Information includes: water uses, vegetative patterns and distribution, disturbance factors, fish and wildlife species and their habitats, hydrology, soils, and human use patterns including cultural, socioeconomic, subsistence, and recreation.

Landscape analyses are a step between a forest plan and project implementation. They provide a means of refining the desired condition of the landscape given the Forest Plan goals and objectives, management prescriptions, and standards and guidelines, current policy, and other applicable State and Federal regulations. They provide an opportunity for managers and users to brainstorm monitoring and inventory needs and projects to help reach the desired future condition. The end result is not a decision document but a report that can be used in future site-specific analyses and planning.

A team of resource specialists from the Chugach National Forest Cordova Ranger District and Supervisor's Office prepared this assessment with input solicited from other Federal and State Agencies, the communities of Cordova, Whittier, Valdez, Seward, Chenega Bay, and Tatitlek, local Tribal Governments, and landowners.

Following are the six steps used to conduct the analysis and corresponding chapters in this report.

- Step 1 – Characterization (Chapter 2)
- Step 2 – Issues and Key Questions (Chapter 3)
- Step 3 – Current conditions (Chapter 2)
- Step 4 – Historical Conditions (Chapter 2)
- Step 5 – Interpretation & Synthesis (Chapter 4)
- Step 6 – Recommendations (Chapter 5)

Chapter 1

Purpose

The purpose of this landscape scale ecosystem assessment is to develop and document an understanding of the processes and interactions occurring in the analysis area and determine how we can achieve our desired future condition described in the revised Chugach Forest Land and Resource Management Plan (Forest Plan) and Record of Decision (ROD) signed in May 2002. The Big Islands analysis area includes the watershed associations that comprise the western most portion of the Cordova Ranger District of the Chugach National Forest. It includes Montague, Green, Little Green, Wooded, Hinchinbrook, and Hawkins islands and The Needle. These islands extend in a line almost 100 miles long across the eastern side of Prince William Sound (fig. 1.1).

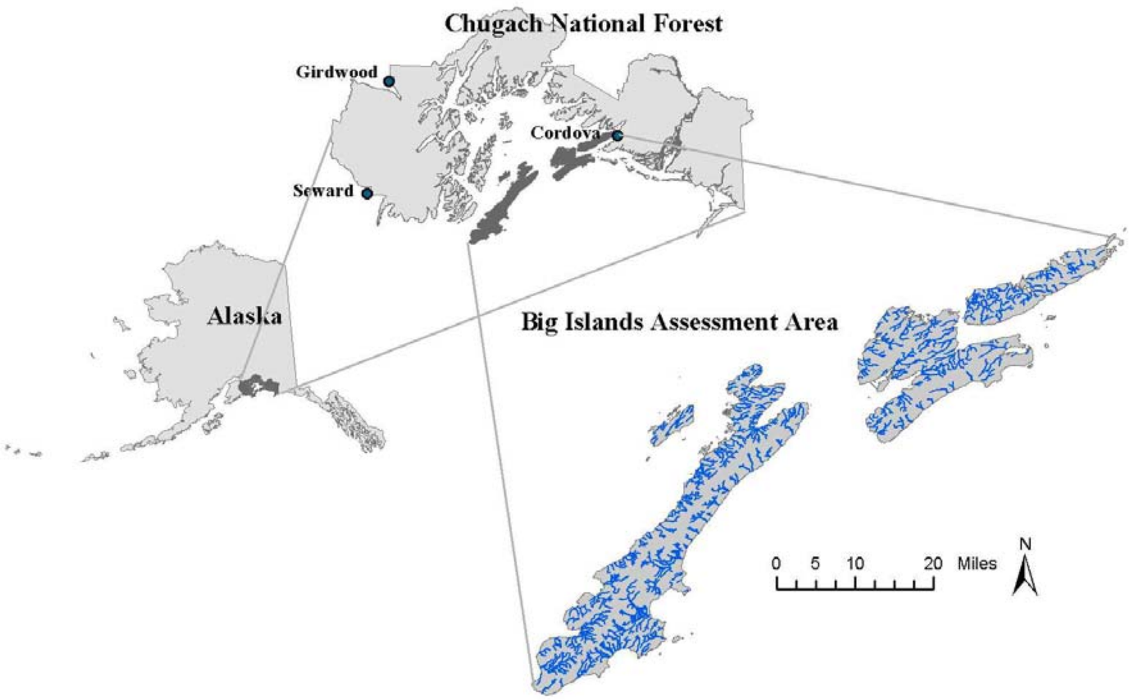

Figure 1.1 - Location of the Big Islands Landscape Assessment area.

The Analysis Area

This analysis area of approximately 372,850 acres (583 square miles, excluding salt water) is located in southcentral Alaska west of Cordova, Alaska in Prince William Sound. It includes four main islands; Montague (208,017 acres), Hinchinbrook (112,214 ac), Hawkins (44,325 ac), Green (7224 ac), and three smaller islands; Little Green (54 ac), Wooded (290 ac), and the Needle (10 ac). It is bounded by Prince William Sound to the north and the Gulf of Alaska to the south. Access is by aircraft or boat.

Most of the analysis area is characterized by high relief and small drainage basins. Tectonic uplift and heavy precipitation are the major driving forces that control the geomorphology and hydrology in the area. Few glaciers currently exist on these islands, with small remnant glaciers covering only 4100 acres, or 1% of the analysis area. Streams draining these islands are predominantly short with high gradients. Steep peaks and high relief are characteristic of Montague Island and parts of Hinchinbrook Island, while the remainder of the analysis area has low to moderate relief and more abundant wetlands. Vegetation on these islands is largely a pristine mosaic of spruce hemlock forest and muskeg. Alpine tundra and snow fields occupy the highest elevations of Montague, Hinchinbrook, and Hawkins islands. Wildlife populations reflect this pristine vegetation and remoteness with all native fauna intact.

Most of this area receives little use due to its remoteness and limited accessibility. Development is minimal. There has been scattered timber harvest on Montague and Hinchinbrook, a lodge is present in MacLeod Harbor on Montague Island, Chugach Alaska Corporation has a spirit camp at Nuchek on Hinchinbrook Island, and several private inholdings are at Boswell Bay, Canoe Pass, and Deep Bay. Hinchinbrook and Hawkins Islands are relatively accessible to residents of Cordova. Hunting, fishing, and sightseeing are some of the activities that take place in the area, and several public use cabins attract visitors mainly during the summer.

The area includes National Forest System land (85%), State land, Native Corporation land, and other private land. Table 1.1 and Figure 1.2 summarize the acreage of each. Chugach Alaska Corporation retained subsurface rights on lands the *Exxon Valdez* Oil Spill Trustee Council bought from Eyak Native Corporation where surface estate became part of the National Forest System. The EVOS fee simple lands have specific management goals that reflect the goals of the *Exxon Valdez* oil spill (EVOS) settlement agreement. Lands acquired under the EVOS purchases are surface estate or surface conservation easements. The Chugach Alaska Corporation reserves the subsurface title and is entitled to access for exploration and development of the subsurface estate such as minerals, oil, and gas, as well as rock, sand and gravel.

Table 1.1 - Summary of land ownership for Big Islands analysis area

Ownership	Acres	% of area
National Forest	318,759	85.49 %
State of Alaska	3,618	0.97 %
State of Alaska with Forest Service easement	5,158	1.38 %
USCG Lighthouse Reserve and NF Reserve	5,661	1.52 %
Private	214	0.06 %
Eyak Native Corporation	2,875	0.77 %
Eyak Native Corporation, FS Timber Easement	1,512	0.41 %
Selected by Eyak Corp.	2,319	0.62%
Chugach Alaska Corporation (CAC)	16,770	4.50 %
USFS Surface, CAC - Subsurface	8,301	2.23 %
Selected - State	7,645	2.05 %
Private land with FS Site Easement	18	~ %
Total	372,850	100%

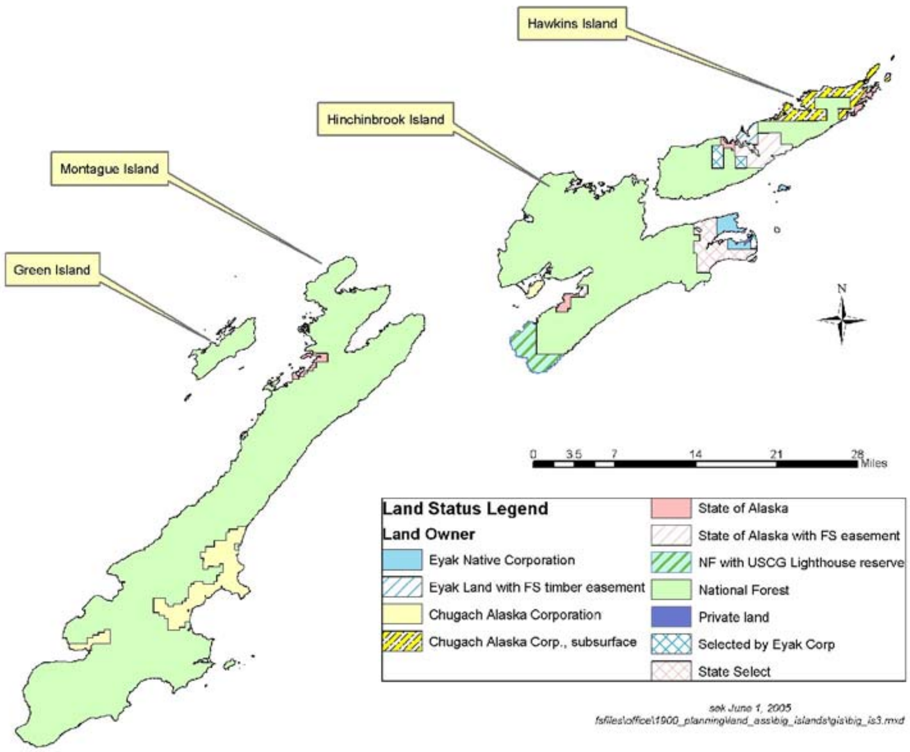

Figure 1.2 - Landownership patterns for Big Islands Analysis Area

Montague Island

At 50 miles long and 208,017 acres, Montague Island is the largest island of Prince William Sound (the Sound). Elevations range from sea level to 2999 feet. The maritime weather is perhaps the greatest influence on Montague Island; it experiences heavy rainfall throughout the year; in fact, Alaska's greatest rainfall recorded in one year, 332 inches, was measured at MacLeod Harbor in 1976. The maritime influence generally creates a warmer environment than the surrounding mainland in winter, but can be cold enough to produce extreme snowfalls during some winters. The higher ridges of Montague generally are snow covered year round and small glaciers exist in the higher north facing basins.

Montague Island's outer (southeast) coastline is subjected to high winds and heavy surf. This shoreline is the most rugged, consisting largely of rock ledges and cliffs. Sandy beach habitats occur at Beach River, Nellie Martin River, Log Jam Bay, and San Juan Bay. Shorelines along the inside coastline vary from rock ledges to gravel with protected intertidal areas existing in MacLeod Harbor, Hanning Bay, Port Chalmers, Stockdale Harbor, Rocky Bay, and Zaikoff Bay. The low and mid elevations of Montague Island are a mosaic of conifer forest and muskeg.

The second largest earthquake ever recorded struck Prince William Sound on March 27, 1964. This 9.2 magnitude earthquake affected a large area with the greatest vertical displacement of land occurring on Montague Island. Some areas were uplifted 12 to 36 feet resulting in significant changes to the shoreline. Young thickets of spruce that now rim the island (and other islands in the Sound) are a result this new land being exposed.

Portions of Montague Island, mainly near Rocky Bay and Hanning Bay were oiled as a result of the *Exxon Valdez* oil spill which occurred on March 24, 1989. Oiling of beaches in those areas was not as heavy as in other areas of the Sound.

Timber harvest has occurred on Chugach Alaska Corporation (CAC) lands at MacLeod Harbor and between Nellie Martin River and Beach River, and on National Forest System lands along the Montague Straits coast and Zaikoff Bay. CAC built a road, now obliterated so that it can no longer be used by motorized vehicles, between Beach River and their log transfer site in MacLeod Harbor.

No permanently occupied human residences exist on Montague Island. An outfitter's fishing and hunting lodge, seasonally occupied, exists in MacLeod Harbor. MacLeod Harbor also was the location of a logging camp while CAC was harvesting their lands in the early 1990s. Forest Service public recreation cabins are located at Port Chalmers, San Juan Bay, Log Jam Bay, Nellie Martin River, and Beach River.

Hinchinbrook Island

At 112,214 acres, Hinchinbrook Island is the second largest island in the Sound. It is roughly 22 miles long and 13 miles wide with elevations up to 2910 feet. The island has extensive alpine habitat, some of it covered in permanent snowfields. The mid elevations are a mosaic of conifer forest and muskeg meadows. Hinchinbrook Island also has extensive and diverse shoreline habitats. From Point Steele to Johnstone Point, the outer coast, exposed to strong wind and wave action, is largely cliff or rock ledges. Sandy beaches exist from Strawberry Entrance to Point Steele and just south of Hook Point. Protected intertidal habitats occur at Port Etches and Constantine Harbor, Double Bay, Anderson Bay, and Boswell Bay and along the shorelines of the Hawkins Island Cutoff.

Human residences, some occupied nearly year-round, exist in Boswell Bay, Johnstone Point, and at Nuchek. Forest Service public recreation cabins are located at Hook Point, Shelter Bay, and Double Bay.

Hawkins Island

Hawkins Island is 22 miles long, consists of 44,325 acres, and has elevations up to 2024 feet. The island is mostly forested with a mosaic of muskeg meadows at mid elevations. The highest ridges just break tree line, so alpine habitat is limited. The island's extensive shoreline is mostly exposed to relatively sheltered waters. Cliff and gravel beaches surround much of the island. Much of the southern shoreline, generally from South Canoe Pass west and northward to Makarka Point, is intertidal mud flats; basically the westward extension of the Copper River Delta.

Hawkins Island's close proximity to Cordova makes it the most heavily used by humans, especially by deer hunters in the fall. Permanent human residences occur in North Canoe Pass, Cedar Bay, and near Shipyard Bay. A commercial oyster farm exists in marine waters of Windy Bay, just off shore from National Forest System lands.

Green Island

Green Island, at 7224 acres, is low in elevation and consists of rolling hills covered with coniferous forest and muskeg meadows. Its shorelines are gravel beaches or rock shelves. Gibbons Anchorage on the north side of Green Island is a protected estuary with intertidal marine habitat. A Forest Service public recreation cabin is located in Gibbons Anchorage. Several smaller islands occur near Green Island, including Little Green and Channel Island. Little Green is forested while Channel Island is mostly gravel.

The *Exxon Valdez* oil spill affected Green Island more greatly than any other area within the Big Islands analysis area. Heavy oiling was reported at locations on the northwestern shore while light and medium amounts of oiling were reported elsewhere on the Island. The southeast portion of Green Island is designated as a Research Natural Area (RNA). The Green Island RNA was established to study and protect important habitat and species characteristics on the Chugach National Forest. These characteristics include some of the oldest forests, a remnant sea otter population that is believed to have repopulated the Sound, haul-out sites for marine mammals, and close linkages between highly productive marine and terrestrial ecosystems.

Wooded Islands

The Wooded Islands consist of Wooded, Tanker, and Fish Islands which total 290 acres. Wooded Island, the largest, consists of mostly cliff shorelines and forested uplands. Fish and Tanker Islands consist of cliff and rocky intertidal shorelines with mostly grass uplands. Fish Island hosts a National Marine Fisheries Service seasonal field camp.

Desired Future Condition

Chugach Land and Resource Management Plan direction

The Record of Decision for the revised Chugach Forest Plan was signed in May 2002. Chapter 3 of the Forest Plan outlines forest wide direction, goals and objectives, and standards and guidelines. Chapter 4 describes the management area prescriptions, outlines each with regards to desired future condition for ecological and social systems, and displays allowed activities, standards, and guidelines. Chapter 5 of the Forest Plan includes the monitoring, evaluation, information and research needs, and potential projects. The prescriptions for this area, displayed in Figure 1.3, include 141-Research Natural Area (part of Green Island), 210-Backcountry (Hawkins and Hinchinbrook Island), 221- EVOS Acquired lands (part of Hawkins Island), 244-Fish and Wildlife Conservation Area (Montague Island and rest of Green Island), and 213-ANILCA 501(b)-2.

In general, the desired future condition for fish and wildlife resources as described in the Forest Plan is as follows:

Natural processes with active management in selected locations will sustain fish and wildlife habitat. Fish and wildlife will continue to flourish in their current abundance with stable populations and abundant habitat. Threatened and endangered species will have populations moving toward recovery. Sensitive species will have appropriate habitat conditions with stable or improving population trends. Management indicator species and species of concern will have stable population trends, providing a continuing subsistence resource. Brown bear/human confrontations will be minimal in important seasonal feeding areas and travel corridors, resulting in limited risks to brown bears through "defense of life and property" mortality. Species used for subsistence will continue to be available for subsistence uses (USDA Forest Service 2002).

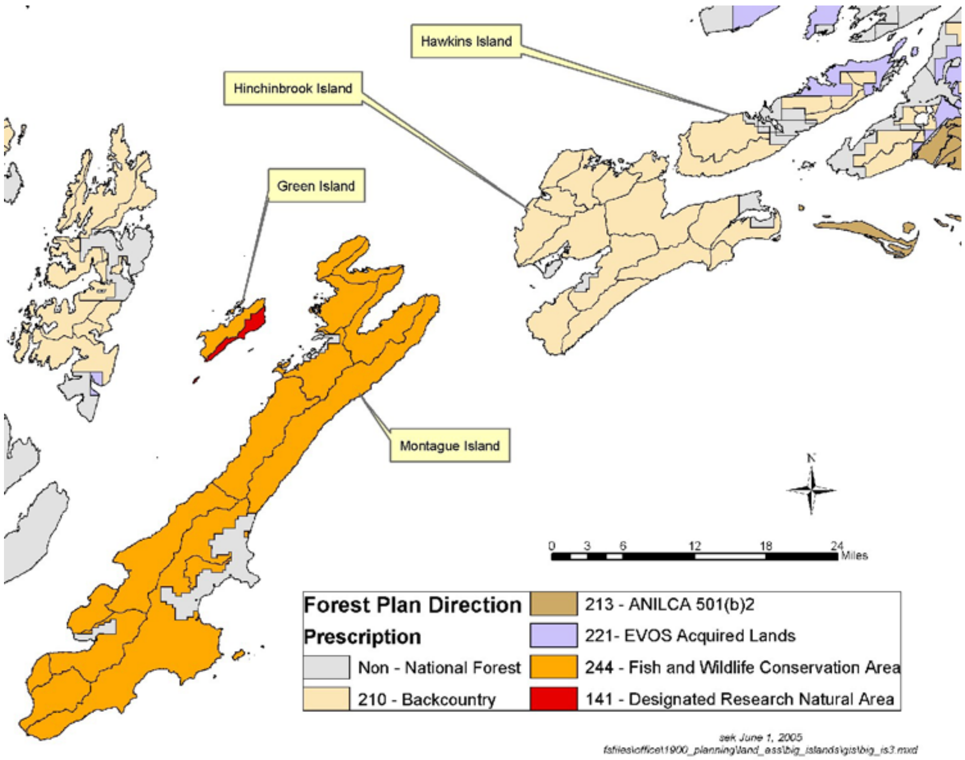

Figure 1.3 - Forest Plan Direction for the Big Islands Analysis Area

Green Island Research Natural Area (141) - The Green Island Research Natural Area (RNA) includes 2861 acres on the southeast side of Green Island, Little Green Island, and The Needle and represents the Prince William Sound Islands ecological subsection. RNA management focuses on allowing natural conditions to prevail, usually by eliminating or limiting human intervention. RNA's serve as baseline reference areas for measuring long-term ecological change and provide outstanding opportunities for research, study, observation, monitoring, and educational activities that maintain unmodified conditions. Prescribed management actions may be used to restore natural processes. Habitat manipulation is allowed if specifically designed for the protection of threatened, endangered, or sensitive species. (USDA Forest Service 2002b) Recreation uses that interfere with the purpose of the RNA may be restricted.

Mineral materials sales are not allowed in the RNA, however the Forest Plan does not address leasable minerals. Locatable minerals development is allowed with the following guidelines: a)RNA's may be withdrawn, subject to the establishment of valid existing rights, from mineral entry for locatable minerals; b) Mineral activities may be limited, modified, or restricted to maintain the natural values of the area to the extent possible.

Refer to pages 4-30 to 33 of the Forest Plan for addition information about management intent, area specific standards and guidelines, and allowed activities.

The Green Island RNA possesses important habitat and species characteristics on the Chugach National Forest. These characteristics include some of the oldest forests, a remnant sea otter population that is believed to have repopulated PWS, haul-out sites for marine mammals, and close linkages between highly productive marine and terrestrial ecosystems. The anadromous fish species on Green Island are an important component of the link between marine and terrestrial ecosystems (Willson and Halupka et al. 1995; Willson et. al. 1998). The establishment record (Juday 1995) for the Green Island Research Natural Area provides additional information. A copy is in Appendix E.

Backcountry (210) - This prescription emphasizes managing Hinchinbrook and Hawkins islands for a variety of recreational opportunities for backcountry activities in natural appearing landscapes. The desired condition is for these islands to provide opportunities for solitude, isolation and quiet. Recreation Opportunity Spectrum (ROS)classes will range from Primitive to Semi-Primitive Motorized. Recreation cabins may be present and new cabins may be constructed. Vegetation will be mostly late successional. Modifications to the vegetation as well as fish and wildlife habitat improvements may be present, blending into the area's natural features. Locatable minerals activities are allowed and mineral material sales are "conditional". Small mineral materials sites may be developed to support trail or facility construction. All sites will be completely rehabilitated upon completion of projects (USDA Forest Service 2002b). Refer to pages 4-34 to 36 of the Forest Plan for addition information about management intent, area specific standards and guidelines, and allowed activities.

EVOS Acquired Lands (221) - This prescription applies to the northeast end of Hawkins Island. The primary goal on these lands where the surface estate has been purchased in fee is to maintain the land in perpetuity for conservation and restoration purposes. All subsurface rights and minerals are privately owned and available for private owner development. Development activities are only allowed when necessary to convey information to the public to protect public safety or natural resources or for research or managing the area for conservation or wilderness purposes. These lands are closed to recreational motorized use. On Timber Conservation easements, the Native corporations retain all rights to surface ownership except the right to harvest timber. The purpose of Conservation Easements is to ensure that the conservation values of the property is maintained by the Native corporation and to prevent any use of the property that impairs or interferes with its conservation values. On Hawkins Island, public access is not allowed on these conservation easements. Refer to pages 4-40 to 4-45 of the Forest Plan for more information.

Fish & Wildlife Conservation Area (244) - This prescription emphasizes the conservation of fish and wildlife habitats on Montague Island and the northwest half of Green Island. The desired conditions include ecological processes managed to meet the needs of fish and wildlife. Projects to restore or enhance fish and wildlife habitat are encouraged. Vegetation will be in mostly late successional stages, however vegetation mosaics of various types, age classes and structural stages may be found throughout the area to maintain or enhance specific species habitat requirements.

On the social end, this prescription provides opportunities for solitude, isolation and quiet. Scenery will be relatively unmodified in appearance. The ROS will range from Primitive to Semi-Primitive. Recreation cabins, lodges and day-use facilities may occur consistent with ROS settings. Development should be concentrated to minimize effects on the area as a whole.

Figure 1.4 - Nellie Martin River on Montague Island

Both locatable and salable mineral activities are "conditional". Mineral exploration activities will include terms and conditions controlling operating methods and times to prevent or control adverse impacts to wildlife and fish. Small salable mineral materials sites may be developed to support trail and facility development. All sites will be completely rehabilitated upon completion of the project. (USDA Forest Service 2002b) Refer to pages 4-59 to 64 of the Forest Plan for addition information about management intent, area specific standards and guidelines, and allowed activities.

Recreation Access - The type of motorized use allowed varies across the analysis area. Figure 1.5 displays the summer and winter motorized/non motorized direction for the area. If summer motorized access is listed as "Open to all motorized use", off-highway vehicles (OHV's), helicopters, and airboats on land are included. If winter recreation motorized access is listed as "Open to all motorized use", snow machines, helicopters, and other craft are included. Winter is defined as December 1 through April 30. New Forest Service roads are not allowed in areas with the Backcountry (210), Fish and Wildlife Conservation Management (244), or Research Natural Area (141) prescriptions.

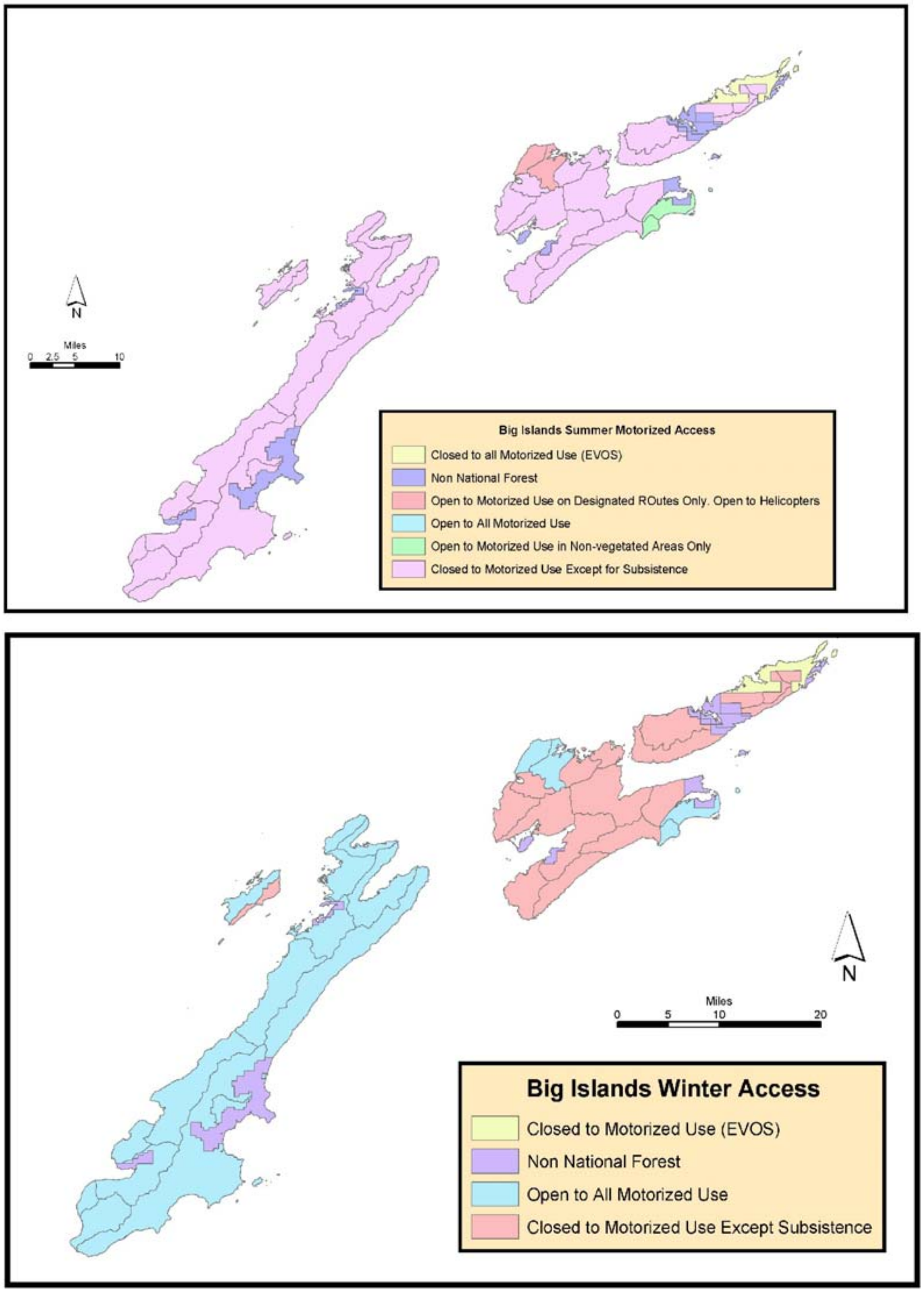

Figure 1.5 - Summer and Winter Motorized Recreation Access

Chapter 2 – Analysis Area Description[1]

Physical Characteristics

Climate

The Big Islands analysis area has a maritime climate with mild temperatures and very heavy precipitation. About 50 years of weather data are available for three low elevation sites in this area (Western Regional Climate Center 2004). The average annual daily temperature near sea level is 41^{o} to 42^{o}F (Table 2.1). Average maximum July temperatures range from 58^{o}F at Cape Hinchinbrook to 62^{o}F at Port San Juan, and minimum January temperatures range from 25^{o} to 26^{o}F at these sites. Temperatures decrease dramatically with increasing elevation.

Table 2.1 - Climate summary for weather stations in the Big Islands analysis area.

		Cordova North	Cape Hinchinbrook	Port San Juan
Location	Elevation (ft)	20	180	0
	Latitude	60º33'	60º14'	60º03'
	Longitude	145º46'	146º39'	148º04'
	# of years of data	36	26	24
Temp	Average Daily Temp (F)	41.8	41.2	41.0
	Average Max July Temp (F)	61.6	58.3	61.9
	Average Min Jan Temp (F)	24.7	26.2	26.2
Precip	Average Annual Precip (in)	162.6	91.7	130.3
	Average Annual Snowfall (in)	102.1	93.7	105.0
	Average Jan snowpack depth (in)	11	7	12
	Average March snowpack depth (in)	13	13	14
Weather Station data from Western Regional Climate Center (2004)				

Low pressure storms generally circulate counterclockwise in the Gulf of Alaska, and weather and winds in the Big Islands analysis area generally come from the southeast. Precipitation increases dramatically with elevation, as the higher areas of the islands capture moisture from these storms. These islands are the first land masses that moisture-laden storms from the Gulf of Alaska encounter, and orographic lifting over these high-relief islands results in very high precipitation, particularly on Montague Island.

The mean annual precipitation is 92 inches at Cape Hinchinbrook and 163 inches at Cordova. Hawkins, Hinchinbrook, and Green Islands generally receive 80 to 200 inches of annual precipitation (fig. 2.1). With higher elevation and sharper relief, Montague Island receives from 80 inches of annual precipitation along the coast to over 300 inches at the highest elevations. The heaviest rainfall generally occurs in the late summer and fall, and the lightest occurs in the spring and summer. Rain can occur at any time of the year, while snow falls at all elevations between mid-October and mid-May. The low

[1] Where appropriate, descriptions of existing resources are from Chapter 3 of the Big Islands Management Area Final Environmental Impact Statement (R10-MB-76) prepared June 1989 by the Chugach National Forest.

elevation areas receive about 93 to 105 inches of snow annually, with maximum snowpacks averaging 1 to 2 feet. Snowfall and snowpack increase dramatically with elevation.

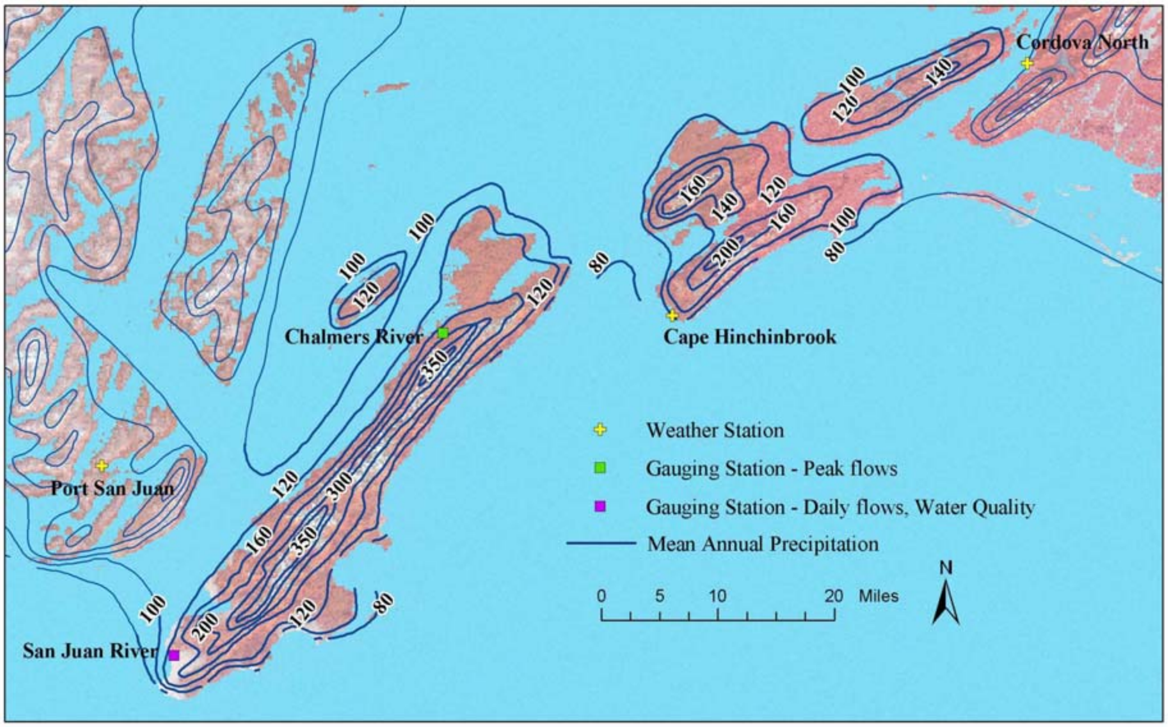

Figure 2.1 - Weather stations and mean annual precipitation, in inches, for the Big Islands analysis area. Precipitation data from USDA Forest Service.

Watershed Morphology

The Big Islands analysis area lies within the Hawkins Island, Hinchinbrook Island, Montague Outside, and Montague Inside-Green Island watershed associations, as delineated by the Chugach National Forest. These watershed boundaries divide the area by island. Watersheds are also delineated to the 4th, 5th, and 6th-levels in Prince William Sound, accounting for ocean currents and broad patterns of sediment transport along the Gulf of Alaska (fig. 2.2). Westerly currents in the Gulf of Alaska carry glacial sediment from the Copper River Delta to the southeastern shore of Hinchinbrook Island, but these currents do not go through the Hawkins Island Cutoff or into Orca Inlet.

As a result of the linear orientation of the islands and the high relief, drainage basins on these islands are very small, ranging up to about 12 square miles. The largest drainages are on Montague Island, which consists of a range of peaks rising abruptly from sea level to elevations of about 3000 feet. Hinchinbrook Island consists of multiple linear ridges with elevations up to about 2900 feet, along with large areas of lower relief. Hawkins Island has moderate relief with elevations up to about 2000 feet. Green Island is relatively flat, with elevations reaching about 500 feet. No large lakes are present, but numerous small lakes and ponds are scattered across the islands, covering about 3540 acres, or about 1% of the land area in the analysis area. The average tidal fluctuation in this part of Prince William Sound is about 12 feet.

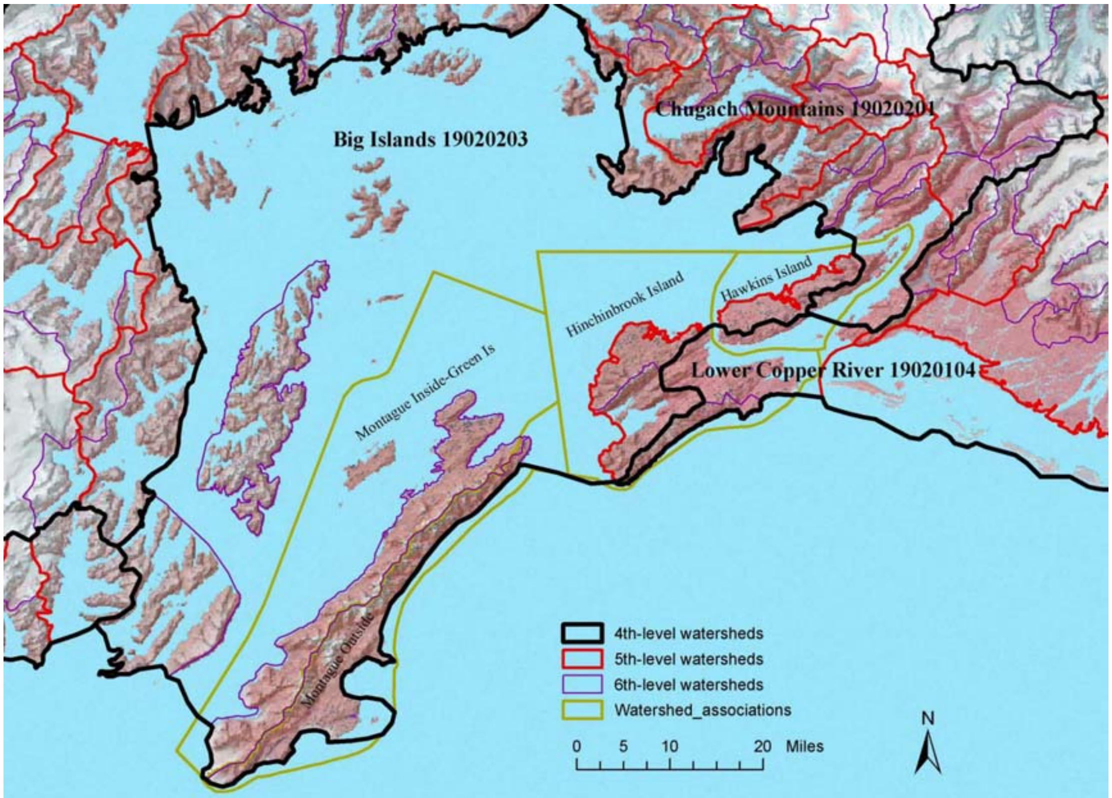

Figure 2.2 - Watersheds of the Big Islands and Prince William Sound.

Ecological Classification

The Big Islands Analysis Area is in the Prince William Sound Islands Subsection of the Northern Gulf Fjordlands Section of the Pacific Gulf Coastal Forest-Meadow Province. The topography includes islands with vegetated, steep, rugged and rolling mountains and uplifted marine terraces. The lithology consists primarily of marine shales and meta-sandstones. The east side of Hinchinbrook Island consists of volcanic extrusive rocks.

Geomorphology

The Big Islands form the southern boundary of Prince William Sound. These islands are oriented in a linear fashion, with narrow mountain ranges down the length of the islands. Because of limited high elevation areas, no large glaciers are present on the islands, although small remnant glaciers exist on Montague Island. The islands were shaped by Pleistocene glaciers that covered most of the Sound, and alpine areas have been shaped by more recent glacial activity from small valley and cirque glaciers. Fluvial erosion has continued to shape the landforms of these islands. The mountainous areas have very high relief and rugged terrain, whereas the low-relief areas are characterized by bedrock ridges and wetland areas. Snow avalanches commonly occur on the steep peaks of these islands.

The epicenter of the magnitude 9.2 earthquake of March 27, 1964 was located near College Fiord in Prince William Sound. A maximum uplift of over 30 feet from that tectonic event occurred along the longitudinal axis of Montague Island, causing drastic geomorphic changes along the shoreline. Only 4 to 8 feet of uplift occurred on Hawkins and Hinchinbrook Islands (USDA Forest Service 1983).

Events such as the 1964 earthquake have been shown to occur on average every 600 to 800 years (Combellick 1991). Uplift from these successive events has resulted in a series of uplifted beach terraces visible along some portions of the shorelines, as is evident on the east end of Hinchinbrook Island (fig. 2.3). Uplift also causes steepening of streams at the coast, which leads to channel incision, head-cutting, and increased sediment transport during a period of dis-equilibrium. An example can be seen near Deception Creek on Montague Island, where the channels have cut through the uplifted beach deposits and created small alluvial fans at the new beach (fig. 2.3).

Figure 2.3 - Uplifted beach terraces at Point Bentinck on Hinchinbrook Island in 1996 (left) and near Deception Creek on Montague Island in 1990 (right).

Stump Lake on Montague Island was formerly a bay on the Gulf of Alaska that was transformed into a freshwater lake by sediment deposited in a baymouth bar at the mouth of the bay. Subsequently, uplift from the 1964 earthquake caused the outlet stream to incise into the former baymouth bar and lower the lake level. A weir structure was built in the outlet stream of Stump Lake to maintain the lake's water surface elevation. The mouth of the San Juan River at San Juan Bay was similarly transformed by the earthquake, but the lake ultimately drained and was replaced by a wetland meadow.

The southern coasts of Montague and Hinchinbrook Islands are affected by high-energy ocean waves from the Gulf of Alaska. Woody debris, tree trunks, and abundant trash accumulate along these shorelines. Because the ocean currents in the Gulf of Alaska rotate in a counterclockwise direction, glacial sediment from the Copper River is transported to and deposited along the southern shorelines of Hinchinbrook Island and even as far as Montague Island. As a result, sand bars, islands, and tidal flats have developed east of Hinchinbrook Island and south of Hawkins Island.

Landtype Associations

Landtype Associations (LTA) are part of the National Hierarchal Framework used to delineate landscapes on the Chugach National Forest. Ecological units at this level are defined by the "geomorphic process and how it affects the topography, surficial geology, local climate, soils, and potential natural plants community patterns" (Davidson 1997). Soils in the analysis area can be described in terms of where they lie on the landscape because the geomorphic processes that formed the different landtypes are intricately related to the pedogenic processes that formed the soil on those sites (USDA Soil Conservation Service 1993). Soil mapping units and their descriptions are provided if they have been developed for the particular landtypes. The mapping units represent the major soil types typically found on those sites based on survey work done throughout the Chugach National Forest by D.F. Davidson (1978, 1989, and Davidson et al 1989) however, the units may also include minor soil components not described here.

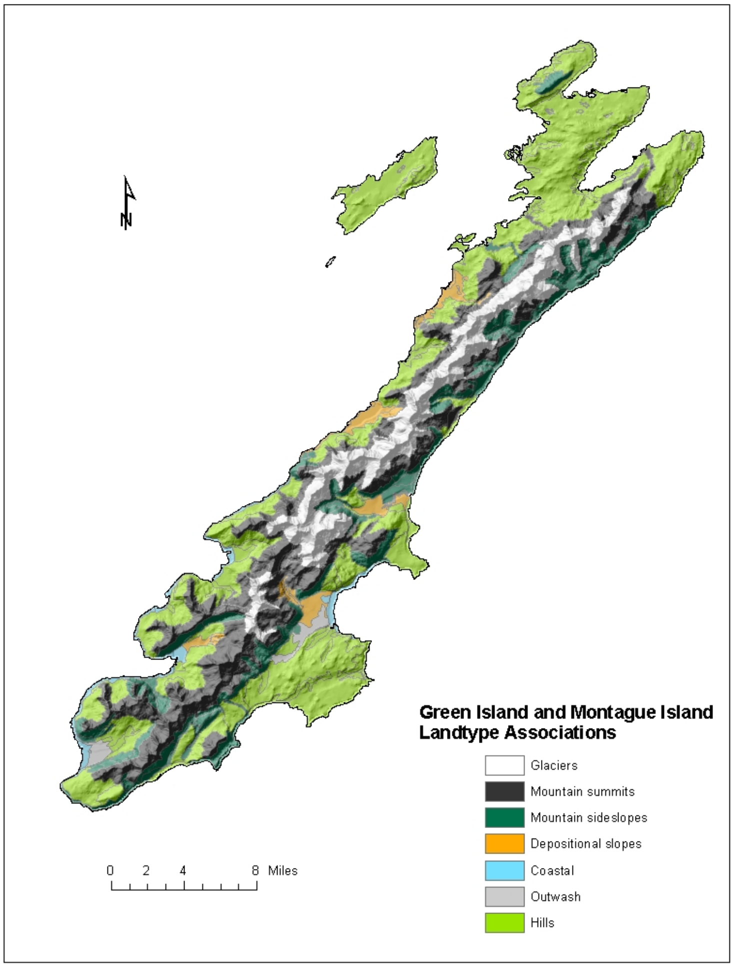

Figure 2.4 - Landtype Associations for Green Island and Montague Island.

Glaciers – This landtype association occurs only at higher elevations on Montague Island and consists primarily of glaciers and rock inclusions. Soil development is minimal because of the relatively young age of any exposed surface (fig. 2.4).

Mountain Summits - These areas occur at higher elevations on all of the islands except for Green and Wooded Islands and are characterized by rocky terrain with intermittent ice and snow. The soil tends to be stony, weakly developed and shallow. Subtle changes in the soil profile and depth occurs as one moves from concave to convex positions on the landscape.

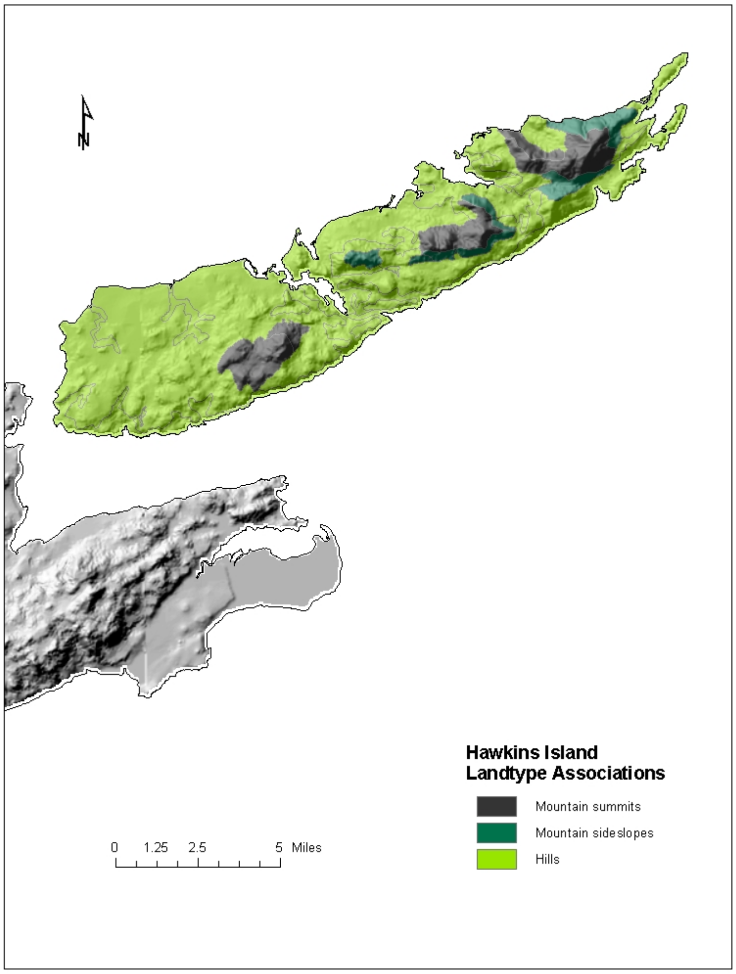

Figure 2.5 - Landtype Associations for Hawkins Island.

Mountain Sideslopes – This LTA occurs at higher elevations on all the islands except for Green and Wooded Islands. The areas are characterized by disturbance in the form of mass wasting and slope erosion. The soils may be forming on top of compact glacial till which can act as a water restricting layer and can increase the likelihood of failure on steeper slopes (Swanston 1997). A land stability analysis (Appendix C) should be done before ground disturbance to evaluate the risks. The extent of pedogenesis is typically determined by location on the sideslope. The soils get deeper and more developed as one moves from the higher, steeper, convex positions to the lower, less steep, concave positions. Soils are typically medium textured and well drained. Areas that are not subject to continual erosion or deposition from material above will usually exhibit greater soil development and will support mature coniferous forests.

Depositional Slopes - This association includes stream terraces and floodplains that primarily occur on Hinchinbrook and Montague Island. The soils are formed at the base of long sideslopes where sediments from higher slopes accumulate, such as alluvial fans and forested footslopes. Soils are usually deep, coarse textured, and well-drained, except where subsurface runoff accumulates.

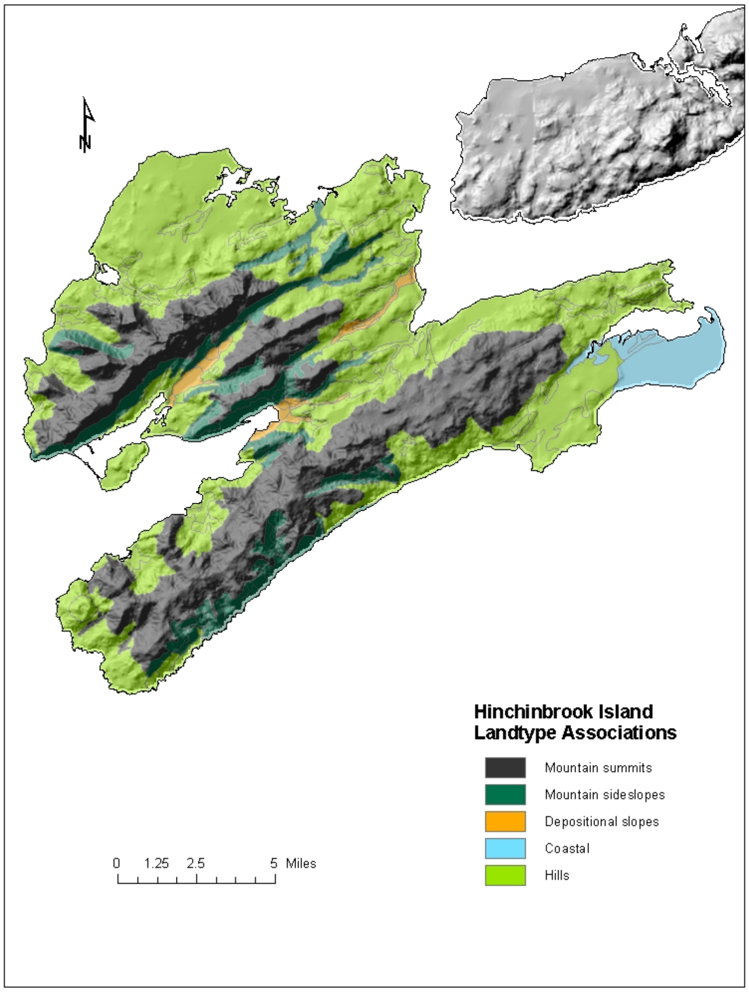

Figure 2.6 - Landtype Associations for Hinchinbrook Island.

Hills - This LTA is mapped throughout the analysis area but is particularly common on Green, Wooded, and Hawkins Islands (figs. 2.4 and 2.5). Soils are formed from glacial till or ice-scoured bedrock knobs. Soil type is highly dependent on landscape position. Soils on knobs and shoulder slopes will be shallower and less developed than those on sideslopes. Soils in toe slope positions and basins where water collects will tend to develop organic soils and may support wetland vegetation.

Coastal - This association occurs on the east end of Hinchinbrook Island, Wooded Island, and the south end of Montague Island (figs. 2.4 and 2.6). It includes landscapes resulting from marine processes such as tidal fluctuations, wave carving and splash, and blowing sand, such as estuaries, beaches, marine deltas, and marine terraces. Some of the landscapes have been uplifted by isostatic rebound after glacial recession or from earthquakes. Uplifted landscapes are no longer associated with the active processes of the ocean and may be located inland from the ocean. The soil may consist of either poorly drained silts deposited in low energy environments or well-drained sands deposited in high-energy environments. The poorly drained soils on deltas or tidal flats, and marine terraces produce the largest expanses of wetlands (Davidson 1997).

Outwash - This association occurs only in valley bottoms on Montague Island. The soils are forming on active floodplains and on glacial outwash sediments that were laid down under high water energy. These soils are typically somewhat well drained to excessively drained. Soils forming on alluvium tend to be stratified with different layers of sediments. Layer composition will differ in the amount of fine sediments and rock size depending on the energy of the stream flows that laid them down. Limitations for these soils are usually due to drainage or permeability problems associated with one or more restrictive layers in the soil profile or a high water table.

Geology

The bedrock geology of the analysis area consists primarily of undivided sedimentary rocks of the Orca Group. The Orca Group is part an accretionary belt thought to make up the Prince William Terrane (Dumoulin 1987). Major structural trends in the Orca Group are northeasterly. The estimated thickness of the Orca Group is as many as thousands of feet, possibly 19,000 to 32,000 feet (Winkler and Plafker, 1993). Siltstone, shale, greywacke, and slate are common throughout the area, with a few areas of mafic volcanic rocks interbedded with sedimentary rocks, particularly on Hinchinbrook and Hawkins Island. These sedimentary rocks were laid down as turbidites. Turbidites are rocks deposited by turbidity currents - submarine slurries of sediment avalanching down the edge of a continental shelf into deep water. As the cloud of sediment comes to rest on the deep ocean floor, the larger particles settle first creating graded bedding. Later, metamorphism occurred after the sediments were deeply buried and subjected to intense heat and pressure, changing the fabric and mineralogy of the original rock. Metamorphic grades range from zeolite and prehnite-pumpellyite facies to lower green-schist facies (low to medium grade). Conglomerate rocks are found on the outer edges of both Montague and Green Island (fig. 2.7).

Several types of Quaternary deposits are present in the analysis area. They are recent deposits composed entirely of clastic material (clay, silt, sand, gravel, and talus). Qu or Qs is the general symbol for these deposits but they may be broken down into several different types, such as beaches, spits, and offshore bar deposits (Qb); landslide deposits (Qls), morainal deposits (Qm); and lagoonal deposits (Ql).

Montague, Hinchinbrook and Green Islands contain a distinct set of rocks known as the Montague Belt (Helwig and Emmit 1981). These rocks consist mainly of middle fan turbidites probably laid down in a westward sloping fan. What distinguishes these rocks from the rest of the Orca Group is their rare landward vergent structures. Isoclinal folds apparently developed in these rocks shortly after deposition and are inclined to the northwest rather than seaward as would be normal for a subduction complex.

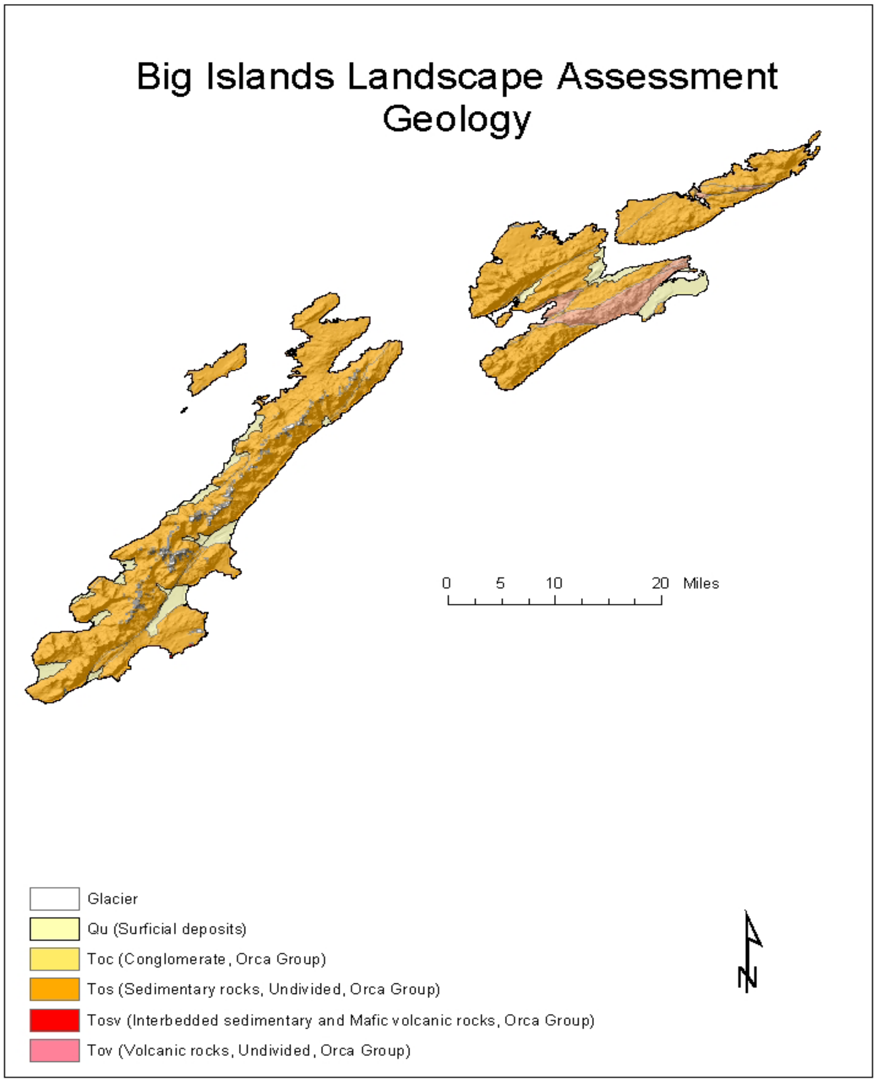

Figure 2.7 - Geology of the Big Islands Landscape Analysis Area. USDA Forest Service, 1996-2000. Chugach National Forest Corporate GIS Data Layers. Accessed February 2005.

Green Island - The Orca Group sedimentary (Tos) bedrock of Green Island consists of black, banded slate and shale with occasional thick beds of greywacke or sandstone. The rocks are remarkable for their sedimentary features which include abundant ripple marks, load casts, rip-up clasts, flute and groove casts. Iron-rich metallic nodules are present in the greywacke at several locations along the shore. Calcareous concretions can be seen in the slate beds along the beaches on the northern end of the island. Generally uncommon in Orca rocks, some conglomerate is exposed along the beach. Fossil evidence is common in the bedrock and includes carbonized fragments of plants and borings and trails of worms or other animals. Examples are near the northeast tip of the island.

Small areas of a conglomerate unit (Toc) have been mapped along the shoreline, mostly at the south and north ends of the island. The unit is massive, clast-supported, and contains well-rounded pebbles, cobbles and boulders. This conglomerate has been interpreted as representing inner fan deposits that mark entry points of major feeder channels into the Orca submarine-fan complex.

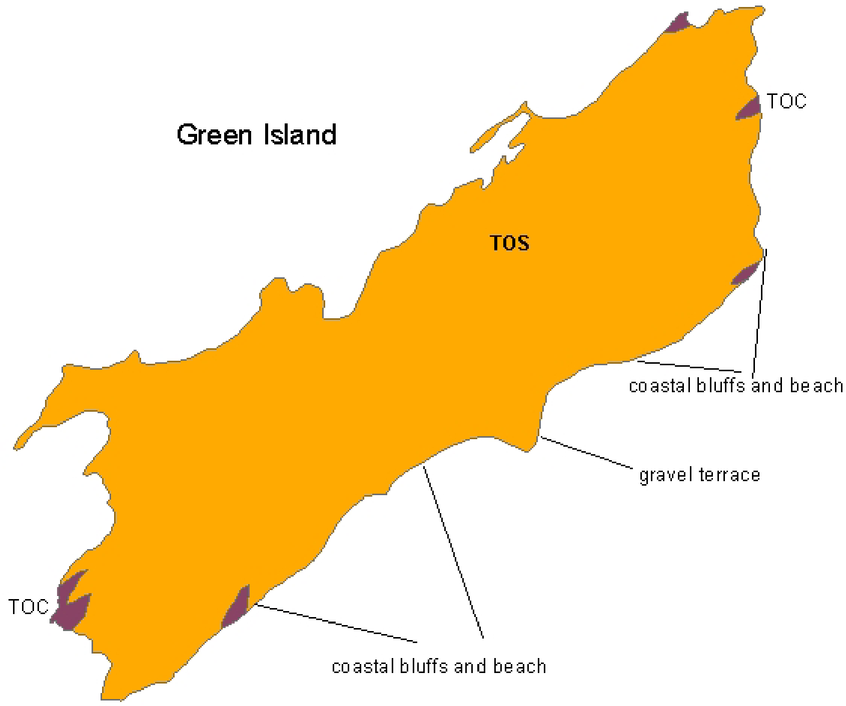

Figure 2.8 - Geology of Green Island

Although some quaternary deposits are present, they are not displayed in Figure 2.8 due to scale. The gravel terrace is a beach deposit of well-sorted gravel and sand.

Montague Island - Bedrock of Montague Island consists of a sedimentary unit (Tos) which makes up a monotonous sequence of thin- to thick-bedded sandstone, siltstone, and mudstone showing abundant sedimentary structures indicative of deposition from turbidity currents. The distinctive “purple bluffs” on the Gulf of Alaska side of the island are composed of slate (metamorphosed mudstone), and the color is a result of the form of iron present.

Montague Island contains the turbidites with landward vergent structures and isoclinal folds inclined to the northwest rather than seaward as would be normal for a subduction complex. Superimposed on these folds are structure due to more recent earthquakes which exhibit normal southeast (seaward) vergent structures.

Microfossils recovered from thin beds of limestone and limestone concretions on Montague and Hinchinbrook Islands yield a Paleocene/Eocene date for this rock belt. Some of these broken, fossiliferous limestones seem to have originated in shallower water and then were swept down into the subduction trench by turbidity currents; others may have formed in shallower waters on pillow basalt flows that reach up towards the sea’s surface.

Montague Island is one of the best places to see evidence of the 1964 earthquake, for it is here that the earth ruptured forming numerous thrust faults. The 4-mile long Hanning Bay fault, traceable from Hanning Bay to MacLeod Harbor had about 16 feet of vertical movement while a maximum displacement of 36 feet occurred along the 22-mile long Patton Bay Fault. The spectacular fault scarp with the northwest side thrust above the southeast side is still visible today. Raised beaches line the shores of Montague Island.

The undifferentiated unconsolidated, surficial (Qs) deposits are predominately alluvium deposited by non-glacial and glacial streams. Locally they include minor deposits that formed on marine terraces and in wetlands. The material is primarily well-sorted, stratified gravel and sand. Terrace deposits are less well sorted, while wetland deposits generally consist of peat, muck, and silt.

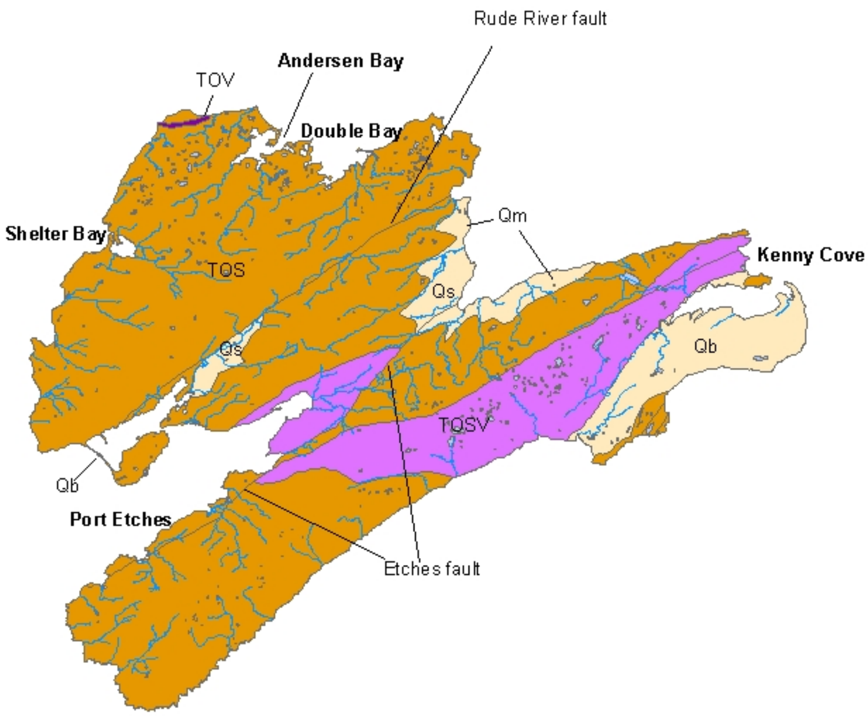

Figure 2.9 - Geology of Hinchinbrook Island

Hinchinbrook Island - The bedrock of Hinchinbrook is primarily Orca Group sedimentary rock (Tos) similar to that described for Green and Montague Islands. On Hinchinbrook, it forms steep rugged ridges, sea cliffs or headlands where sandstone predominates and smooth subdued slopes, valleys and wave-cut platforms where siltstone predominates. Sandstone beds are characterized by abundant sole markings and graded bedding and by frequent convolute lamination and linguoid ripples; siltstone beds often are bioturbated. Some beds contain abundant carbonaceous plant remains, and the hemipelagic deposits contain scattered micro-fossils of probable Paleocene age. Detrital minerals indicate that source terranes are metamorphic volcanic rocks (Winkler 1973).

Figure 2.10 - Limestone layers interbedded with siltstone near Shelter Bay, Hinchinbrook Island.

The next most abundant unit is a greenstone belt (Tosv) extending from the head of Port Etches to Kenny Cove. It seems to be related to the outcrops of volcanic rock on the northeast end of Hawkins Island near Grass Island. This unit is interbedded sedimentary and volcanic rock, with variable proportions of interbedded turbidites and basalt. Basalt consists of pillowed and massive flows, pillow breccia and tuff. Turbidites are generally mudstone, siltstone, and fossiliferous volcanogenic sandstone. The entire unit is complexly deformed and regionally metamorphosed. At Garden Cove and the head of Port Etches, the contact between the greenstone (Tosv) and the turbidites (Tos) is easily observed. Thin lenticular layers of limestone overlying the pillow basalt in this area have yielded shallow water upper-Paleocene microfossils.

Trending approximately east/west, on the northern most tip of the island, is a narrow band of volcanic rock (Tov) consisting of thick and thin tabular bodies of altered tholeiitic basalt. Another small outcrop of this rock occurs at English Bay (entrance to Port Etches, south side); it trends northeast, as do the major structures in the area, including the Etches and Rude River faults. A tract identified as having potential for undiscovered mineral resources correlates well with the Tosv unit shown in Figure 2.9.

Undifferentiated unconsolidated, surficial (Qs) deposits are predominately outwash deposited by glacial melt water and alluvium deposited by non-glacial streams. Locally it includes minor deposits formed on marine terraces and in wetlands. The material is primarily well-sorted, stratified gravel and sand. Terrace deposits are less well sorted. Wetland deposits generally consist of peat, muck, and silt.

Constructional shoreline deposits (Qb) of well-sorted gravel and sand form as beaches consisting of successive sequences of runnels and ridges extending landward from present shoreline. At least six successive episodes of progradation are preserved in beach sequences at the eastern end of Hinchinbrook. These deposits are south and west of Kenny Cove and between Nuchek Island and Hinchinbrook, as displayed in Figure 2.9.

Terminal, lateral and ground moraine deposits (Qm) consist of unsorted boulders, cobbles, gravel, and sand deposited during glacier retreat. Seaward deposits are relicts of older regional glaciation and consist of till that has a well-developed profile. These deposits may be both unvegetated and vegetated, locally sustaining dense brush and forest, but retaining their morainal morphology. Substantial quantities of morainal deposits occur at Dan Bay.

Hawkins Island - The bedrock of Hawkins, like the other islands, is primarily Orca Group sedimentary rock (Tos). The next most abundant unit is a northeast trending greenstone belt (Tosv) extending from the Canoe Passage east-northeast across the island. This unit is an interbedded sedimentary and volcanic rock, with variable proportions of interbedded turbidites and basalt. It is similar and appears to be related to the greenstone unit on Hinchinbrook Island. A small quantity of volcanic rock (Tov) is exposed on the north side of Shipyard Bay. It consists of thick and thin tabular bodies of altered tholeiitic basalt and is also exposed on the north end of Hinchinbrook Island. Major structures are northeast to east-northeast trending Rude River and Cordova faults.

At Windy Bay, at least four raised beaches that parallel and have similar morphology to the current beach can be seen. Presumably, they resulted from past earthquake events similar to the 1964 earthquake. Three of the raised beaches are evident in Figure 2.11.

Figure 2.11 - Series of uplifted beaches near Windy Bay, Hawkins Island

Soils

Montague and Hinchinbrook Islands have retained rugged mountain peaks and alpine glaciers. The other islands in the analysis area have hills with rounded tops indicative of glacier scouring (Davidson 1989). These areas tend to be underlain with compact glacial till, which can restrict water movement and are able to support wetlands and associated hydric soils. Bedrock geology can be the primary influence on soil characteristics in areas not overlain by other materials such as colluvium, alluvium, or glacial deposits. These more recent deposits provide the parent material for soil development and therefore contribute both chemical and physical attributes. In areas where geologic or geomorphic characteristics restrict water movement, their influence on soils will be indirect by creating anaerobic conditions that support the formation of organic soils.

The ways soil and landform characteristics are measured relative to impacts from various management activities are soil productivity, erosion potential, and mass movements. Soil productivity is based on the amount and type of vegetation. The factors common to the more productive sites include soils that are moderately deep to deep, well drained and an organic layer more than two inches thick. These soils usually produce stands of large trees. Some soils are less productive because of thin organic surface layers, moderate drainage, shallow depths or low nutrient content; or they have non-compatible site characteristics such as avalanches, bedrock outcrops or unstable soils. These units will most often be vegetated with shrubs and herbaceous vegetation. Other soils have low productivity due to poor drainage or saturation by water. They are normally vegetated with herbaceous and hydric vegetation. High elevation areas with rock outcrops, snowfields, and glaciers have growing conditions that are too harsh and unsuited for abundant vegetative growth. These are usually unvegetated or have minor amounts of moss or alpine vegetation (USDA Forest Service 1989).

Soil erosion and sedimentation is not a major problem because most soils are covered by an organic layer. Once the organic layer is removed, soils with a medium to fine texture are susceptible to erosion on steep slopes. Shallow soils regardless of the texture are more susceptible to erosion. Soils that do not have an organic layer or are located on floodplains are continually being naturally eroded. (USDA Forest Service 1989).

Naturally occurring landslides due to high precipitation, steep slopes, and continuous undercutting of sideslopes by streams are a common occurrence in the analysis area. The potential increases as slope increases and may become serious on slopes over 72% that have had vegetation removed. They may also be accelerated where roads are constructed across slopes where soils are poorly drained, have fine texture or a high amorphous component. (USDA Forest Service 1989).

Wetlands

Wetlands cover about 43% of the analysis area. The majority of these wetlands are palustrine wetlands, or areas associated with swamps, bogs, ponds, beaver ponds, and floodplains. Estuarine, lacustrine, marine, and riverine wetlands also exist on these islands, but are limited in area. About 62% of Hawkins Island is covered by palustrine wetlands, and upland areas cover about 36% of the island. About half of Hinchinbrook

Island is covered by palustrine wetlands, mostly on the eastern and northern portions of the islands, and most of the rest is uplands. Palustrine wetlands only cover about 30% of Montague Island along the coastal areas and about 67% of the island consists of uplands. About 69% of Green Island is covered by palustrine wetlands, with uplands consisting of only the narrow bedrock ridges throughout the island.

Streams

A total of 970 miles of mapped streams are in the Big Islands analysis area (fig. 2.12). Channel types were assigned to these streams based on the Tongass National Forest Channel Type User Guide (USDA Forest Service 1992a). Field verification of these channel types is limited in this area.

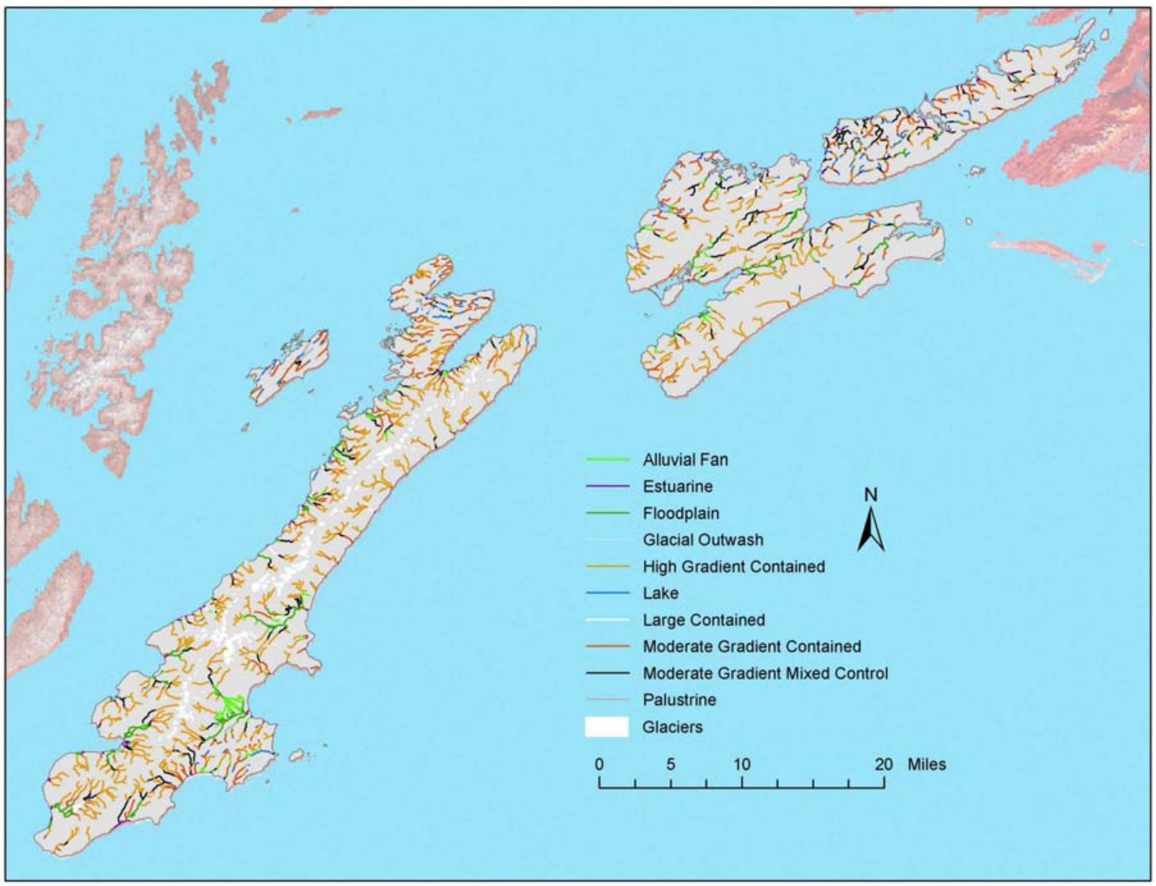

Figure 2.12 - Channel types for streams in the Big Islands analysis area.

High Gradient Contained (HC) channels are the most common on the Big Islands due to the high relief and small drainage areas (Table 2.2). About half of the stream channels on Montague and Hinchinbrook Islands are High Gradient Contained channels, draining the ridges of peaks on these islands. Moderate Gradient Contained (MC), Moderate Gradient Mixed Control (MM), and Floodplain (FP) channels are present in the lower elevations and low-relief areas of Montague and Hinchinbrook islands. Moderate Gradient Contained and Moderate Gradient Mixed Control channels are common on Hawkins Islands. Most of the channels on Green Island are in the Moderate Gradient Contained process group. Palustrine (PA) channels are common on Green Island, and Estuarine (ES) channels are common on Hawkins Island. The largest drainage in the analysis area is the San Juan River flowing into San Juan Bay on the southwest end of Montague Island.

Table 2.2 - Distribution of stream miles on the Big Islands, and percentage of stream channels in each process group by island.

		Green Island	Montague Island	Hinchin-brook Island	Hawkins Island	TOTAL
Total Stream Miles		21	588	247	114	970
Drainage Density (mi/sq mi)		1.9	1.8	1.4	1.6	1.7
PROCESS GROUP (%)	High Gradient Contained	0.7	50.6	44.2	17.8	44.0
	Moderate Gradient Contained	51.5	15.1	15.5	24.9	17.2
	Moderate Gradient Mixed Control	5.1	8.3	10.6	24.2	10.6
	Floodplain	0.6	10.2	12.7	5.0	10.0
	Alluvial Fan	-	6.7	5.9	-	5.6
	Estuarine	1.8	2.8	4.3	10.9	4.2
	Palustrine	18.8	1.9	1.6	3.4	2.4
	Large Contained	-	1.6	1.2	-	1.3
	Glacial Outwash	-	0.02	-	-	0.01
	Lakes	21.4	2.9	4.0	13.9	4.9

Streamflows

Streamflow data for the Big Islands are limited to historical daily flow data for the San Juan River and historical peak flow data for the Chalmers River, both located on Montague Island (US Geological Survey 2004). Because of the marine influence, heavy precipitation, and mild temperatures, peak flow events in the area are predominantly the result of rainfall runoff. Peak flow events during heavy rainstorms are generally much larger than the average snowmelt runoff peak flow, which generally occurs in May (fig. 2.13). Although large flood events can occur during any time of the year, the largest floods typically occur during fall rainstorms. Some streams on Montague Island are influenced by small glaciers, but this component is insignificant compared to the influence of rainfall runoff.

Because of the high relief and small watersheds, many streams in the area are very flashy, and peak flow durations are very short. Streamflows per unit drainage area are the highest on Montague Island, where the 10-year flood can produce over 500 cfs per square mile of drainage area (Table 2.3). Montague Island captures a large amount of moisture from storms in the Gulf of Alaska because of its location, high elevations, and high relief. Unit streamflows are somewhat lower on the other islands.

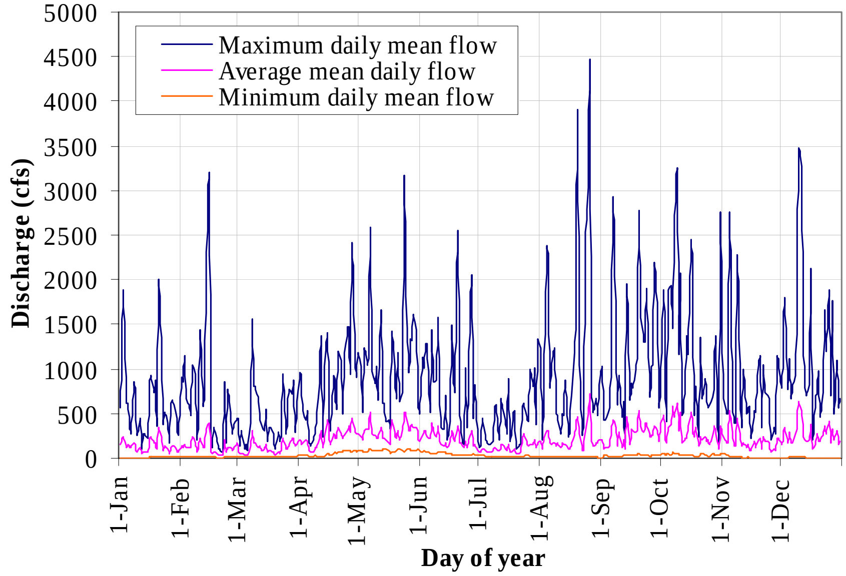

Figure 2.13 - Average daily streamflows for the San Juan River, USGS gauging station #15237360. Period of record 05/25/86 to 09/30/96 (USGS 2004).

Table 2.3 - Flow statistics for stream gauges in the Big Islands analysis area.

	San Juan River	Chalmers River
USGS Station Number	15237360	15237400
Latitude	59°49'05"	60°13'10"
Longitude	147°53'00"	147°13'30"
# of years data	10 (1986-1996)	13 (1967-1980)
Drainage area (sq miles)	12.4	6.32
Average daily flow (cfs)	208	n/a
Extreme minimum daily flow (cfs)	2.3 (1/9/90)	n/a
Extreme instantaneous peak flow (cfs)	5280 (8/20/93)	3380 (8/15/79)
Average June flow (cfs)	219	n/a
Average March flow (cfs)	115	n/a
2-year flood (Q_2) (cfs)	3,880	2,720
cfs/square mile	313	430
10-year flood (Q_{10}) (cfs)	4,860	3,390
cfs/square mile	392	536
Data from US Geological Survey (2004). Flood frequency statistics from Curran et al. (2003), weighted skew.		

Water Quality

Only a limited amount of water quality data exists for streams or lakes of the Big Islands. The US Geological Survey (USGS) collected water quality data for the San Juan River from 1988 to 1994 (USGS 2004). Data collected for a variety of basic water quality parameters suggest that this water is relatively pristine, with little impairment from human influences. However, little baseline data exist from which to measure change.

Turbidities rarely exceeded 1 NTU[2], the pH ranged from 6.1 to 8.0, dissolved oxygen ranged from 8.6 to 13.4 mg/L, and specific conductivities ranged from 38 to 264 uS/cm[3]. Because of the limited human development or disturbance, any abnormalities in water quality are likely to be the result of natural processes. Sediment loads are generally low, but can fluctuate greatly. Factors such as high flows, steep terrain, and erodible geology contribute to the potential for very high sediment loads during floods. Localized impacts from OHV use on Hinchinbrook and Hawkins Islands or effects of the Montague Island road can potentially cause increased sediment runoff. Metallic mineral deposits are not present in great quantities on the Big Islands, and heavy metals are not abundant in surface waters.

Biological Characteristics

Fish

Fisheries resource conditions have been, and are still controlled by the dynamic climatic and geologic activity in Prince William Sound (PWS). Twelve thousand years ago during the last major glacial period, there were no freshwater fish in the analysis area because it was covered under a thick layer of ice. Since then, fish have invaded the many streams and lakes created by receding glaciers.

Over the past 2,000 years there has been persistent subsidence of land interrupted by punctuated intervals of uplift due to earthquakes occurring at intervals of 600 – 1,000 years (Christensen and Mastrantonio 1999). Subsidence likely increases proportions of salt water and tidally influenced habitats in the analysis area. These tidal habitats are important areas for the early life stages of pink (*Oncorhynchus gorbuscha*) and chum salmon (*O. keta*) but they may limit freshwater rearing habitat for coho (*O. kisutch)* and sockeye salmon (*O. nerka*). Uplift can create morphological channel changes that increase spawning habitat available to salmon (Noerenberg and Ossiander 1964; Roys 1971). Populations have likely fluctuated around periods of subsidence and uplift, as well as from other natural environmental and climatic factors associated with the region.

Anadromous salmonids are present on all islands in the analysis area. Pink salmon are present in most streams (ADFG 1998) and can be extremely abundant. They possess a distinct 2 year life history pattern with typically higher numbers of fish returning during odd years than even years (Gray et al. 2003). Other anadromous salmon species present are chum salmon, coho salmon, and sockeye salmon (ADFG 1998). Dolly Varden char (*Salvelinus malma*) and coastal cutthroat trout (*O. clarkii clarkii*) occur in the analysis area in both resident and anadromous forms (Schelske et al. 1998). Other anadromous fishes that may occur infrequently in the analysis area include chinook salmon (*O. tshawytscha*), Atlantic salmon (*Salmo salar*), and eulachon (*Thaleichthys pacificus*).

Pacific herring (*Clupea pallasi*) and capelin (*Mallotus villosus*) can occur near the shores in estuaries and may be important food resources for adult chinook and coho salmon as well as several species of marine mammals.

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[2] NTU = nephelometric turbidity units
[3] uS/cm = micro Siemens per centimeter

Additional freshwater fishes that may occur are round whitefish (*Prosopium cylindraceum*), arctic grayling (*Thymallus arcticus*), three-spine stickleback (*Gasterosteus aculeatus*), coast range sculpin (*Cottus aleuticus*), slimy sculpin (*C. cognatus*), and prickly sculpin (*C. aster*).

There are no federally listed threatened or endangered fish species in the analysis area; however, coho salmon and Dolly Varden are Management Indicator Species (MIS) and cutthroat trout are listed as a Species of Special Interest (SSI) in the Forest Plan (USDA Forest Service 2002b).

Habitat Characteristics – Unlike the Copper River Delta analysis areas, no large active glaciers are present in the Big Islands area. Thus the drainages are relatively small and characterized by short clear water streams fed by rain and snowmelt flowing directly into the estuaries of the Sound and the Gulf of Alaska (fig. 2.12). The lower reaches of these streams generally provide excellent spawning and rearing habitat for salmonids. The headwaters of these streams are typically steep, high gradient contained channels that mainly function to transport sediment (USDA Forest Service 1992). They provide gravels for spawning and rearing salmonids in low gradient, unconfined habitats downstream. They are also important in collecting and transporting large wood from the upland riparian zones. Headwater tributaries typically contain minimal fish habitat due to steep gradients and large substrates. The mid and lower stream reaches contain most of the spawning and rearing habitat for salmonids. Channels in the flood plain and moderate gradient mixed control process groups provide important spawning and rearing habitat for salmon, trout, and char species (USDA Forest Service 1992). Riparian zones composed of mixed deciduous and coniferous forests offer overhanging stream bank cover and in-stream habitat through recruitment of large wood. Pools, ponds, and lakes habitats provide depth and complexity necessary for overwintering survival (Bustard and Narver 1975; Smith and Griffith 1994). Pink and chum salmon generally spawn in intertidal stream reaches of the estuarine process group (USDA Forest Service 1992), although pinks can travel several miles upstream if accessible.

Periods of heavy rain and steep, flashy, headwater streams result in frequent flooding of stream channels. Floods can dislodge and transport aquatic and terrestrial invertebrates downstream, making them more vulnerable to predation by juvenile salmonids (Pearson and Franklin 1968; Irvine 1985). Flooding can also make previously inaccessible food resources available to stream rearing salmonids through the inundation of water on flood plains and pond margins (Junk et al. 1989; Wissmar et al. 1991).

Stream habitat in the analysis area was affected by the uplift caused by the 1964 earthquake which raised the coastal areas of the Big Islands 5 to 32 feet. Uplift was greatest on the southwest end of Montague Island (Roys 1971, Solf 1973). The uplift radically altered stream channels leaving them in an unstable, erodible condition as the new gradient regime began to re-establish equilibrium (Noerenberg and Ossiander 1964; Roys 1971). Intertidal spawning habitat of pink and chum salmon was destroyed. The spawning success and survival of pink salmon was greatly reduced (Noerenberg and

Ossiander 1964).The earthquake is believed to have played a major role in the decline in chum salmon runs on Montague Island during the mid 70s to mid 80s.

Stream habitat on Montague Island has been significantly impacted from natural and past human disturbance. The habitat will likely improve naturally as the harvested riparian forests mature in the alluvial fans. Stream habitat improvement projects may be able to accelerate the rehabilitation of these systems. Improved habitat and increased production may be needed to meet the increasing demands of the commercial, sport, and subsistence users of the fisheries resources.

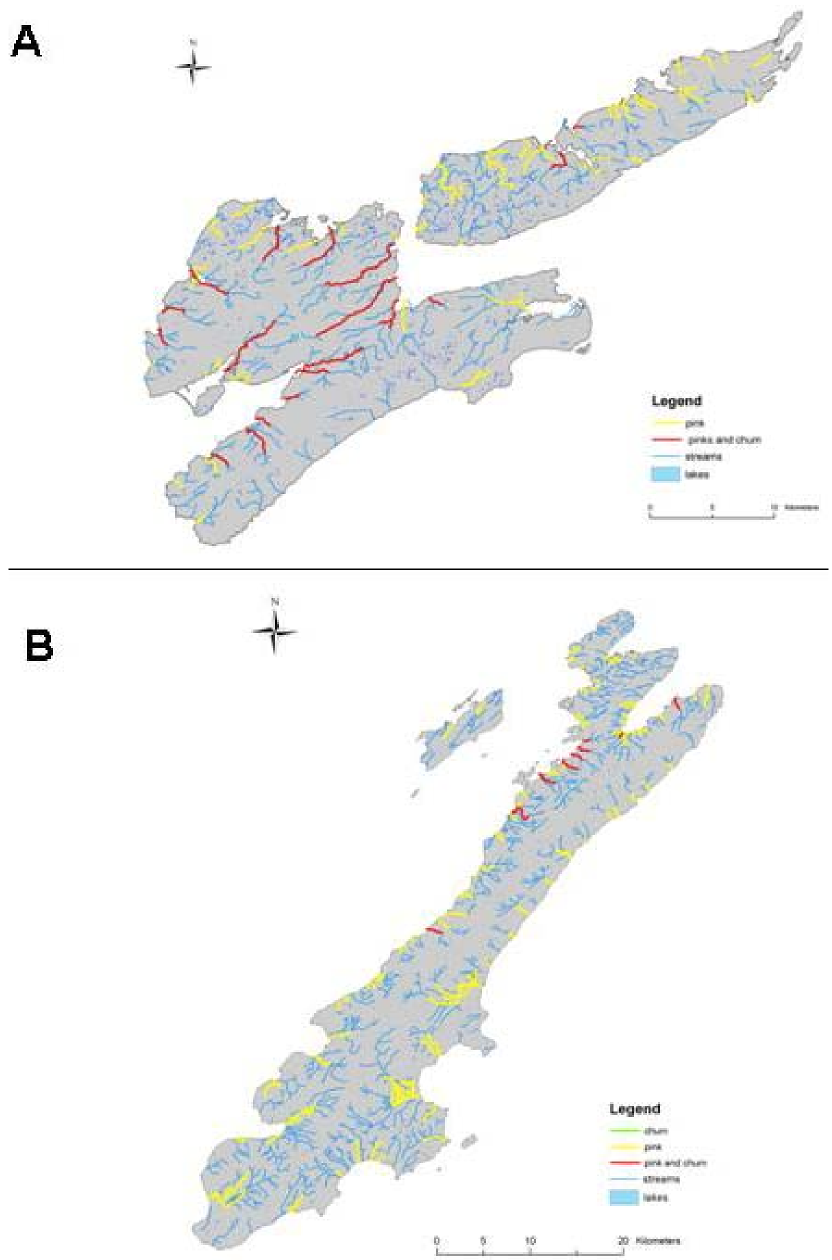


Figure 2.14 - Distribution of pink and chum salmon on Hawkins and Hinchinbrook Islands (A) and Montague and Green Islands (B) based on current GIS corporate stream layer (USDA FS GIS 2002).

Fish Distribution - The current GIS corporate stream layer for the Chugach National Forest may not include all salmonid stream systems or all documented data on fish species presence. The data presented here likely underestimates the true presence and distribution of the key species.

Pink salmon are the most abundant and widely distributed species in the analysis area; they are documented in 187 miles of the streams (Figure 2.14 and 2.17). They occur in all the major streams on the islands, except for Green Island, and are present in most small streams as well. The biggest pink producing stream systems are those flowing into Port Etches and Orca Inlet (cutoff area) on Hinchinbrook Island and those flowing into Port Chalmers, Stockdale Harbor, and MacLeod Harbor on Montague Island.

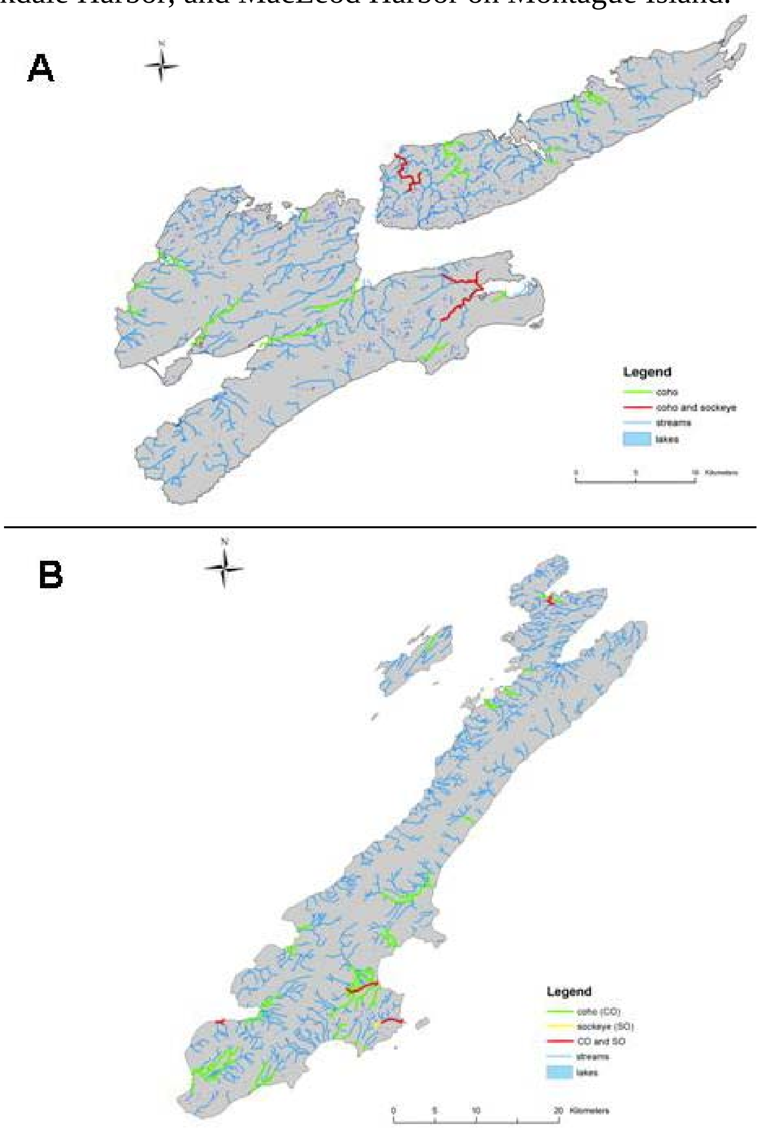


Figure 2.15 - Distribution of coho and sockeye salmon on Hawkins and Hinchinbrook Islands (A) and Montague and Green Islands (B) based on current GIS corporate stream layer (USDA FS GIS 2002).

Coho salmon are the second most widely distributed species in the analysis area (fig. 2.15). They are present on all of the islands and occupy approximately 109 miles of streams in the analysis area (USDA Forest Service GIS 2002). Montague Island has the most coho habitat of the four main islands (fig. 2.17).

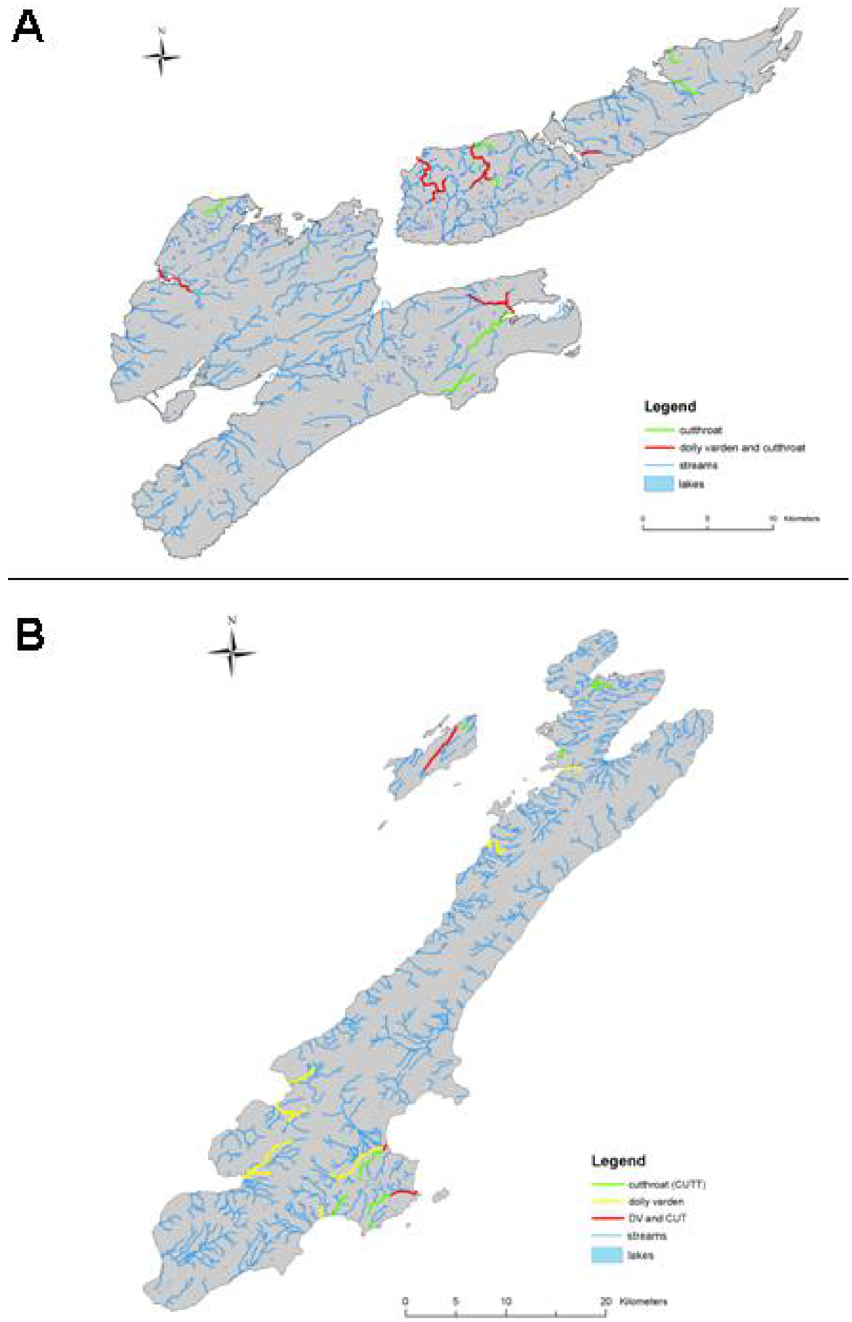


Figure 2.16 - Distribution of cutthroat trout and Dolly Varden on Hawkins and Hinchinbrook Islands (A) and Montague and Green Islands (B) based on current GIS corporate stream layer (USDA FS GIS 2002).

Coastal cutthroat trout are documented in 40 miles of streams in the analysis area (fig. 2.16, USDA Forest Service GIS 2002). However, cutthroat trout may be more widely distributed. Documenting their presence can be difficult because these fish are in relatively small populations that exhibit complex life history strategies. Cutthroat trout populations on Green Island appear to be genetically isolated from those on Hawkins Island due to the distance of open water between these populations (Currens et al. 2003). Makarka and Hawkins Creeks, streams in the Boswell Bay area, and streams on Green Island appear to contain important habitat for cutthroat trout populations (Figs. 2.16 and 2.17, Hepler et al. 1996).

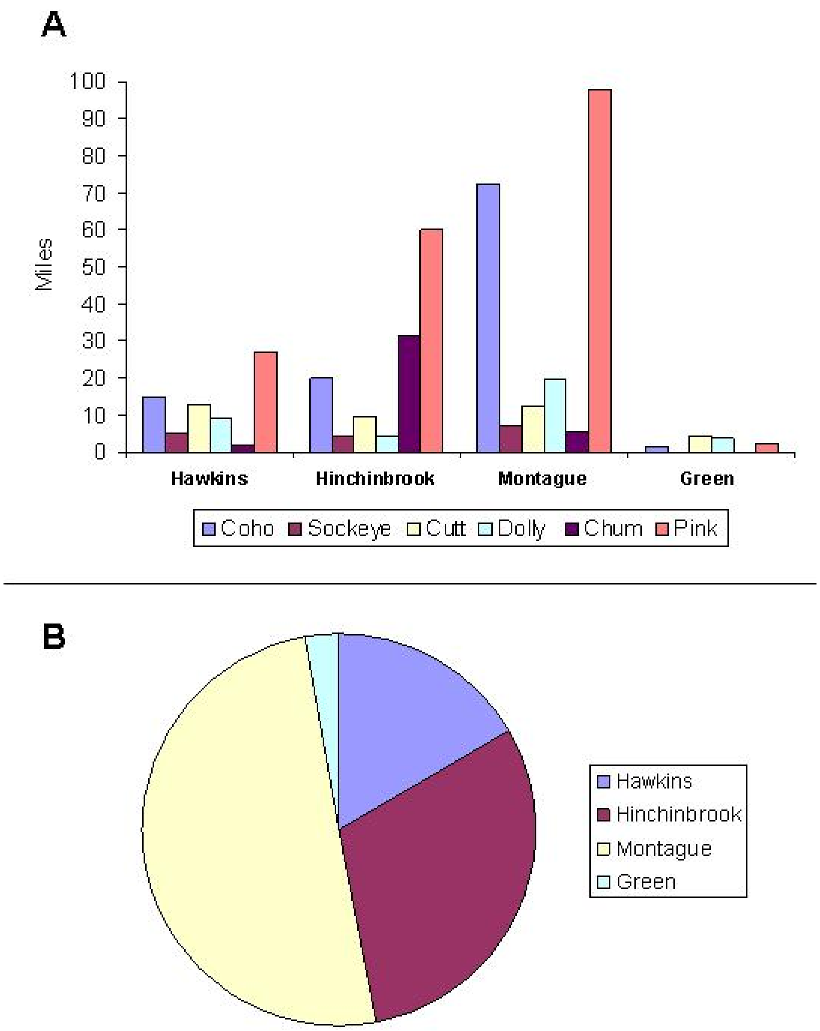


Figure 2.17 - Presence and distribution of selected salmonid species based on the GIS corporate stream layer. (A) shows the species presence in miles of stream for each island. (B) shows the salmonid presence on each island as the percentage of total miles of stream in the analysis area with these species.

Dolly Varden are found on all the islands (Figs. 2.15 and 2.17). They can be found in approximately 37 miles of streams in the analysis area (Figs. 2.16 and 2.17). This species is more widely distributed than shown in the GIS layer. For instance Dolly Varden are currently present in the San Juan River, a large system on the southern tip of Montague Island (Dirk Lang, USDA Forest Service, personal observation). There is a high degree of genetic mixing between anadromous Dolly Varden populations in the analysis area

(Currens et al. 2003). In some systems in the analysis area, Dolly Varden appear to spend winters out in the ocean environment rather than in streams (Bernard et al. 1995). This life history and migration pattern contradicts that documented for Dolly Varden in southeast Alaska (Armstrong and Morrow 1980).

In terms of abundance, chum salmon are second only to pink salmon but according to the current GIS database they are not as widely distributed as some of the other species. Chum salmon are documented in 39 miles of streams (Figs. 2.14 and 2.17). The distribution of chum salmon is underestimated since they are present in many streams on Montague Island that are not shown, including some major streams flowing into MacLeod Harbor, Patton Bay, and along the north shore of the island (ADFG aerial survey data; Bert Lewis, ADFG commercial fish biologist, personal comm.; Dirk Lang, personal obser.). The major chum salmon producing streams include those flowing into Port Etches and Constantine Harbor on Hinchinbrook Island and Port Chalmers and Stockdale Harbor on Montague Island.

Sockeye salmon are the least abundant and least distributed species in the analysis area (figs. 2.15 and 2.17), documented in only 17 miles of stream (USDA Forest Service GIS 2002). These fish are generally associated with lakes because juveniles often rear in lakes for 1 to 3 years before migrating to the ocean as smolts (Groot and Margolis 1991). Fish Lake near Boswell Bay, Stump Lake, and Rocky Bay are systems with sockeye salmon rearing habitats in the analysis area. The Stump Lake and Rocky Bay sockeye populations are small and appear to have smaller body sizes than those in other systems on the Cordova Ranger District (Ken Hodges, Cordova R.D. Fisheries Biologist, personal comm.). Sockeye have also been documented in Patton River, near the confluence with the Nellie Martin River (Dirk Lang, Cordova R.D. Fisheries Biologist, pers. obser.).

The abundance of pink salmon in the analysis area may positively influence other fish populations. Spawning pink salmon are a food and nutrient source for other fishes. Feeding on eggs and carcasses during spawning can lead to increased growth of stream rearing salmonids (Wipfli et al. 2003, Lang 2003). Scouring of streambed gravels during spawning can dislodge benthic invertebrates making them available for fish to consume (Foote and Brown 1998). After spawning, pink salmon die and decompose leaving behind a rich supply of nutrients that are absorbed into the aquatic environment (Wipfli et al. 1999). The abundance of other salmon populations can be related to the number of pink salmon spawning in streams (Michael 1995). In the spring, abundant pink salmon fry migrate to the estuaries and are fed upon by cutthroat trout and Dolly Varden.

Interactions with pink salmon can also negatively influence patterns of salmon abundance. Spawning occurs from mid July into September with the peak usually occurring in August (Gray et al. 2003). Pink salmon run timing can overlap with chum salmon spawning and disrupt the success and survival of chum offspring if the eggs are lost through the superimposition of redds during pink spawning (Groot and Margolis 1991). Chum and pink salmon also may compete for food in juvenile and adult life stages (Beacham and Starr 1982; Groot and Margolis 1991).

Vegetation

Around 14,000 years ago, the glaciers which covered the area began to recede and plants steadily moved in from the south and from glacial refuges in Alaska. Extrapolating from paleoecological evidence (Heusser 1983, Peteet 1986), Sitka spruce[4] and western hemlock forests became established about 3000 years ago.

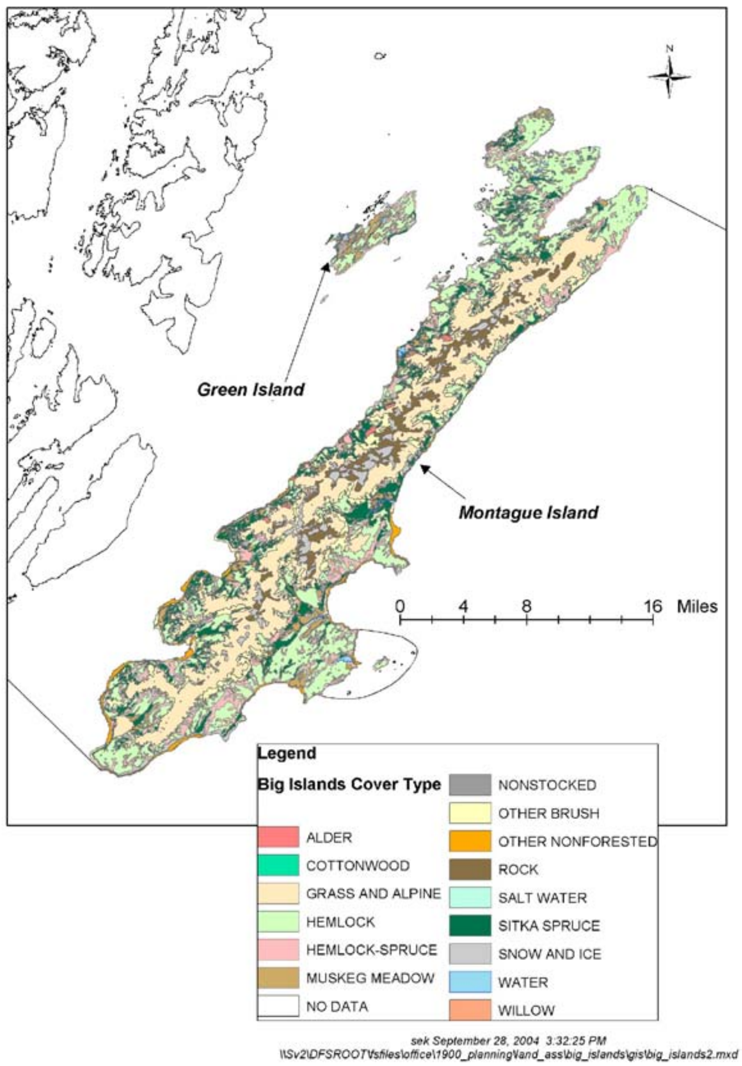


Figure 2.18 - Cover types for Montague, Wooded, and Green Islands area.

Tables 2.4 and 2.5 display the amount of each vegetation cover type by island. This information is based on 1976 data and aerial photo interpretation and has not been updated. For the most part, the vegetation type for private land will show up as acres with "no data" since the information is not in the database. The existing vegetation for Montague and Green islands is displayed in Figure 2.18, and Figure 2.19 displays Hinchinbrook and Hawkins Island vegetation. The cover type in the analysis area ranges from tidelands, marsh, grass, willow, muskeg, needle leaf forests, alpine, rock, snow, and ice. The predominate vegetation from the beach to 1000 feet in elevation consists of

[4] The scientific names for the species listed are provided in Appendix A, Table A.2.

muskeg vegetation intermingled with forested stands ranging from 5 to 400 acres in size. Steeper slopes in the 1000 to 2500-foot elevation range are generally covered with alder and mountain hemlock. Above 2500 feet, alpine meadows predominate.

Table 2.4 - Cover type acres for Montague and Green Islands

Vegetation Type	Montague		Green	
	Acres	Percent of Area	Acres	Percent of Area
Alder	1,172	0.5%	0	
Brush - other	15,002	7.1%	46	0.6%
Cottonwood	50	~%	0	
Grass and Alpine	56,277	26.6%	17	0.2%
Hemlock	60,475	28.6%	3,292	45.6%
Hemlock-Spruce	18,029	8.5%	1,592	22.0%
Sitka Spruce	23,386	11.0%	493	6.8%
Muskeg	7,406	3.5%	1,544	21.4%
Willow	13	~ %	0	
Rock	11,552	5.5%	0	
Snow and Ice	8,045	3.8%	0	
Other Non-Forest	8,552	4.0%	0	
Water	1,590	0.8%	239	3.3%
No Data	2	~%	1	~%
Total Area	211,564	100%	7,224	100%

Table 2.5 - Cover type for Hinchinbrook and Hawkins Islands

Vegetation Type	Hinchinbrook Island		Hawkins Island	
	Acres	Percent of Area	Acres	Percent of Area
Grass and Alpine	5,383	5.0%	312	0.7%
Hemlock	56,335	52.5%	33,371	75.3%
Hemlock-Spruce	18,542	17.3%	6,336	14.3%
Sitka Spruce	0		185	0.4%
Muskeg	4,546	4.2%	3,096	7.0%
Willow	0		0	
Rock	1,700	1.6%	166	0.4%
Snow and Ice	16,050	15.0%	23	~%
Other Non-Forest	3,331	3.1%	82	0.2%
Water	1,331	1.2%	753	1.7%
No Data	2	~%	2	~%
Total Area	107,220	100%	44,326	100%

The characteristic needleleaf forest species include Sitka Spruce, mountain hemlock, and western hemlock. Alaska yellow cedar occurs on Hawkins islands. Tall shrubland dominated by Sitka alder characterize avalanche chutes and beach fringe areas. Understory species common beneath the tree canopies of the forest zone include: early and Alaska blueberry, salmonberry, devil’s club, rusty menziesia, copper bush, yellow skunk cabbage, deer cabbage, Pacific reedgrass, wood fern, foamflower, goldthread, Canada dogwood, splendid feathermoss, and rhytidiadelphus mosses. Characteristic species of the shrublands and herblands include: salmonberry, crowberry, bog blueberry, starry cassiope, Aleutian mountain heather, Luetkea, tall Alaska cotton grass, tufted clubrush, bluejoint reed grass, beach rye, Lygbyei sedge, few-flowered sedge, many-flowered sedge, and sphagnum mosses (USFS 1996a, DeVelice 1999).

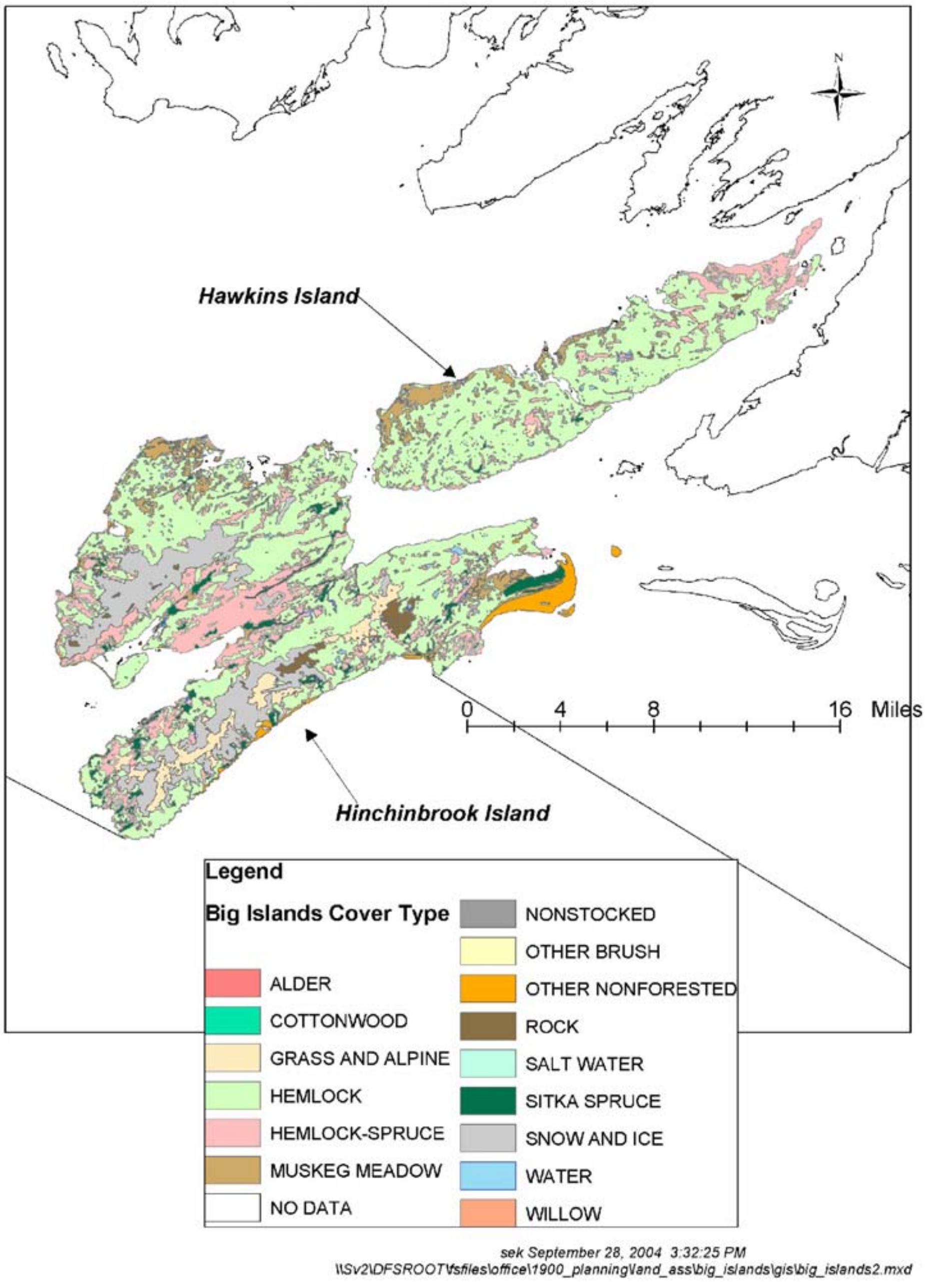


Figure 2.19 - Cover types for Hinchinbrook and Hawkins Islands area

Table A.2, in Appendix A, lists the 272 vascular plant species present within the analysis area documented in the University of Alaska Herbarium database, the Forest Inventory and Analysis plots installed by the Forestry Sciences Lab, or the Eco-plots installed by DeVelice et al in 1999. Included in the list are 4 tree species, 17 tall shrubs, 16 sub or dwarf shrubs, 166 forbs, 48 graminoids, and 21 fern and allies species.

An analysis done in 1989 indicated that 95% of the National Forest productive forest stands in the analysis area were mature to over-mature. These stands were generally well past the age of maturity as evidenced by declining growth rates and presence of dead and dying trees, snags, and down woody material. The stands are characterized by large diameter trees, multi-layered canopies, a range of tree sizes, and the presence of understory vegetation. Net stand volumes averaged 21,000 board feet per acre (BF/ac) and ranged from 8,000 to 40,000 BF/acre. Forty-three percent of the productive forest stands were a mix of hemlock and spruce, 29% were Sitka spruce, and 28% were hemlock and in total contained 1.083 MMBF of sawtimber. (USDA Forest Service 1989)

The remaining 5% of productive forestland supported even-aged stands of young growth hemlock and Sitka spruce that regenerated after timber harvest dating back to 1947 or had seeded in after the uplift from the 1964 earthquake. These stands regenerated naturally and have trees of nearly uniform age and size with a few dead and dying trees and less dead and down woody material than in mature stands. (USDA Forest Service 1989)

Table 2.6 summarizes the known size class for each forest type based on 1976 data and aerial photo interpretation. The data for Montague and Hinchinbrook Islands were updated using the Chugach GIS database in 2004, interpreting aerial photos from 1950s to 1990s, and timber sale records. No ground verification has occurred for a majority of the area. The timber type records only include information for lands that are National Forest System lands.

Table 2.6 - Acres of each size class for forested lands.

Size Class	Green	Hawkins	Hinchinbrook	Montague
Seedling / sapling (0.1 – 4.9")	-	-	45	4,557
Pole size (5-8.9" dbh)	2.7	-	542	3,609
Young growth sawtimber (9.0" dbh or greater & <150 yrs old)	0	194	13	2,131
Mature-Over mature saw timber (9.0" dbh or > & >150 yrs)	4,425	18,246	30,072	60,954

Wildlife

The natural diversity of the area provides habitat for many species. Wildlife populations reflect the pristine vegetation that is present and the remoteness of the area. All native fauna is intact. A few exotics have been introduced, the most widespread being the Sitka black-tailed deer (*Odocoilus hemionus sitkensis*).

Following is a discussion of species of concern to the United States Fish and Wildlife Service (USFWS), ADFG, or the Forest Service, or have other notable issues surrounding them (i.e. hunting, viewing, etc.). Sensitive Species are those plant and animal species identified by the Regional Forester for which population viability is a concern on National Forest System lands within the region. Federally listed threatened and endangered species are those plant and animal species formally listed by the USFWS under authority of the Endangered Species Act of 1973, as amended. ADFG lists Species of Special Concern as any species or subspecies of fish or wildlife or population of mammal or bird native to Alaska that has entered a long-term decline in abundance or is vulnerable to a significant decline due to low numbers, restricted distribution, dependence on limited habitat resources, or sensitivity to environmental disturbance.

The Final Environmental Impact Statement for the Forest Plan outlines important habitat components and conservation options for selected species of concern in Table 3-39 on page 3-230 and lists management indicator species and species of interest in Table 3-50 on page 3-231.

Birds - The Big Islands landscape analysis area includes extensive shoreline, forest, and other habitats ranging from sea level to alpine. Over 219 bird species have been documented within the North Gulf Coast-Prince William Sound Region of Alaska (Isleib and Kessel 1973). The Big Islands contain roughly 483 miles of shoreline habitat, and therefore, are important to many species of shorebirds and sea birds.

The conservation of birds is complex due to the migratory nature of many species. Additionally, bird species fall under various management authorities depending on their population trends and game status. Table 2.7 lists the bird species of the Big Islands analysis area that are a concern for the USFWS, USFS, ADFG, or the National Audubon Society (NAS). Although much of the habitat in the area, and the associated avifauna, is in near pristine conditions, some bird-related issues exist in the area. Following are species or groups of birds meriting special attention in the Big Islands analysis area. Project specific environmental analyses would address how each of these species is affected by management actions.

Table 2.7 - Bird species likely occurring in the Big Islands Analysis Area considered to have special conservation concerns by either the USFWS (T=Threatened Species), USFS (S=Sensitive Species, M= Management Indicator Species, I = Species of Special Interest), ADFG (C= Species of Special Concern), or the NAS (A = Audubon WatchList).

Common Name	Latin Name	Occurrence	Abundance	Conservation Concern
Loons and Cormorants				
Red-throated loon	*Gavia stellata*	Breeds, Winters	Common	A
Yellow-billed loon	*Gavia adamsii*	Winter	Uncommon	A
Waterfowl				
Trumpeter swan	*Cygnus buccinator*	Migrant, breeds, winters	Common	A, S
Canada goose	*Branta canadensis*	Migrant, Breeds	Common	S, M
Brant	*Branta bernicla*	Migrant	Uncommon	A
Long-tailed duck	*Clangula hyemalis*	Winters	Common	A
Black scoter	*Melanitta nigra*	Winters	Uncommon	A
Steller's Eider	*Plysticta stelleri*	Winters	Rare	T, A
Raptors				
Bald Eagle	*Haliaeetus leucocephalus*	Resident	Abundant	I
Peregrine Falcon	*Falco peregrinus*	Breeds, Migrant	Uncommon	A, C, S
Northern goshawk	*Accipiter gentilis*	Breeds, Winters	Common	I
Osprey	*Pandion haliaetus*	Migrant	Uncommon	S
Shorebirds				
Black oystercatcher	*Haematopus bachmani*	Breeds, Winters	Common	A,M
Black turnstone	*Arenaria melanocephala*	Migrant	Common	A
Surfbird	*Aphriza virgata*	Migrant	Common	A
Wandering tattler	*Heteroscelus incanus*	Migrant, Breeds	Uncommon	A
Short-billed dowitcher	*Limnodromus griseus*	Migrant, Breeds	Common	A
American golden plover	*Pluvialis dominica*	Migrant	Uncommon	A
Pacific golden plover	*Pluvialis fulva*	Migrant	Uncommon	A
Whimbrel	*Numenius phaeopus*	Migrant	Common	A

Common Name	Latin Name	Occurrence	Abundance	Conservation Concern
Bar-tailed godwit	*Limosa lapponica*	Migrant	Rare	A
Hudsonian godwit	*Limosa haemastica*	Migrant	Rare	A
Marbled godwit	*Limosa fedoa*	Migrant	Uncommon	A
Rock sandpiper	*Calidris ptilocnemis*	Winters	Uncommon	A
Red knot	*Calidris canutus*	Migrant	Rare	A
Terns and Alcids				
Aleutian Tern	*Sterna aleutica*	Breeds	Uncommon	A
Kittlitz' murrelet	*Brachyramphus brevirostris*	Breeds, Winters	Uncommon	A
Marbled murrelet	*Brachyramphus marmoratus*	Resident	Common	A, I
Flycatchers and Songbirds				
Olive-sided flycatcher	*Contopus cooperi*	Migrant, Breeds	Rare	A, C
Rufous hummingbird	*Selasphorus rufus*	Migrant, Breeds	Common	A
Gray-cheeked thrush	*Catharus minimus*	Breeds	Uncommon	C
Townsend's warbler	*Dendroica townsendi*	Breeds	Common	C, I
Rusty blackbird	*Euphagus carolinus*	Winter, Breeds	Uncommon	A

Trumpeter Swan

Trumpeter swans are a Region 10 sensitive species. In the 1930s, the trumpeter swan populations were severely depleted, with only 69 individuals known to exist and unrecorded flocks existing in Alaska and Canada. The majority of the world's population of trumpeter swans breed in Alaska. Trumpeter swans nest on the Copper River Delta and surrounding wetlands but little suitable nesting habitat exists throughout the Big Island analysis area. Wetlands on the eastern tip of Hinchinbrook Island receive some use by trumpeter swans, but heaviest use occurs during spring and fall migration.

Dusky Canada goose

The dusky Canada goose (*Branta canadensis occidentalis*) is a Region 10 sensitive species. Its breeding range is restricted to the Copper River Delta and wetlands east to Bering Glacier, Prince William Sound, and Middleton Island (Campbell 1990). It winters primarily in the Willamette Valley in Oregon and along the Columbia River in Washington (Comely et al. 1988, Bartonek et al. 1971). Canada geese in the Sound have been found to be genetically distinct from dusky Canada geese and therefore, do not have the same conservation concerns. Because of their morphological similarities to dusky Canada geese; however, their harvest is strictly regulated near their wintering grounds in Oregon. Canada geese nest on small islands and shorelines of the Sound, but little is known of nesting densities or productivity. They also use the uplands of the islands, but little is known about the frequency of use or nesting density in these habitats. Beginning in 2005, Cordova Ranger District will inventory overwintering geese in the Sound. Currently, it is thought that most overwintering geese are found at the mouths of mainland rivers and not on the islands.

Steller's Eider

The Steller's Eider is a Threatened species listed by the USFWS and on the Audubon WatchList (National Audubon Society 2002). It is a rare winter visitor along the North Gulf Coast and in Prince William Sound (Isleib and Kessel 1973), normally wintering in coastal waters well to the west of the Sound. It breeds along the western and northern coasts of Alaska. In the analysis area, it has been observed in Double Bay (Isleib and Kessel 1973) and Rocky Bay (Milo Burcham, USDA Forest Service, personal obs.).

Threats to this species in North America are not well known. Actions on Chugach National Forest System lands would have little effect on this species, due to the marine habitats it uses in winter and the small numbers of this species within the Sound.

Seabirds

Many seabird colonies exist along the shorelines of the analysis area including nesting tufted puffins (*Fratercula cirrhata*), horned puffins (*Fratercula corniculata*), double-crested cormorants (*Phalacrocorax auritus*), pelagic cormorants (*Phalacrocorax pelagicus*), red-faced cormorants (*Phalacrocorax urile*), common murres (*Uria aalge*), parakeet auklets (*Aethia psittacula*), pigeon guillemots (*Cepphus columba*), fork-tailed storm petrels (*Oceanodroma furcata*), Leach's storm petrels (*Oceanodroma leucorhoa*), arctic terns (*Sterna paradisaea*), black-legged kittiwakes (*Rissa tridactyla*), glaucous-winged gulls (*Larus glaucescens*) and mew gulls (*Larus canus*) (fig. 2.20). These species generally nest in areas that are safe from mammalian predators such as small islands and cliffs. Some excavate underground burrows, such as puffins and auklets. Cormorants, kittiwakes, and murres generally prefer cliffs. Mew and glaucous-winged gulls will nest on the ground in habitats ranging from dunes and marsh to rock outcrop islands. Recent counts of seabirds in these colonies are provided in Table 2.8.

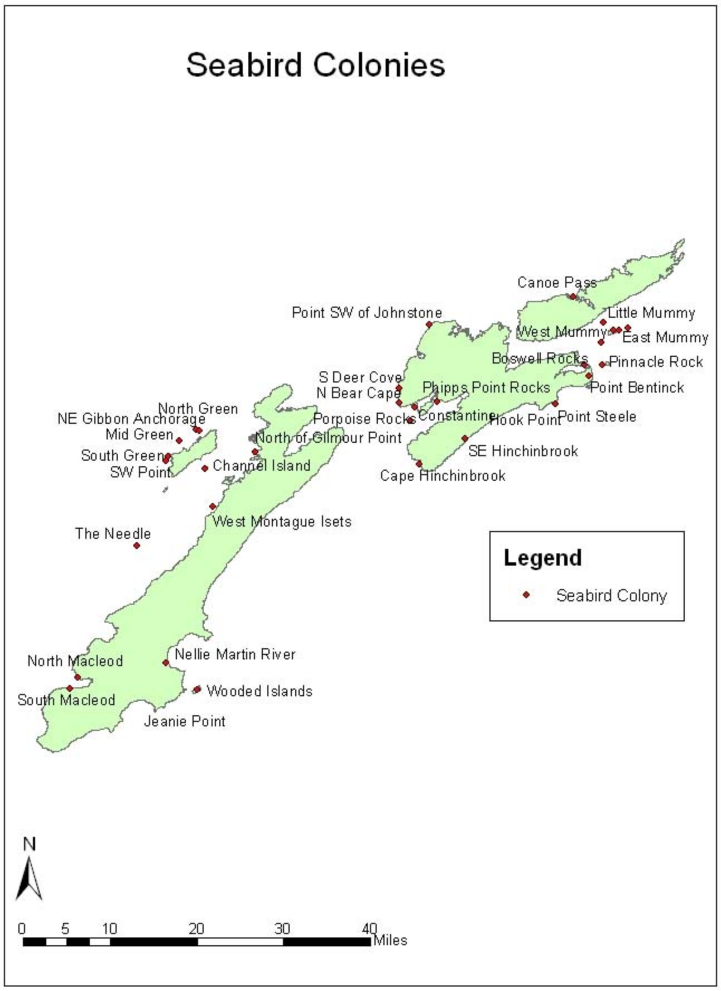


Figure 2.20 - Map of seabird colonies in the Big Islands landscape analysis area.

These species are all sensitive to disturbance during the nesting season and particularly vulnerable to introductions of mammalian predators such including rodents, canids, felids, and mustelids. The Forest Plan states that human activities may be restricted from known seabird colonies during the sensitive seasons, consistent with the Migratory Bird Treaty Act. Specific requirements would be determined in cooperation with the USFWS during project analysis.

Table 2.8 - Seabird counts at colonies in the Big Islands Analysis Area (USFWS 2000).

	Fork-tailed Storm Petrel	Leach's Storm Petrel	Double-crested Cormorant	Pelagic Cormorant	Red-faced Cormorant	Black Oystercatcher	Mew Gull	Glaucous-winged Gull	Black-legged Kittiwake	Arctic Tern	Common Murre	Pigeon Guillemot	Parakeet Auklet	Tufted Puffin	Horned Puffin
Green Island															
Channel Island						4	2			120		21		6	
South Green												16		20	10
North Green									44						
Mid Green										11					
NE Gibbon Anchorage												12			
SW Point												17			
Hinchinbrook I.															
C. Hinchinbrook				56				42				40		30	2
S.E. Hinchinbrook			6	128				50				200		2000	106
Hook Point			4					91	0			10			
Phipps Pt. Rocks														60	
Point Steele			4					4	104			2			
Boswell Rocks			52	56				7	1800			6		60	
Point Bentinck								0		0					
Constantine Harbor						14				112		0			
"N of" Bear Cape												14			
"S of" Deer Cove												24			
"Pt SW of" Johnstone Point												12			
Montague I.															
Neck Point														100	10
Jeanie Point								20						100	10
Nellie Martin R.										200					
N MacLeod Harbor												13			
S MacLeod Harbor												8			
W. Montague Islets												8			
N of Gilmour Pt												4			
East Mummy I.												40			
West Mummy I.												40			
Little Mummy I.												80			
Pinnacle Rocks						2		246	832					12	4
Porpoise Rocks								86	4234		1500			3000	12
The Needle								3	314						
Wooded Islands	2060	400	8	44	4	6		150	2350		80	100	25	9600	30

Seabird populations were directly affected by the *Exxon Valdez* oil spill, and collectively, have not recovered. Cormorants and pigeon guillemots have not recovered, marbled murrelets and common loons (*Gavia immer*) are recovering, while common murres are considered to be recovered. Not enough data exists to determine the effect of the spill on Kittlitz's murrelet (EVOS Trustee Council 2002).

Kittlitz's murrelet

The USFWS published a revised list of Candidate Species in the Federal Register on May 4, 2004. A Candidate Species is a species for which the USFWS has sufficient information to propose listing as endangered or threatened, but for which preparation and publication of a proposal is precluded by higher-priority listing actions. This list now includes Kittlitz's murrelet, a small diving seabird, that inhabits Alaskan coast waters discontinuously from Point Lay south to northern portions of Southeast Alaska and appears to be in significant population decline. The Forest Service Alaska Region plans a thorough review of the Regional Sensitive Species and anticipates adding the Kittlitz's murrelet to the list.

The Kittlitz's murrelet is an uncommon and secretive breeder; only about 2 dozen nest records exist (Day et al. 1999). All of the North American and most of the world population of Kittlitz's murrelets breed, molt, and winter in Alaska. During the breeding season, the distribution is highly clumped within its geographic range (Isleib and Kessel 1973), with birds congregating near tidewater glaciers, and to a lesser extent, offshore of remnant high-elevation glaciers and deglaciated coastal mountains (Day et al. 1999, Day and Nigro 1999). The literature indicates that this species nests in unvegetated scree fields, coastal cliffs, barren ground, rock ledges, and talus above timberline in coastal mountains, generally in the vicinity of glaciers, cirques near glaciers, or recently glaciated areas, primarily from the Alaska Peninsula to Glacier Bay (Day et al. 1999, Day et al. 1983, Day 1995, Piatt et al. 1999). During the non-breeding season, the marine distribution of Kittlitz's murrelets is farther offshore. In winter, few Kittlitz's murrelets occur in the protected waters of Prince William Sound, Kenai Fjords, Kachemak Bay, and Sitka Sound (Kendall and Agler 1998, Day et al. 1999). Little data exists about Kittlitz's murrelet use of the analysis area, although the area probably does not provide suitable nesting habitat.

Marbled Murrelet

The marbled murrelet is a USFS species of special management interest and on the Audubon WatchList (National Audubon Society 2002). Murrelets are a small seabird which feeds on small fish and invertebrates and nests in trees. Throughout much of its range in the Pacific Northwest, British Columbia, and Alaska, the marbled murrelet nests in large, mature, coniferous trees in structurally complex, coastal old growth stands.

Marbled murrelets are numerous and widespread throughout the coastal waters of Alaska with estimates of 100,000 occurring in the Sound (Kuletz 1997). Population trends within the Chugach National Forest have been downward, with a 67% decline since surveys were initiated in 1972; however, populations have been stable since 1990 (Kuletz 1990). Possible causes of murrelet declines include oil spills, mortality from gill netting, cyclical changes in marine productivity, and the harvesting of old-growth forest. Suitable nesting habitat for marbled murrelets exists in forest stands throughout the analysis area and around the perimeter of the Sound, and most has been little modified by humans.

Undoubtedly, logging on Montague Island has reduced nesting habitat, although logging is not widespread in the analysis area and is not expected to be in the future.

Shorebirds

Millions of shorebirds use the Sound and the Copper River Delta during migration and many species nest in the area. Black oystercatchers are considered a Management Indicator Species on the Chugach National Forest and many species of shorebirds appear on the Audubon WatchList. The Forest Plan recommends locating human activities to avoid disturbance of known shorebird intertidal concentration or nesting areas as follows: provide a minimum distance of 330 feet from human activities on the ground from shorebird intertidal concentration or nesting areas (including black oystercatchers). Forest vegetation within these zones is considered to be unsuitable for timber production.

The Big Islands analysis area contains the western extent of the Copper River Delta, and therefore, plays a role as a spring migration staging area for 4-6 million western sandpipers, dunlins, and other shorebirds(Bishop et al. 2000). Mud flats from the delta extend from Strawberry Entrance to Boswell Bay and Orca Inlet, through the Hawkins Island Cutoff to the Middle Ground Shoal. Least sandpipers (*C. minutilla*), pectoral sandpipers (*C. melanotos*), lesser yellowlegs (*Tringa flavipes*), short (*Limnodromus griseus)* and long-billed dowitchers (*L. scolopaceus*), marbled godwits, red knots (*C. canutus*), black-bellied plovers (*Pluvialis squatarola*), Pacific and American golden plovers (*P. dominica*), and many other species use this area during migration. These birds use the mudflats as critical feeding areas to replenish their fat reserves during the long migration to breeding grounds.

Another significant shorebird staging area is located on the northern tip of Montague Island. Here, large numbers of surfbirds (*Aphriza virgata*) and black turnstones (*Arenaria melanocephala*) stage in late April and early May (Norton et al. 1990). The area is used for feeding and resting just prior to departing for sub arctic and arctic breeding grounds. This end of Montague Island may provide critical intertidal habitat for both species and significant fractions of each species populations use this restricted habitat. Roe of pacific herring (*Clupea pallasi*) deposited in the intertidal zone is available to predators for about 2 weeks annually (Bishop and Green 1999). Large numbers of other avian predators, including glaucous–winged gulls, mew gulls, surf scoters (*Melanitta perspicillata*), white-winged scoters (*Melanitta fusca*), and bald eagles (*Haliaeetus leucocephalus*) are also attracted to this Spring event.

Black oystercatchers nest within the area at high densities. Relatively high densities of oystercatcher nests occur on Montague Island as compared to nearby mainland shorelines in the Sound. The locations of many nests, on low gradient gravel beaches, make them particularly vulnerable to disturbance by recreationists.

Human activity in the Sound is increasing at a rapid rate, largely due to better access from Anchorage via the Whittier tunnel. Much of this activity takes place in shoreline habitat where black oystercatchers nest. The Cordova Ranger District began shoreline surveys for black oystercatchers in the Sound in 1999. During these surveys, locations of all water birds, with an emphasis on black oystercatchers, are recorded. In subsequent years the District has surveyed the mainland shoreline from Red Head to Galena Bay, much of the Montague Island, and parts of eastern Prince William Sound. To date, the shoreline of Montague Island is the only portion of the Big Islands analysis area surveyed. Shorelines of Hinchinbrook, Hawkins, Green, and smaller islands of the analysis area will be surveyed in the future.

Northern Goshawk

The northern goshawk is a Region 10 sensitive species and is the largest North American accipiter. It is a forest habitat generalist, breeding in coniferous, deciduous, and mixed forests across its holarctic range (Reynolds et al. 1992). The species is considered a non-migratory resident in the Prince William Sound area and is a fairly common resident of the North Gulf Coast and the Sound (Isleib and Kessel 1973). No goshawks nests are known in the analysis area; however, they likely occur in the appropriate forest habitats.

While goshawks occur in a variety of forest successional stages, it is believed that nesting birds are most commonly associated with mature forests (Crocker-Bedford 1993, Titus et al. 1994, Titus 1996). Preferred habitat during the breeding season is mature and old growth forest with structural characteristics that allow goshawks to maneuver in and below the canopy while foraging and large trees for nesting (Reynolds et al. 1992). In Alaska, goshawks are most often associated with old growth forests (McGowan 1975, Crocker-Bedford 1993, Titus 1996).

Due to concerns about population declines, the northern goshawk is currently a species of management concern for the USFWS. Species of management concern are those species for which there is some evidence of vulnerability but not enough data to consider a listing proposal under the Endangered Species Act of 1973. In general, goshawk population declines may be associated with forest harvest activities and habitat loss associated with roads (Bosakowski and Speiser 1994, Bright-Smith and Mannan 1994).

Bald eagle

The bald eagle is an abundant and conspicuous resident of the North Gulf Coast and Prince William Sound region (Isleib and Kessel 1973). The analysis area has almost 500 miles of shoreline and a relatively high density of nesting bald eagles (fig. 2.21). Bald eagles are year-round residents using old growth timber (spruce hemlock, cottonwood) for nest sites, and feeding in streams, lakes, and marine waters. Salmon spawning in streams can concentrate large numbers of eagles. The bald eagle is a species of special concern on the Chugach National Forest. The USFWS and USFS maintain an interagency agreement for bald eagle habitat management in the Alaska Region, which includes standards and guidelines for regulating human disturbance within identified bald eagle use areas. The minimum retention zone is 330 feet around known eagle nest locations. The active bald eagle nesting season is generally from March 1 to August 31.

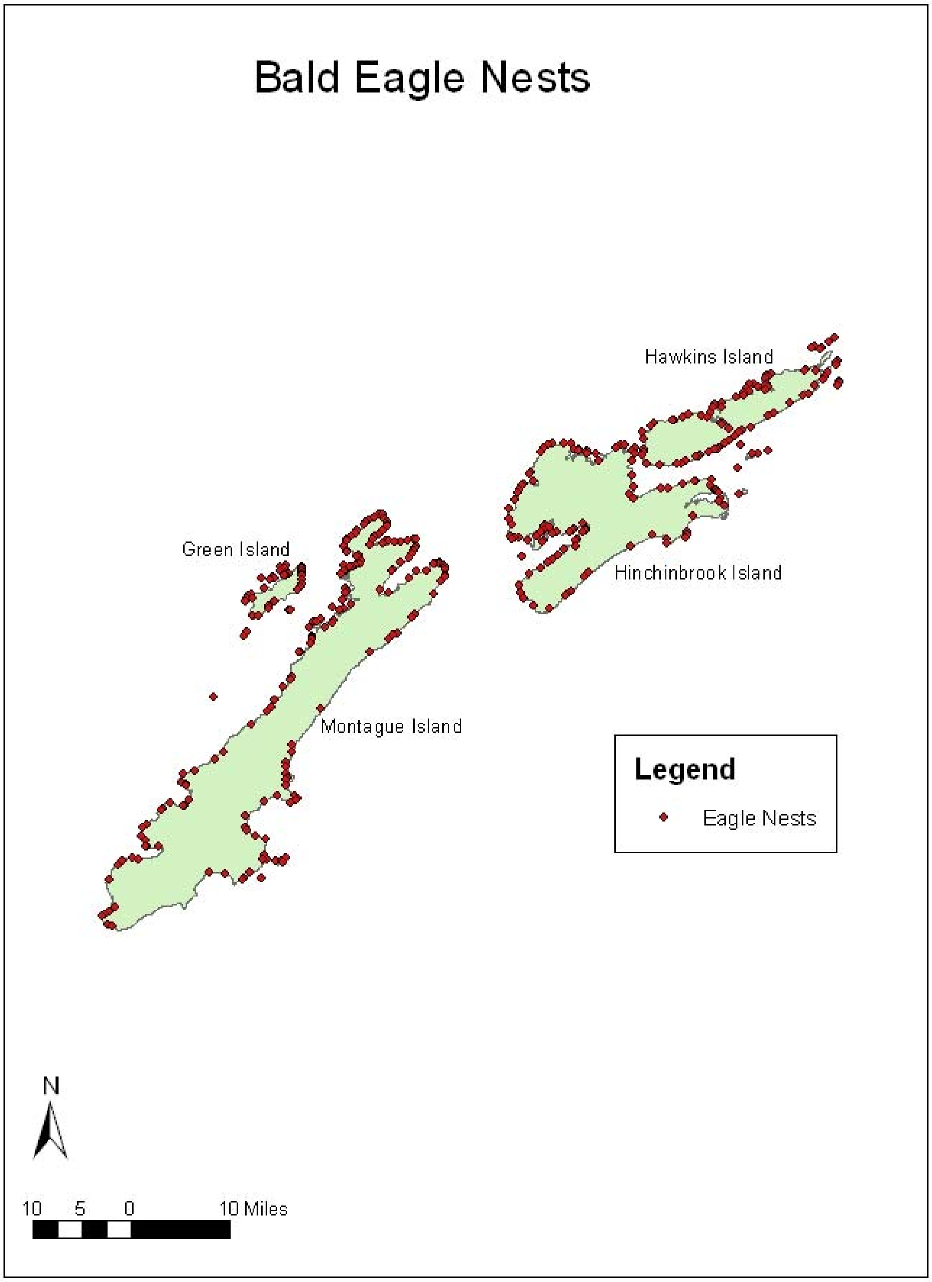


Figure 2.21 - Locations of active and inactive bald eagle nests within the Big Islands analysis area.

Osprey

The osprey is a Region 10 sensitive species. It is an uncommon migrant and rare local breeder in the North Gulf Coast-Prince William Sound region (Isleib and Kessel 1973). No osprey nests are known in the Prince William Sound area. It has probably always been uncommon in southcentral Alaska.

Peregrine falcon

The Peale's subspecies of peregrine falcon (*F. p. pealei*) is a Region 10 sensitive species. Other subspecies of the peregrine falcon, which may use the analysis area in migration, appear on the Audubon WatchList or are considered species of concern by ADFG

(National Audubon Society 2002). The peregrine falcon is a rare resident of the North Gulf Coast and Prince William Sound region. Most birds in the region appear to be F. p. pealei, but some migrants and one winter observation appeared to be the rare F. p. anatum (Isleib and Kessel 1973).

During spring migration, peregrines appear most frequently between April 15 and May 5. Twelve to 20 pairs breed along the North Gulf Coast (Isleib and Kessel 1973). Eyries are on or in view of the coast and are generally associated with nesting seabird colonies or waterfowl breeding areas. Peregrine eyries have been documented on the east side of Hawkins Island, Boswell Bay on Hinchinbrook Island, and several locations on Montague Island. Other eyries likely exist within the analysis area.

Rufous Hummingbird

The rufous hummingbird is a National Audubon WatchList species, which means that their populations have shown a declining trend (National Audubon Society 2002). They are common breeders and migrants in the North Gulf Coast and Prince William Sound region (Isleib and Kessel 1973). Few data exists from the analysis area, however they are common inhabitants of the nearby mainland, so are likely common throughout the Big Islands analysis area.

Olive-sided flycatcher

The olive-sided flycatcher is a considered a species of special concern by the ADFG and is on the Audubon WatchList (National Audubon Society 2002). They are considered rare within the Sound (Isleib and Kessel 1973), although they have been seen near Cordova during migration. Olive-sided flycatchers breed in interior Alaska, and breeding pairs could occur in forested portions of the analysis area. They have been reported during breeding season on Hawkins Island (Milo Burcham, USDA Forest Service, personal observation).

Townsend's warbler

The Townsend's warbler is a considered a species of special concern by the ADFG and is a species of special interest on the Chugach National Forest. It is a common, migratory breeder throughout southcentral Alaska. They usually arrive from mid-May through early June and leave Alaska in August (Isleib and Kessel 1973). Townsend's warblers likely inhabit spruce-hemlock/alder forest, spruce-hemlock forest, and alder habitats within the analysis area. (Lance et al. 1996).

Gray-cheeked Thrush

The Gray-cheeked thrush is a considered a species of special concern by ADFG. Isleib and Kessel (1973) state that this thrush is a rare migrant and rare local breeder in the Prince William Sound-North Gulf Coast region. Breeding Bird Survey data show this species to be fairly common east of mile 30 of the Copper River Highway. Although it may be found within the analysis area, appropriate habitat is limited.

Mammals - The Big Islands analysis area is predominantly a mosaic of forest and muskeg, but includes shoreline, alpine areas, and isolated rock island habitats. No comprehensive mammal list for the analysis area exists. Two mammal species in or near the analysis area are listed as endangered by the USFWS: the humpback whale (*Megaptera novaeangliae*) occurs strictly in marine waters, while the Steller sea lion (*Eumetopias jubata*) occurs in marine waters but has haul-out sites on Chugach National Forest lands. Two rodents, the Montague Island vole (*Microtus oeconomus elymocetes*) and Montague Island Hoary marmot (*Marmota caligata sheldoni*) are known to occur only on Montague Island and have special management status on the Chugach National Forest as a sensitive species and species of special interest, respectively. Sitka black-tailed deer were introduced to the Sound. European rabbit (*Oryctolagus cuniculus*) may have been introduced to south Montague Island, although their status is unknown. Although much of the habitat and the associated mammal species are in near pristine conditions, some mammal related issues exist in the analysis area. Following are species meriting special attention this analysis area.

Brown bear

Brown bears (*Ursus arctos*) are common on Hinchinbrook, Hawkins, and Montague Islands. In fact, the distribution of brown bears in Prince William Sound appears unchanged from that observed by Heller (1910). In the spring, avalanche paths and tidal grass flats are important sources of herbaceous vegetation. Bears use berry patches during summer, and salmon streams are important to bears during summer and fall. Stranded marine mammals such as gray whales (*Eschrichtius robustus*), humpback whales, and others, occur annually and provide infrequent feeding opportunities for brown bears along shorelines. In this area, the Forest Plan recommends that the forest cover approximately 750 feet around important bear feeding areas or between areas used by bears and humans be managed for brown bear habitat. Within the 750-foot brown bear management zone, new road construction and vegetation management not intended to maintain or improve brown bear habitat is not allowed.

High brown bear densities occur on Hinchinbrook Island, while populations on Hawkins and Montague Islands are more comparable to mainland densities in other part of Game Management Unit 6 (GMU 6). For the years between 1997 and 2002, ADFG estimated 90-100 bears on Hinchinbrook, 19 bears on Hawkins Island, and 50-75 bears on Montague Island (Crowley 2003). The bear population on Montague Island is recovering from excessive harvest that occurred during the 1970s and 80s. Currently 5 outfitter guides are permitted to hunt brown bears within the analysis area. Bears feeding at salmon streams and on shoreline vegetation represent viewing opportunities for ecotourism.

Brown bear hunting season in Prince William Sound (GMU 6D) is from October 15 through May 25. Residents and nonresidents may take one brown bear every four regulatory years. The fall hunting season on Montague was closed in 1989 and the spring season was closed in 1994. A limited fall hunt was resumed in 2003, allowing a total harvest of 4 bears. Montague Island is open from October 15 through November 30 to Alaska residents only.

Sitka black-tailed deer

Sitka black-tailed deer, Figure 2.22, is a species of special management interest for the Chugach National Forest and is important to both sport and subsistence hunters. They are indigenous to the coastal regions of Southeast Alaska and northwest British Columbia. They were introduced to Hinchinbrook and Hawkins Islands from Sitka in 1916 with later supplemental stockings prior to 1925 (Burris and McKnight 1973). At least 24 deer were released on Hawkins and Hinchinbrook islands. Sitka black–tailed deer spread throughout Prince William Sound and the mainland and peaked in population numbers by 1945 (Greise and Becker 1988). Highest densities occur on Hawkins, Hinchinbrook, and Montague. Deer are at the northern limit of their range in Prince William Sound and populations on the islands have reached higher densities than on the nearby mainland. The climate is milder on the islands compared to the surrounding mainland because of a strong maritime influence. Snow intercept by tree canopies in mature forests provide accessible forage and shelter during winter (Shishido 1986, Reynolds 1979).

Figure 2.22 - Sitka black-tailed deer at Beach River, Montague Island.

Deer forage at higher elevations including the alpine, when snow does not bury forage plants making them unavailable. Old-growth forests have the highest value during winter because they intercept snow and provide access to understory forage plants. Snow depths greater than 2 feet push the deer to lower elevations; in some winters, down to the beach fringe where snow accumulation is reduced or absent. Key deer winter range consists of uneven-aged climax conifer stands with enough gaps in the canopy to allow the understory shrub growth necessary for forage production (Shishido 1986).

Sitka black-tailed deer have been hunted in the Prince William Sound area since 1935 and are the big game species with the highest sport and subsistence hunting use in the State of Alaska. Population trends are monitored cooperatively by the USFS and ADFG. Pellet transects are conducted at several locations on Hawkins, Hinchinbrook, and Montague Islands, as well as on Knight and Naked Islands (Figure 2.23).

The five-year trend for Sitka black-tailed deer harvest in the Prince William Sound area has been upward, with the highest harvest coming from Montague Island (ADFG 2001, 1999a). Due to consecutive mild winters, Sitka black-tailed deer numbers in the Prince William Sound area are considered to be moderate to high, and show a general trend of increase. Severe winters occasionally reduce populations (ADFG 1999b). Currently, state bag limits in GMU 6 allows the harvest of 5 deer by state residents. Hunting begins on August 1 and ends on December 31. Does may be harvested after October 1.

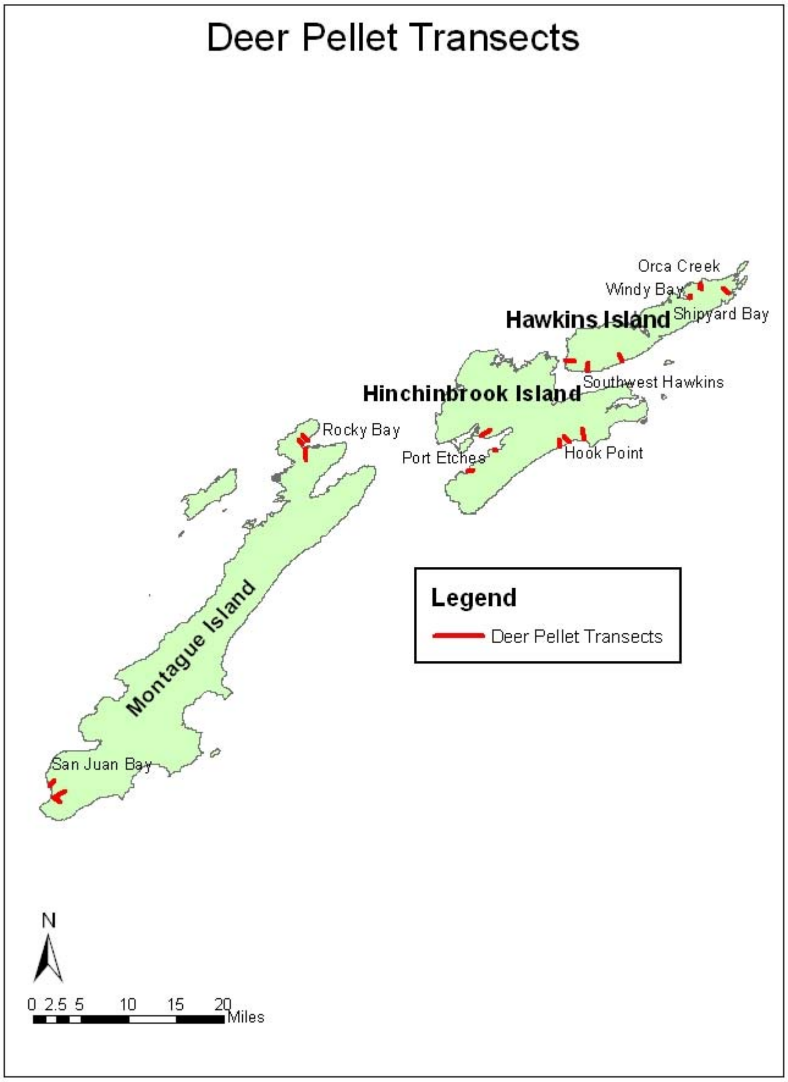


Figure 2.23 - Locations of deer pellet transects on Montague, Hinchinbrook, and Hawkins Islands.

Montague Island hoary marmot

Montague Island hoary marmot is a species of special interest on the Chugach National forest. They were first described during the early 1900s, and have rarely been documented since. These endemic marmots were first reported by Heller (1910) in alpine habitat near timberline at Hanning and Zaikof Bays. No other sightings of the marmot were recorded until 1978-79 when one was seen on talus slopes along the northeastern coast. Presently, the Montague Island hoary marmot is not provided any protective status. It is currently classified S2S3 by the Natural Heritage Program because it is endemic, found only on one island. The population size and trends are unknown, as are the effects of past commercial timber harvest (Lance 1999a). Based on their limited, known distribution and questionable taxonomic status, Montague Island hoary marmots are a population of concern.

Marmots generally occupy open habitats such as alpine meadows and forest edge. Hoary marmots occur at high elevations, near timberline, on talus slopes, and alpine meadows (Lee and Funderburg 1982), however, on nearby Hinchinbrook Island, they are also found at sea level in sand dune and tidal grass flat habitats (Milo Burcham, Cordova RD Wildlife Biologist, pers. obs.). Marmots feed mainly on green vegetation, especially grasses and forbs, but may also feed on fruit, grain, legumes, and occasionally insects (Nowack 1991). Naturally occurring predators on Montague Island include raptors, brown bears, and river otters. In addition, mink were introduced to Montague Island in the early 1950s and are present today at unknown densities (Burris and McKnight 1973). Grizzly bears are known to feed on marmots, putting forth great efforts to dig them out of their dens (Bansfield 1974). Predation by bears may occur in spring prior to the time of the first salmon runs.

Because no current information exists regarding population levels or even persistence of this endemic population, there is some level of concern. Past road building for timber activities may have adversely affected talus slope habitats. Alpine habitats have not been affected (Lance 1999a).

Montague Island tundra vole

The Montague Island tundra vole is a subspecies of the widely distributed tundra vole (*M. oeconomus*), is listed as a Sensitive Species in the Chugach Forest Plan. Montague Island voles are most frequently found in beach fringe zones consisting of beach rye and beach pea (Weintraub and Cook 1995). They have also been captured in wet muskeg and subalpine meadows and have been reported in every vegetation type from shoreline to alpine, including forest.

Montague Island tundra vole were first collected from Montague Island, Prince William Sound, Alaska, and described as a new subspecies, Microtus oeconomus elymocetes, by Osgood in 1906 (Lance 1999b). This subspecies is known only from Montague Island. This species is rated by the Nature Conservancy, Alaska Natural Heritage Program, as G5T2/S2, a population of highly ecological concern both at the state and national levels. This vole occurs throughout Montague Island, and has been recorded from shoreline to alpine (Heller 1910, Lance 1999b, Lance and Cook 1995). High populations of Microtus are typically associated with early stages of plant succession (Rose and Birney 1985), when grasses and woody perennials dominate the plant community (Wetzel 1958). Montague Island tundra voles have most frequently been found in beach fringe zones, and are often found in association with riparian vegetation such as skunk cabbage (Weintraub and Cook 1992). Historically they have been reported in every vegetation type from shoreline to alpine, including forest (Heller 1910). Currently, there are no data available on population estimates for the Montague Island tundra vole. Other populations of Microtus fluctuate cyclically with a roughly 3-year periodicity, and highs for one period are not necessarily similar to highs in another period. There is no reason to believe that Montague Island tundra vole does not experience large fluctuations in population numbers, and may exhibit population cycles as do other microtines. The USFWS recommended further investigation of population trends prior to adopting further land use practices on Montague Island (Lance and Cook 1995).

Factors that limit Montague Island voles are unknown. Loss of habitat, predation, and disease may contribute to fluctuations in populations of this species. Timber harvest and road construction would have a direct effect on tundra vole habitat. Use of OHV's could indirectly influence the habitat for this species, especially through winter operations in the beach fringe habitats (Lance 1999b).

Timber harvest, road construction, or construction of developed facilities would pose the greatest direct effect on tundra vole habitat on Montague Island. Activities that directly remove tundra vole habitat, such as road construction or developed facilities, would remove a small amount of habitat from the overall available habitat base of about 304 square miles, but the collateral disturbance at the road's edges or near developed facilities would provide some preferred early seral habitat. The tundra vole is a habitat generalist, and none of its habitat is in short supply. However, some types appear to be preferred over others such as beach fringe. Forest-wide standards and guidelines for riparian areas limit disturbance to the preferred habitat, and none of the Chugach National Forest's management or permitted activities have the potential to adversely affect the viability of the Montague Island tundra vole population or its habitat.

Rabbits

There are reports of rabbits, probably European rabbit, having been released on Montague Island near San Juan Bay. Whether or not a population has been established is unknown, however, there is a report from the visitor log at the San Juan Bay Cabin of a rabbit sighting in 2002 (Dana Smyke, Cordova RD, pers. comm.). Rabbits have the potential to reproduce rapidly and devastate vegetation communities on small, grass dominated islands. European rabbits introduced to Middleton Island in the early 1950s have attained numbers in the thousands.

Sea Otter

The sea otter (*Enhydra lutris*) is a conspicuous resident of the Sound, popular with visitors to the area and harvested by natives under the Marine Mammal Act of 1972. By the late 1800s sea otters had been eliminated from most of their historical range in Alaska due to excessive harvesting by fur traders. Surveys in the 1970s and 80s, however, indicated expanding populations in Alaska including the Sound (EVOS Trustee Council 2002). The area around Green Island served as a refugia for sea otters during the period of heavy harvest. This remnant population of otters is thought to have been the source of animals repopulating Prince William Sound.

Approximately 1,000 sea otter carcasses were recovered following the *Exxon Valdez* oil spill in 1989 and additional animals likely died that were not recovered (EVOS Trustee Council 2002). Sea otters are considered as recovering in all but the portions of the Sound that received the greatest amounts of oil.

Steller sea lion

The Steller sea lion, Figure 2.24, is listed as Endangered by the USFWS and is a species of special concern for ADFG. Although the eastern population has remained stable at an estimated 39,000 for the last few years, the western population of Steller sea lions has been declining rapidly, from an estimated total of 227,000 in 1960 to 45-46,000 in 2000 (Sease and Gudmundson 2002). In 1997 the U.S. population of the Steller sea lion west of 144ºW (Cape Suckling, Alaska) was reclassified as Endangered under the Endangered Species Act, the remainder of the population remaining classified as Threatened, a status it has held since 1990.

Figure 2.24 - Steller sea lions at the Needles. Photo by Milo Burcham

Steller sea lion habitat includes marine and terrestrial areas that are used for a variety of purposes. Sea lions use haul outs on suitable beaches or rock outcrops. Adults also congregate on rookeries for pupping and breeding. Rookeries are generally located on relatively remote islands, often in exposed areas where access by humans and mammalian predators is difficult. Steller sea lions eat a variety of fish and invertebrates.

Steller sea lions inhabit the Gulf of Alaska and Prince William Sound. Seal Rock (just offshore of Hinchinbrook Entrance and outside the analysis area) and Fish Island represent important sea lion rookeries. The Needle, Cape Hinchinbrook, and Hook Point are sea lion haulouts and considered critical habitat by National Marine Fisheries Service. Numbers of sea lions have generally declined from counts made in the 1970s and 80s (Table 2.9). Large numbers of sea lions gather in the waters off the northern tip of Montague Island as schools of herring concentrate during winter and spring when spawning.

None of the factors thought to have caused Steller sea lion declines are under the jurisdiction of the Forest Service. The National Marine Fisheries Service has promulgated regulations (50CFR 226.12(a)) for the protection of the Stellar sea lion critical habitats which are applicable to National Forest management. Accordingly, implementing the Forest Plan will not allow any adverse effect on the Steller sea lion or its habitat.

Table 2.9 - Trend counts of Steller sea lions using haulouts and rookeries within and near the Big Islands landscape analysis area (Sease and Gudmundson 2002).

Year	Cape Hinchinbrook	Hook Point	Seal Rocks	The Needle	Wooded (Fish)
1976			1709	537	878
1978			2463		
1979			2961		
1989			2159	668	1333
1990	76		1471	926	1232
1991	163		1220	430	1350
1992	204	608	1042	312	1410
1994	110	154	636	260	648
1996	245	30	544	126	502
1998			730		330
1999	15	2	624	127	311
2000	106	60	820	126	408
2002	107	258	768	115	396
2004	496	96	841	123	523

Harbor seal

The harbor seal (*Phoca vitulina*) is listed as a species of special concern by ADFG. It is found along the Alaskan coast Alaska from British Columbia north to Kuskokwim Bay and west throughout the Aleutian Islands. Harbor seals haul out of the water periodically to rest, give birth, and nurse their pups. Reefs, sand and gravel beaches, sand and mud bars, and glacial and sea ice are commonly used for hauling sites. Harbor seals are sometimes found in rivers and lakes.

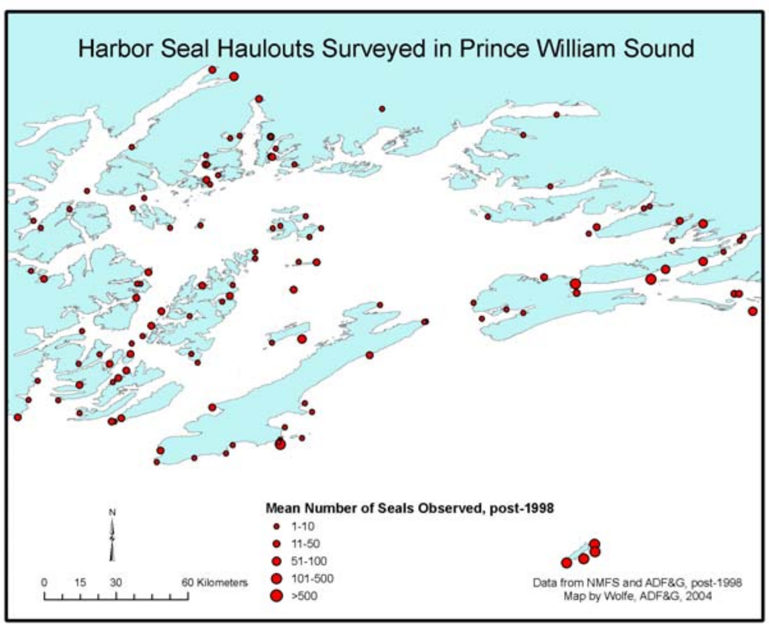


Figure 2.25 - Map of harbor seal haulouts within Prince William Sound.

Harbor seals declined by more than 63% in the Sound beginning in the mid 1980s. Although the rate of decline has decreased, the decline continues at 3.1%/yr (Gail Blundell, NMFS, pers. comm.). Harbor seals haul out in many locations in the Sound and may have pups at these sites in May and June (Figure 2.25). Alaska Natives are allowed to harvest harbor seals under the 1972 Marine Mammal Protection Act.

Amphibians - Only 2 amphibians are found in southcentral Alaska. The wood frog (*Rana sylvatica*) and the western toad (*Bufo boreas*) are uncommon residents of the area. Wood frogs inhabit diverse vegetation from grasslands to forest, muskeg, and tundra and are documented on the west Copper River Delta. Western toads are generally found in open, non-forested areas near fresh water. Western toads have been documented on Hawkins, Hinchinbrook, and Montague Islands. Large numbers of western toads have been seen along the logging road at the southern end of Montague Island (Dirk Lang, Cordova RD, pers. comm.). There have been no reports of wood frogs in the analysis area. Declines in amphibian populations have been documented worldwide; no data exists on the status of amphibians on the Chugach National Forest.

Human Dimension

Human Occupation

The Big Islands analysis area was occupied prehistorically by the Suqpiaq, who speak the Aluutiq language. This occupation has been documented to at least 4,000 years ago. The prehistoric Suqpiaq were a maritime-oriented people whose activities rarely penetrated inland. There are eight identified sub-groups of the Chugach people (Johnson 1984), including:

- The Palugvirmiut of Hawkins, Mummy, and northeastern Hinchinbrook Islands;
- The Nutyirmiut of western Hinchinbrook, based at Nuchek;
- The Alukarmiut of Sheep Bay;
- The Atyarmiut of Gravina Bay;
- The Tatitlarmiut of northeastern Prince William Sound, based at Kunin and Palutaq (Ellamar);
- The Kangirtlurmiut (Kiniklik) of northwestern Prince William Sound from Columbia Glacier to Port Wells;
- The Tyanirmiut of Chenega Island, based at Kalakat and Ingimatya; and
- The Shuqlurmiut of Montague and Knight Islands.

The Shallow Water People lived on the eastern half of Hinchinbrook Island and all of Hawkins Island. The people of Nuchek inhabited the western half of Hinchinbrook Island, while the Montague Island People occupied Green and Montague Islands.

In prehistoric times the Tlingit people from southeast Alaska settled at Katalla, Chilkat, and Kayak Island, south of the Copper River around Controller Bay. Also, Eyak migrated down the Copper River valley to settle at Alaganik and Eyak Lake near concentrations of Eastern Chugach people. The Eyak also settled at Katalla, where they adopted the Tlingit culture. Finally, the Aleut people from the Aleutians Islands and Alaska Peninsula area came into Prince William Sound where they were the first Alaskans to contact the Russian explorers. (Johnson 1984)

The Suqpiaq (Chugach) of Prince William Sound controlled the territory east to Controller Bay until the early nineteenth century. At that time, Eyak, whose original homeland stretched from an area east of Yakutat to Cape Suckling, and possibly Controller Bay, pushed the Chugach out of Controller Bay, with the effect that "mostly pure Eyak people" subsequently occupied the Copper River Delta and the very eastern margin of Prince William Sound (de Laguna 1990:189). Eyak Natives in 1933 described Eyak territory as having at one time extended from Cordova Bay, inside Prince William Sound, east to Martin River, including the Copper River north as far as Miles and Childs Glaciers. Kayak Island was then described as having been within Tlingit territory (Birket-Smith and de Laguna 1938:17). The Russians enforced peace between the Eyak and the Suqpiaq, after which the Eyak expanded their territory as far north as Port Gravina (Birket-Smith and de Laguna 1938:18). Non-Native use of the analysis area increased significantly at the end of the nineteenth century, as prospectors and miners came into the area to look for gold, silver, copper, and other minerals. Other uses included timber for mines, fish wheels, canneries, and lumber.

Heritage Resources

Cultural resources of the analysis area include prehistoric and historic remains and historic properties that are eligible for the National Register of Historic Places. During project analysis, archaeological surveys have been conducted on the Chugach National Forest, as required by section 106, part 800 of the National Historic Preservation Act. However, the entire analysis area has not been inventoried. In addition to the currently inventoried sites, background literature for the Big Islands analysis area suggests that numerous additional cultural sites of both historic and prehistoric nature are present. The Chugach Alaska Corporation has a spirit camp facility on their land on Hinchinbrook Island in Port Etches at Nuchek.

Many of the identified cultural sites on National Forest System lands have been selected by Chugach Alaska Corporation under Section 14(h)(1) of the Alaska Native Claims Settlement Act (ANSCA) which provides for the conveyance of certain cemetery and historical sites to the regional corporations. Currently these sites are under review for conveyance. Forest Service interim management of selected sites requires Regional ANCSA Corporation (CAC) concurrence of management activities on all open selected 14(h)(1) sites. Field surveys to locate all potentially eligible National Register sites have been conducted in response to federal undertakings in order to satisfy the requirements for Section 106 of the National Historic Preservation Act of 1966.

Although over 200 individual cultural resources have been assigned site numbers within the Big Islands analysis area, some will need field verification and be surveyed to the current standards as outlined in the Region 10 Programmatic Agreement. Most identified cultural resources have not received formal evaluations for the National Register of Historic Places (NRHP). However, if a site is determined eligible but not formally nominated to the National Register, the same level of resource protection is granted. Many surveys in the past not formally documented are subject to further field review and documentation to be considered meeting current standards as outlined in Region 10 Programmatic Agreement.

Table A.4 - Cultural Resource Sites within the Big Islands Analysis area, in Appendix A, displays known sites. Sites are categorized by site type and association if known. Categories include native association, subsistence related, mining related, cabins and buildings (including ruins), engineering (FAA sites/Coast Guard related), exploration, and other. The analysis area includes cultural features of historic significance related to western culture such as evidence of mining, timber harvesting, fox farming, commercial fishing, hunting and trapping. The exact site locations were not identified to protect the resources. However, this information is known and is available to cultural resource specialists for performing site research and field survey.

Socio-Economic

The management of resources and environmental conditions in the Big Island analysis area affect the social and economic well being of people living in Prince William Sound and other forest users. The three affected borough/census areas are described in the FEIS for the Forest Plan in Chapter 3, pages 3-508 to 570, and include the Kenai Borough, the Municipality of Anchorage, and the Valdez-Cordova Census Area. Anchorage residents use the area for a variety of recreational activities while certain occupational sectors in Seward would benefit from tourism, logging, and wood processing activities. Cordova, Chenega Bay, and Tatitlek residents use localized areas for a variety of economic, recreation and subsistence purposes. Other communities whose use of the area is less frequent include Whittier and Valdez. Area users believe more deer hunting, sport fishing, and general recreation is occurring in the analysis area.

This analysis focuses on the socio-economic conditions of the Valdez-Cordova census area. The Valdez-Cordova census area contains about 1% of the state's population and has a population density of 0.3 persons per square mile of the area as a whole, due to the large amount of federal land and the lack of road access to communities within the census area (Crone et al 2002). The Valdez-Cordova census area experienced population declines during the recession of the mid-1980s and had a slower recovery than the Anchorage or Kenai Peninsula census areas (Crone et al 2002). Table 2.10 displays the vital statistics for the communities of Chenega, Cordova, Tatitlek, Valdez, and Whittier along with the statistics for the State of Alaska and the Nation as a whole based on the 2000 US Census Bureau information.

In general, the smaller communities in Prince William Sound depend to some degree on resources from the forest and marine environment for employment, recreation, and subsistence. Lifestyles are characterized by remote living conditions, seasonal and cyclical employment opportunities, and escape from the problems of crime, crowding, noise, and pollution often associated with urban environments (USDA Forest Service 1989). The *Exxon Valdez* oil spill had significant economic, social, and psychological impacts on these communities. See Picou and Gill (1996), and Davidson (1990) for assessments of the scope and magnitude of these impacts (Crone et al 2002).

Table 2.10 – Census Year 2000 Vital Statistics for nearby communities.

	Cordova	Tatitlek	Chenega	Valdez	Whittier	Alaska (Nation)
Population	2,454	107	86	4,036	182	626,932 (281,421,906)
1990-2000 Pct population change	16.3*	-10.1	-8.5	-0.8	-25.1	14.0 (13.2)
Population density (persons/mi^2)	40.0	14.7	3.0	18.2	14.5	1.1 (94.7)
Size –miles^2	61	7	29	222	12.5	671,951 (3,536,338)
Demographics:						
Male : Female Ratio	1.2	0.9	1.3	1.1	1.1	1.1 (1.1)
Mean Age	34.0	32.4	31.9	32.1	35.7	29.3 (35.3)
Pct Am. Indian-Alaska Native	11.1	84.9	76.8	7.5	6.0	16.5 (0.9)
Pct 4-year College Educated	21.4	3.6	15.0	21.9	15.9	24.7 (24.4)
Households:						
Pct Same house as 5 years Ago	58.0	72.7	51.4	45.1	41.2	46.2 (54.1)
Pct Family Households	62.4	76.3	81.8	69.8	53.5	68.7 (68.1)
Pct Owner Occupied Households	52.3	40.4	55.6	64.9	16.0	62.5 (66.2)
Median Household Income	$50,114	36,875	$53,750	$66,532	$47,500	$51,571
Pct Families below poverty level	4.3	17.9	16.7	5.0	4.1	6.7 (9.2)
Employment and Income:						
Pct Civilian Labor Force Unemployed	4.6	4.2	8.5	4.5	11.9	6.1 (3.7)
Pct with Private Wages/Salary	52.9	48.6	13.0	70.1	44.4	64.9 (78.5)
Pct Government	28.7	40.0	87.0	21.8	23.3	26.8 (14.6)
Pct Self-employed	17.6	4	0	8.0	32.2	8.0 (6.6)
Pct Unpaid family worker	0.9	0	0	0.1	0	0.3 (0.3)
Pct Employed in Agri.Forest/Fishing/ Mining Sector	14.1	8.6	0	5.4	7.8	4.9 (1.9)
Pct Employed in Arts/Enter / Accomm/Food Services	6.3	5.7	0	18.9	23.3	8.6 (7.9)
Pct income w/retirement, change from 1990	4.9 (8.1 - 13.1)	30.3 (0 -30.3)	19.0 (0-19.0)	1.1 (10.9- 11.9)	9.6 (5.6-15.1)	1.9 (1.1) 12.8->14.7 (15.6-16.7)
Shannon Weaver Index*	0.937	0.861	0.305	0.909	0.930	0.931

*The Shannon Weaver Diversity Index is used to measure and compare the diversity of the employment in an area. An index of 100 indicates a diverse economy able to recover if one sector lags.

Chenega Bay – The unincorporated village of Chenega Bay was originally located on the south side of Chenega Island in southwestern Prince William Sound. A tidal wave generated by the 1964 earthquake destroyed the village and killed 23 residents. In 1984, the community was re-established 35 miles from the original village at Crab Bay on Evans Island, 42 miles southeast of Whittier. Access is by float plane or boat. It is an

Alutiiq community of 86 people (2000 census) who practice a subsistence and commercial fishing lifestyle. Commercial fishing, a small oyster farming operation, and subsistence activities occur in Chenega Bay. Three residents hold commercial fishing permits. Cash employment opportunities are very limited. In anticipation of an increase in the number of boats in the Sound due to the new road to Whittier, Chenega Bay has installed a fuel dock to service and attract these visitors. As measured by the Shannon Weaver Diversity Index, employment in Chenega Bay is the least diverse of other communities near the analysis area and is less diverse than the state as a whole and the nation. In recent years, Chenega Bay's population has declined.

Cordova – The home rule city of Cordova is located 62 air miles southeast of Valdez on Orca Inlet in eastern Prince William Sound on the mainland. No roads connect Cordova with the rest of the State, however it is accessible by the state ferry system and by commercial jet service. A new fast ferry will be providing daily service between Whittier, Valdez, Tatitlek, Chenega, and Cordova beginning in 2005. Cordova's population has been relatively stable. The 2000 census estimated 2,454 people lived in Cordova. It has a significant Eyak Athabascan population with an active Village council. Commercial fishing and subsistence are central to the community's culture.

Residents of Cordova rely heavily on the adjacent land and marine environment for recreational activities such as boating, camping, sightseeing, and subsistence harvest of a large variety of species. The importance of hunting, fishing, and gathering activities is reflected by data collected by the ADF&G Division of Subsistence (USDA Forest Service 1989). Details are provided in the subsistence section of this chapter.

The principal economic sector is commercial fishing and seafood processing due to Cordova's proximity to prime fishing grounds. It supports a large fishing fleet and several fish processing plants. In the past, over 50% of the community's employment was directly related to commercial fish harvesting and seafood processing. Today, the community is more diverse; other sectors of the economy include transportation, communication and utilities, construction, retail trade and services, and local, state, and federal government. Nearly half of all households have someone working in commercial harvesting or processing and 343 residents hold commercial fishing permits. Red salmon, pink salmon, silver salmon, king salmon, herring, halibut, bottom fish, and other fish are harvested. Reduced salmon prices have affected the economy. The harbor accommodates 850 vessels. As measured by the Shannon Weaver diversity index, employment in Cordova is somewhat less diverse than the state and nation as a whole.

Tatitlek – Tatitlek, the unincorporated Alutiiq village of 107 residents, is 30 air miles northwest of Cordova on the northeast shore of Tatitlek Narrows on the mainland. It is a coastal Alutiiq village of 107 residents (2000 census) with a fishing and subsistence based culture. The sale or importation of alcohol is banned in the village. Access is provided by the state ferry, chartered aircraft, and by boat. Fish processing and oyster farming provide some employment in Tatitlek. Four residents hold commercial fishing permits. Subsistence activities provide the majority of food items. A coho hatchery at Boulder Bay is nearing completion for subsistence use. A fish and game processing facility is under construction. A small community store has recently opened. As measured by the Shannon Weaver diversity index, employment in Tatitlek is somewhat less diverse than the state and nation as a whole. It is more diverse than Chenega, but less diverse than the other communities in the area.

Valdez – The home rule city of Valdez, population 4036, is located on the north shore of Port Valdez, a deep water fjord in Prince William Sound. It lies 305 road miles east of Anchorage and 364 miles south of Fairbanks. The state ferry, commercial and chartered aircraft, boats, and a highway provide access to Valdez. During the 1964 earthquake, a slide of unstable submerged land destroyed the original city waterfront killing several residents. The community was rebuilt on a more stable bedrock foundation 4 miles to the west. It is the southern terminus of the Trans-Alaska oil pipeline, and as a result of significant oil taxation revenues, the City offers a variety of quality public services. Valdez has one of the highest municipal tax bases in Alaska due to the oil terminus. Four of the top ten employers in Valdez are directly connected to the oil terminus. Valdez is a major seaport with a $48 million cargo and container facility. City, state, and federal agencies combined provide significant employment. Seasonal commercial fishing and tourism have spurred the retail and service sectors. In 2002, 27 cruise ships docked in Valdez. It has 3 fish processing plants, and 42 residents hold commercial fishing permits. A small harbor accommodates 546 vessels. As measured by the Shannon Weaver diversity index, employment in Valdez is somewhat less diverse than the state or nation as a whole.

Whittier – The second class city Whittier, of 182 residents, is located on the northeast shore of the Kenai Peninsula 75 miles southeast of Anchorage at the head of Passage Canal on the west side of Prince William Sound. Whittier is accessible by state ferry, rail, and road. The construction of the buildings that dominate Whittier began in 1948. Begich Towers with 198 apartments and the Buckner building with 1,000 apartments completed in 1953 were built for army housing. The Buckner building is no longer occupied. Whittier Manor, built in the early 1950s by private developers as rental units for civilian employees, was converted to condominiums in 1964. Most residents live in Begich Towers. Residents enjoy sport fishing, commercial fishing, and subsistence activities. The city, school, local services, and summer tourism support Whittier. Tours, charters, and sport fishing in Prince William Sound attract seasonal visitors. Nine residents hold commercial fishing permits. Whittier is an ice free port with two city docks and a small boat harbor with 360 slips. With the estimated increase in travel due to the new road accessing Whittier, the town is planning to double the size of its small boat harbor. Projections of up to a million additional people will enter Prince William Sound each year as a result of the new road. As measured by the Shannon-Weaver diversity index, employment in Whittier is somewhat less diverse than the state or nation as a whole.

Subsistence

Subsistence plays a major role in the lives of people who live in Prince William Sound. Ninety-four to 100% of Chenega, Cordova, Tatitlek, and Whittier households use subsistence resources (Table 2.11). While fish plays a major role as food for coastal Alaskan residents, other wildlife, namely large mammals and marine mammals play important roles as well. These resources may be harvested under numerous and sometimes confusing harvest seasons, managed by various jurisdictions including ADFG sport harvest, ADFG subsistence harvest, Federal Subsistence harvest managed by the U.S. Fish and Wildlife Service's Office of Subsistence Management (OSM), National Marine Fisheries Service (NMFS) harvest of marine mammals, and even the NMFS management of subsistence halibut fishery.

The 1985 ADFG community summary for Cordova suggested that the average Cordova household harvested approximately 400 pounds of fish, wildlife, and plants. Of this sample, 59% harvested silver salmon, 44% harvested red salmon, and 30% harvested king salmon. It showed that all five species of salmon were used by a significant portion of the community. Halibut, Dungeness crab, shrimp, and bottom/rock fish are also used by a large number of people. Nearly a third of the households harvested deer; a total of 218 deer were taken, representing 8,720 pounds, and through sharing of deer meat, nearly two thirds of the sample households indicated that they used deer meat. (USDA Forest Service 1989)

By 1989, areas traditionally and currently used by Tatitlek residents for subsistence resources had been mapped, but intensity of use information had not been collected. As of 1989, marine mammals made up 39% by weight of the Chenega community subsistence harvest. Salmon made up 21%, game 20% and other fish 16% of the harvest. Plants, birds, and marine invertebrates each make up 1% of the harvest. Per capita harvest of wild resources by Chenega residents was 361 pounds in 1895-1986 (1,286 pounds per household). Per capita use was 243 pound (866 pounds per household). This compares with a per capita harvest of 151 pounds and per capita use of 145 pounds by residents of Cordova as of 1989. (USDA Forest Service 1989)

During the 1986 Joint Boards of Fish and Game meetings, GMU 6 (Prince William Sound), was determined to be rural for purposes of subsistence uses of resources, except for Whittier and Valdez. Approximately 6865 people (2000 census) reside in GMU 6. Excluding the populations of Whittier and Valdez, about 2647 people qualify for subsistence uses of resources in the Sound. The majority of these residents are from Cordova, Tatitlek, and Chenega Bay. Communities were extensively surveyed between 1985 and 1988 and again between 1990 and 1997 (communities were surveyed in different years – reflected in Table 2.11). The ADFG Subsistence Division collected information on historic and current use patterns, harvest areas, species used, pounds of resources collected and consumed and harvest methods. Table 2.11 displays the summary of use of subsistence resources by community. Information is from the ADFG Community Profile Database (Brown et al 2001). Information collected in 1997 (Table 2.11), indicates that the Chenega per capita use was 275.2 pounds, the Cordova per capita use was 179.4 lbs, and the Tatitlek per capita use was 406 pounds.

Table 2.11 - Summary of nearby communities use of subsistence resources

All resources	Chenega Bay 1997	Cordova 1997	Tatitlek 1997	Valdez 1992	Whittier 1990
% household using	100	97.6	100	97	94
% households harvesting	95.7	89.7	88	83	77
% households receiving	100	88.2	100	86	87
% households giving	91.3	78.7	100	68	66
Estimated pounds	27,809	449,841	32,915	386,078	22,308
Per capita pounds	275.2	179.4	406	103	80
Fish (both salmon and non salmon)					
% household using	100	93.7	100	95	90
% households harvesting	78.3	75.1	75	77	58
% households receiving	95.7	80.6	94	72	71
% households giving	78.3	68.4	81	62	63
Estimated pounds	19,980	263,712	12,858	286,399	14,969
Per capita pounds	197.7	105.2	159	77	54
Land Mammals (both large and small)					
% household using	82.6	79.0	94	62	57
% households harvesting	47.8	52.2	63	23	8
% households receiving	73.9	62.0	81	51	52
% households giving	43.5	47.8	38	16	20
Estimated pounds	1,845	136,612	3,720	71,227	3,064
Per capita pounds	18.3	54.5	46	19	11
Marine Mammals					
% household using	56.5	11.0	94	2	8
% households harvesting	43.5	5.1	50	0	1
% households receiving	56.5	7.1	75	2	7
% households giving	43.5	6.7	56	0	1
Estimated pounds	3,528	9,114	13,372	0	265
Per capita pounds	34.9	3.6	165	0	1
Birds and Eggs					
% household using	52.2	42.3	81	30	21
% households harvesting	43.5	30.4	69	26	15
% households receiving	17.4	18.2	63	6	11
% households giving	30.4	9.9	38	5	9
Estimated pounds	151	5,593	797	5,273	383
Per capita pounds	1.5	2.2	10	1	1
Marine Invertebrates					
% household using	91.3	51.7	81	49	52
% households harvesting	73.9	29.2	63	20	16
% households receiving	73.9	47.4	69	41	44
% households giving	56.5	27.6	38	14	18
Estimated pounds	1,498	13,844	1,509	11,915	2,494
Per capita pounds	14.8	5.5	19	3	9
Vegetation					
% household using	100	87.0	100	66	78
% households harvesting	95.7	85.4	75	60	73
% households receiving	78.3	42.7	63	31	18
% households giving	73.9	44.3	69	27	20
Estimated pounds	808	20,966	658	11,264	1,133
Per capita pounds	8.0	8.4	8.1	3.0	4.1

Sport, commercial, and subsistence fishing

The analysis area encompasses the ADFG Southeastern and Montague fishing districts of the Prince William Sound Fisheries Management Area. The commercial salmon fishery is primarily for pink salmon with chum salmon being a secondary species. Harvest of chum salmon dropped in the early 1970s in the Montague district because of the change in estuarine habitat due to the 1964 earthquake. Since the late 1990s, hatchery stocked chum salmon have become a major component of the salmon harvest around Montague Island. Coho and sockeye salmon stocks are not managed for commercial harvest but are taken incidental to other fisheries.

Razor clams were harvested from tidal beaches in Orca Inlet from 1916 to the early 1980s. In the early years, Cordova was known as the "razor clam capitol of the world" and annual clam harvests frequently topped 1.0 million pounds from 1916 – 1950 (ADFG 1999). Demand for razor clams increased after the 1950s because razor clams began to be used as a bait for harvesting Dungeness crab (ADFG 1999). Razor clams are no longer harvested in Orca Inlet due to insufficient population numbers. The clam population declined dramatically after the 1950s for a variety of reasons, including the 1964 earthquake which caused significant uplift in prime razor clam habitat in Orca Inlet (ADFG 1999). The loss of habitat resulted in record low harvests in the 1970s and the early 1980s. As a result, commercial clam digging shifted to the eastern Copper River Delta and the Controller Bay area, but without much success. No commercial harvests have occurred anywhere in Area E since 1988.

Streams and lakes in the management area and the adjacent saltwater areas support a substantial recreational fishery. Pink salmon, coho salmon and halibut are the most sought after species in saltwater. Coho salmon, Dolly Varden char and cutthroat trout are the primary freshwater game fish. Several river systems in the analysis area are well known for their sport fisheries; the most popular areas include the Nellie Martin River, San Juan Bay, Shelter Bay, and Makarka Creek. Other popular spots are associated with the Forest Service recreation cabins.

The majority of salmon used for personal use in the Sound is harvested by commercial methods. This is true for Chenega and Cordova residents. According to Stratton (1989), 61% of the salmon used by Chenega residents is harvested commercially and an additional 29% comes from non-commercial nets or other methods. Salmon makes up 31% by weight of the wild resources used by Cordova residents and 20% of the Chenega use.

Subsistence fishing in the Big Islands analysis area is minimal at this time. There are several isolated areas of human development on the islands; most are used on a seasonal basis. Boswell Bay on northern Hinchinbrook Island and Nuchek on southern Hinchinbrook Island are the two largest inhabited sites. Boswell Bay is composed of cabins and houses used primarily in the summer by their owners although some winter residence does occur. Nuchek, located in Port Etches, is the site of a summer Spirit Camp operated by Chugach Heritage Foundation. A caretaker and his wife reside there on a year round basis. An oil spill response vessel is also moored in Port Etches, which is staffed year round with a maintenance crew. Canoe Pass, Deep Bay, and Johnstone Point are the other locations with one or two residences. A logging camp on Montague Island closed in 1996. A hunting and fishing lodge is located on Montague Island, but is quite small and used seasonally. No other communities are present in this analysis area.

No federal subsistence fishing permits have been issued to any of the residents on the big islands. A State of Alaska education subsistence salmon permit is issued to the Nuchek Spirit Camp each year to collect chum and pink salmon. These fish are used for demonstration of traditional subsistence harvest and food preparation. The permit allows up to 300 pink and chum salmon to be harvested. The harvest has been generally less than the permitted number. All of the harvest is taken in marine waters during July with small boats and a set gillnet.

Salmon and trout are available in the freshwaters of the big islands, but no documented subsistence harvest in freshwater has occurred in recent years. Some sport harvest of coho, sockeye, and pink salmon does occur, but usually close to the mouths of streams in the intertidal areas. Some sport harvest of cutthroat trout and Dolly Varden occurs in the freshwaters of these islands, but the fishers are generally people that fly in from urban areas for a few days to fish recreationally. It is possible that deer hunters camping on these islands may harvest some fish to supplement their camp rations, but if so, that harvest is unreported or is done under sportfishing regulations.

Subsistence harvest of razor clams (*Siliqua patula*) occurs on the ocean beaches on the northeast end of Hinchinbrook Island. These beaches are accessible by foot from the Boswell Bay. Clams are found in the intertidal zone and vary in density. The State of Alaska regulates the clam harvest, requires the harvester to have a permit in some areas, and stipulates that only clams 4.5 inches in length may be taken or possessed. The reported razor clam harvest is in aggregate with the harvest in other intertidal areas so the amount of razor clams taken from the analysis area is unknown. The total reported average annual razor clam harvest from 1998 to 2002 by subsistence or sport harvesters for all of Prince William Sound, which comes primarily from the Copper River Delta beaches, but includes some Hinchinbrook Island beaches, was 49 pounds. This amount is much reduced from the 1988 to 1992 reported average annual harvest of 2,440 pounds (Berceli et al. 2003).

Capelin (*Mallotus villosus*) are a marine fish available for harvest during their spawning migration. These fish move into shallow water to spawn on beaches in the spring months. They are commonly found around the big islands. It is unknown if any of these fish are harvested for subsistence use. No reported harvest has occurred in recent years.

Future subsistence harvest in this analysis area is expected to grow slowly as the population of Cordova increases and access improves. Currently, the subsistence harvest of salmon is done in marine waters adjacent to this analysis area. The harvest of salmon in freshwater is accomplished under sportfishing regulations.

The ability of freshwater trout stocks to meet subsistence needs is unknown. Little or no data is available on population sizes, ranges or habitat carrying capacities. Trout population studies are needed to determine the exploitation rate that could take place and still maintain a sustainable harvest.

Sport and Subsistence Hunting

Under OSM regulations, all rural residents in the State of Alaska have a Customary and Traditional determination for deer in GMU 6, with a bag limit of 4 deer, while ADFG sport hunting regulations allow a harvest of 5 deer per season. Since the State bag limit is large enough to accommodate determined subsistence needs, and harvest limits are not additive, all deer harvest in Prince William Sound currently takes place under ADFG regulation. This however, could change if deer populations declined to the point where ADFG lowered its bag limit to less than 4 deer.

The Cordova Ranger District of the Chugach National Forest assists ADFG in managing deer populations by cooperatively conducting deer pellet counts each spring to determine trends in deer populations on Montague, Hinchinbrook, and Hawkins Islands.

The Big Islands analysis area plays an important role in providing some of the subsistence harvest for residents of the Sound, with harvest of Sitka black-tailed deer perhaps being the most important. In the community of Cordova, 73% of households use deer, accounting for a total harvest of about 1,447 animals annually (Patton 1992). Much of this harvest likely came from Hawkins and Hinchinbrook Islands. Add the communities of Chenega Bay, Tatitlek, Whittier, and Valdez (a non-subsistence community) and the demands for deer in Prince William Sound appear significant. In 1989, it was estimated that of the 2,000 deer harvested each year in GMU 6, 45% are taken from Montague Island. Hawkins and Hinchinbrook account for another 30% of the yearly GMU 6 harvest. (USDA Forest Service 1989)

Areas important to Unit 6 deer hunters are, in descending order of importance: south half of Hawkins Island, Zaikof Bay - Rocky Bay- Stockdale harbor area of Montague Island, north half of Hawkins Island, northwest side of Hinchinbrook Island and northeast side of Hinchinbrook Island. The area around Zaikof Bay and Rocky Bay had the highest ratio of deer taken per day hunted during 1987. (USDA Forest Service 1989)

Chenega residents use the Big Islands analysis area to a limited extent for subsistence resources. Deer are taken from Green Island, Deep Bay, Mud Bay, and Windy Bay. In the 1960s deer were taken from Zaikof Point and Montague Point on Montague Island (Stratton 1989).

Tatitlek hunters consider the Zaikof Bay – Rocky Bay area extending around to Port Chalmers and south along the inside coast shoreline of Montague Island important for deer hunting. Green, Hawkins, and Hinchinbrook islands are also important for harvesting deer, specifically the south end of Double Bay, Anderson Bay, Eagle Point to Bear Cape and the area either side of Windy Bay. (USDA Forest Service 1989)

Both air and boat charter operators indicate that the majority of hunters that use the south end of Montague Island fly out of Seward or Anchorage. Use of the north end of Montague, Hinchinbrook, and Hawkins islands is primarily by Cordova based hunters. Anchorage based hunters concentrate most of their effort on Montague Island. The areas around Zaikof Bay and Rocky Bay extending to Stockdale Harbor, Hanning Bay to

MacLeod harbor, and San Juan Bay to Patton Bay and Beach River are the areas most hunted. (USDA Forest Service 1987)

In 1985, Cordova residents reported 31% of the household harvested deer and 64% of the household used deer. The average harvest per household was 218 pounds. Deer made up almost 13% by weight of the wild resources used by Cordova residents and 14% of that used by Chenega residents. (USDA Forest Service 1989)

The Board of Game has determined that black bear and mountain goat are subsistence resources used by local residents of GMU 6. No determination has been made for deer. ADF&G 1987 survey report estimated 2,669 deer were harvested by 1,906 hunters, not all of whom were Unit 6 residents. Unit 6 hunters accounted for 32% of the hunting days and 49% of the deer harvested. The remaining harvest was from hunters outside of Unit 6. Deer taken by hunters coming out of Anchorage or Seward cannot be considered to be used for subsistence purposes. Brown bear and moose were not used for subsistence purposes in GMU 6. (USDA Forest Service 1989) Brown bear hunting occurs on Hinchinbrook and Montague islands where 50% of the hunters are non-residents (Culbertson 1979, Bucaria 1979).

Trapping pressure is light in the analysis area because of the relatively low numbers of furbearers and limited accessibility. Most trapping of mink and otter occurs during the winter months. (USDA Forest Service 1989) Harvest of marine mammals, namely sea otter and harbor seal, does not occur on National Forest System lands in the Big Islands analysis area.

Timber harvest

Table 2.12 displays a summary of the estimated acres harvested by year for each island. Estimates are based on 2004 aerial photo interpretation and the Forest GIS database information. There were several areas identified as having trees harvested in a compilation done by Steve Bodnar in the 1990s, however the information has not been verified with the district sale records. Figures 2.26, 2.27, and 2.28 display where harvest took place. Table A.3 in Appendix A lists the location, sale names, harvest acreages, and year harvest began and ended for each sale on record.

In an analysis done in 1989, it was determined that of the 52,764 acres of productive forest land, 34% (17,897 acres) was suitable for timber production and contained an estimated net sawtimber volume of 395.4 million board feet. Of the total suitable acreage, 74% was on Montague Island, 17% was on Hawkins and 5% was on Green Island. Approximately 2,489 acres of timber have been harvested on National Forest System lands on Montague Island between 1946 and 1978. From 1993 – 1997, approximately 4453 acres were harvested on CAC land in the Patton Bay Area on Montague Island. About 496 acres have been harvested on Hinchinbrook; the earliest known occurred in 1835 in Constantine Harbor in Port Etches and the latest occurred in 1966 near Rube Point.

Table 2.12 - Summary of acres harvested by year in the Big Islands Analysis Area

Location	Year	Acres
Montague - Port Chalmers	1949	61
Zaikof Bay, Port Chalmers	1950	120
MacLeod Harbor	1952	177
Zaikof Bay	1956	55
Hanning Bay	1959	340
MacLeod Harbor	1961	295
MacLeod Harbor	1962	57
Nellie Martin Drainage	1964	67
Montague Straits, NW Montague	1966	151
Hanning Bay	1970	113
Montague Lagoon	1971	75
NW Montague, Montague Lagoon	1972	266
MacLeod Harbor	1973	110
Montague Straits	1976	174
Westside	1978	403
CAC lands	1993 - 1997	4452
Hinchinbrook - Port Etches	1835	5
Midway Bay – State Select	1952	150
Port Etches	1954	109
Port Etches	1955	156
Juania Bay	1959	67
Rube Point	1966	9

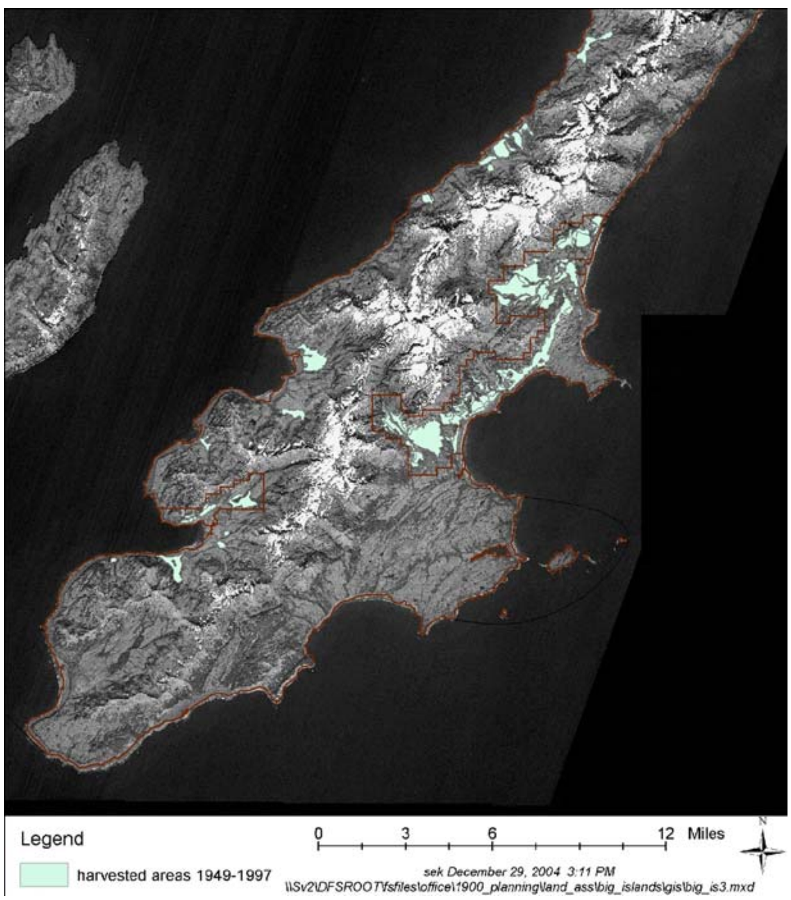


Figure 2.26 - Location of harvest on south half of Montague Island

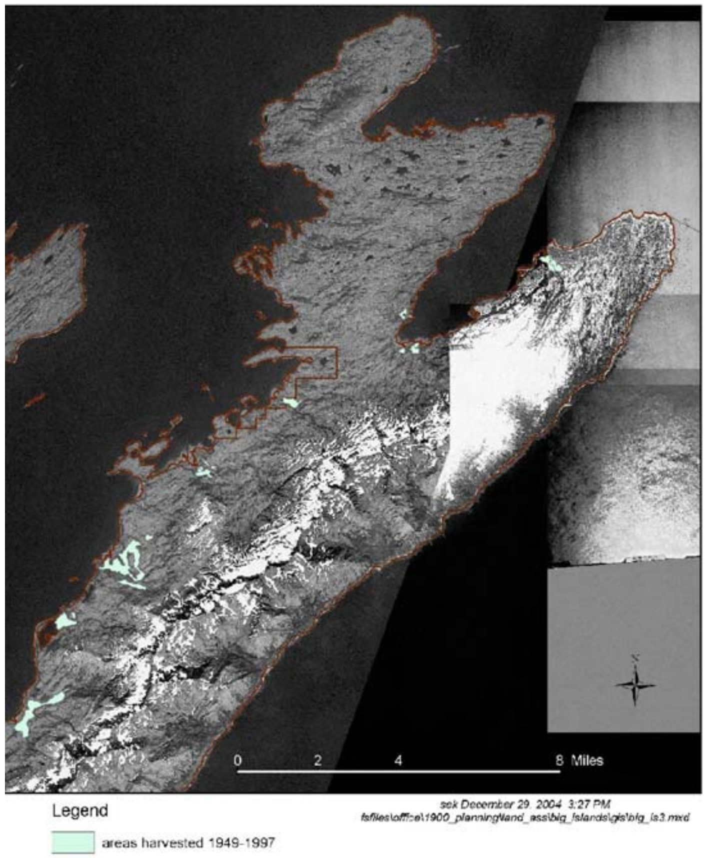


Figure 2.27 - Location of harvest on north half of Montague Island

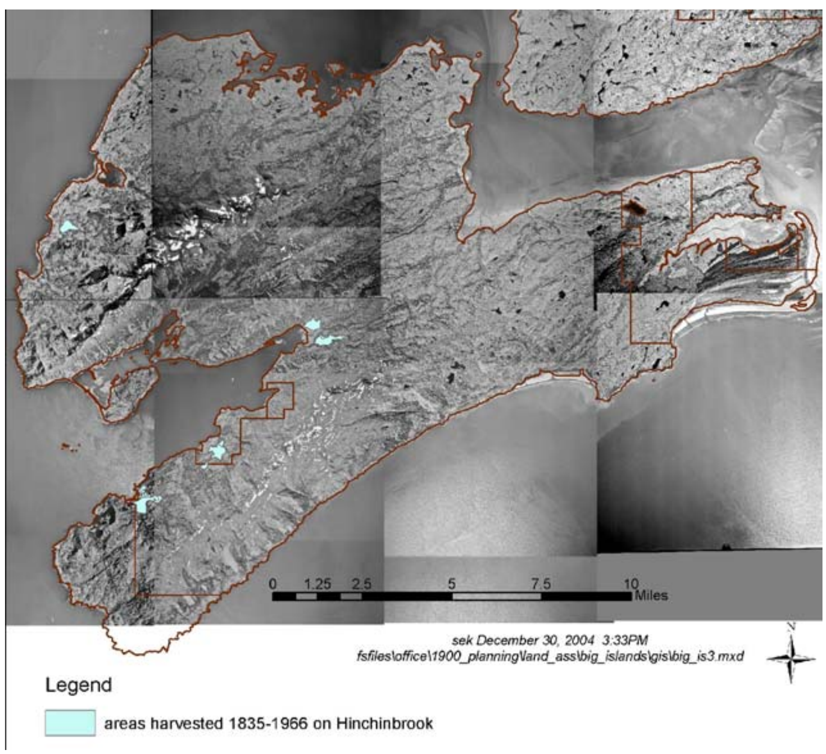


Figure 2.28 - Location of harvest on Hinchinbrook Island

Roads and Access

There are no federal, state or forest roads in the analysis area. There is a low standard 0.5-mile road on private land on the north side of MacLeod Harbor on Montague Island and 34 miles of decommissioned road circling around the south end of the island from MacLeod Harbor to CAC lands in Patton Bay.

During the 1990s, CAC constructed the 34-mile long road to haul the timber harvested from their lands at Beach River and Patton Bay to MacLeod Harbor. The haul road was authorized under a special use permit which was terminated in July 1998. As part of the permit, the roadbed was decommissioned and recontoured. Vegetation is growing back on the old road bed. Not much is noticeable from the shore, but it is visible from the air. No further motorized use is allowed.

Present access to the islands is by boat or small aircraft. Wheeled aircraft use undeveloped beaches during low tides or ridges clear of obstructions and large vegetation. Floatplanes use Stump Lake on Montague Island and various saltwater coves and bays depending on lake, tide, and sea conditions.

With access to Whittier improved, it is anticipated that one million additional people will enter Prince William Sound each year. The high speed ferry coming on line in 2005 connecting Whittier, Valdez, Tatitlek, Chenega, and Cordova also has the potential to increase use in the Sound.

Recreation Use and Facilities

The Big Islands area of Prince William Sound is generally undeveloped and supports a variety of recreation activities. The area has high scenic value and provides the opportunity for recreation in a primitive and remote setting with plenty of solitude. Fish and wildlife resources attract both consumptive and nonconsumptive resource users. Solitude and scenery are also major attractions. Recreational boating is a major use of the Sound and includes power boating, sailing, and sea kayaking. Other recreation activities include sightseeing, cabin use, beach-combing, clamming, and nature study. (USDA Forest Service 1989). Figure 2.29 shows the location of trail easements and recreation cabins.

The commercial fishing fleet also makes use of the analysis area before and after fishing seasons. They use it as an anchorage and they recreate, hunt, and fish here. (USDA Forest Service 1989). In 1986, the recreation use of the analysis area was estimated at 25,000 recreation visitor days (RVDs), including 5,800 visits in develop sites and 19,200 other types of visits. (USDA Forest Service 1989).

Some Anchorage residents use the analysis area for a variety of recreational activities including kayaking, pleasure boating, deer hunting and fishing. Much of this occurs in conjunction with visits to Forest Service public use recreation cabins (USDA Forest Service 1989).

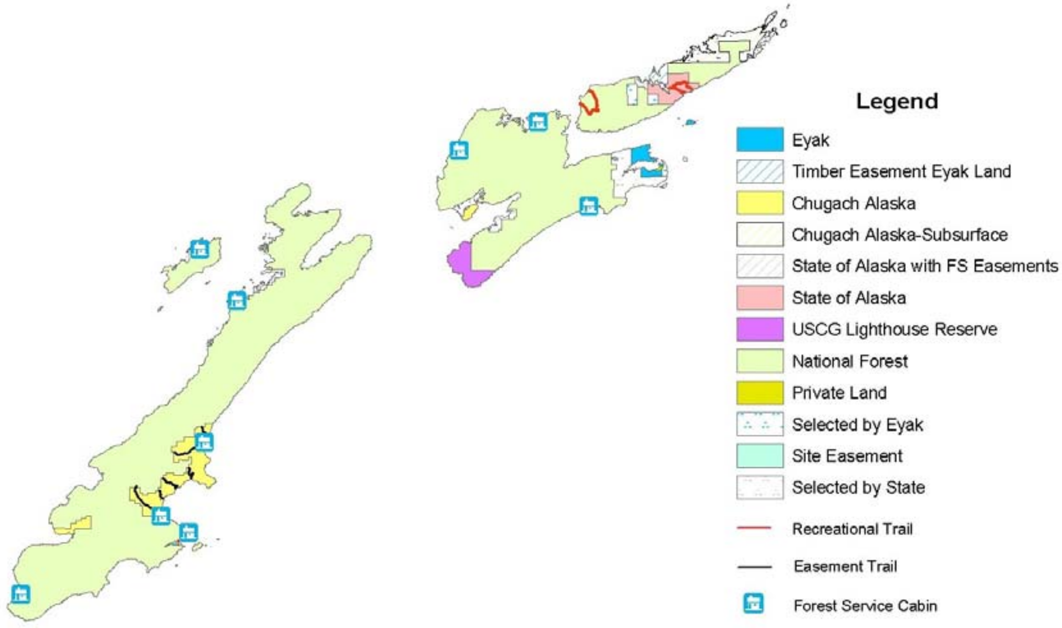


Figure 2.29 - Location of trails, cabins, and easements in the analysis area

In response to a question in a survey conducted by Alaska Pacific University about how the Forest should respond to the expected new demand and associated impacts to the uplands and coastline from the anticipated increase in visitors to the Sound, nearly half of the respondents from the 12 communities of interest felt that the Chugach National Forest should only create new facilities to mitigate expected adverse environmental impacts. Thirty-seven percent favored creating additional facilities that would not only mitigate expected impacts, but would also expand public recreation opportunities throughout the Sound (Crone et al. 2002).

Public Recreation Cabins – The Cordova District has nine recreation cabins in the analysis area with a total capacity of 53 people at one time. These cabins receive low to moderate use relative to other cabins on the Forest. The three on Hinchinbrook are Hook Point, Double Bay, and Shelter Bay cabins. Five cabins are on Montague Island. Three are on the east side facing the Gulf of Alaska, at Beach River, Nellie Martin River and Log Jam Bay, one is on the southwestern end of the island at San Juan Bay, and another is on the northwest side in Port Chalmers. One cabin is located on Green Island in Gibbons Anchorage. No public recreation cabins are on Hawkins Island. In the early 1980s, a public recreation cabin was removed from the Canoe Pass area after the land were selected by the State of Alaska and Eyak Native Corporation. Currently there are no Forest Service anchor buoys or tent platforms in the analysis area.

Hook Point Cabin

This cabin is the only A-Frame cabin on the District and was built in 1967. The cabin is located on the southeastern side of Hinchinbrook Island which faces the Gulf of Alaska (N60 20.848 W146 17.742). In the mid to late 1970s it was relocated inland several 100 feet to eliminate the threat of damage due to an eroding river /stream bank. The eroding stream bank has stayed 100 to 150 feet from the cabin since it was moved. The cabin is accessibly via wheeled plane on the beach at a low tide. A 0.2 mile trail leads from the beach to the cabin; half is through sand and beach grass and half is through an older stand of timber. The cabin sleeps eight and provides recreation opportunities for brown bear and deer hunting, surfing, beach combing, backcountry hiking, and viewing spectacular scenery. Use is considered moderate.

Double Bay Cabin

This cabin, originally located in Anderson Bay, just west of Double Bay, was relocated to Double Bay in 1969. Double Bay is on the northeast side of Hinchinbrook Island facing Prince William Sound (N 60 27.969 W146 26.559). With a failing foundation and surrounded by a wet bog, the cabin was again relocated in 2001 about 100 feet to the west. The Pan Abode style cabin, which sleeps 6, is accessible by float plane or boat, preferable at high tide. The area is known for coho fishing opportunities but also provides brown bear, deer and waterfowl hunting, wildlife viewing and backcountry hiking opportunities. Use is considered moderate.

Shelter Bay Cabin

The cabin was constructed in 1990 in the southwest end of Shelter Bay, located on the northwest side of Hinchinbrook Island facing the entrance to the Sound (N60 25.560 W146 39.812). The Pan Abode style cabin, which sleeps 6, is accessible by float plane, by wheeled planes landing on the gravel spit near the entrance of the bay, and by boat. Boaters need a high tide and knowledge of rocks in the channel. The area was known for its coho salmon run, but fishing pressure has reduced the run and the State has lowered the harvest number. Other recreational opportunities include brown bear and deer hunting, wildlife viewing, and backcountry hiking. Use is considered moderate.

Beach River Cabin

The cabin was constructed in October 1969, 200 yards south of Beach River (N 60 00.889 W 147 23.066). Beach River is near the middle of Montague island facing the Gulf of Alaska. The cabin is accessible via wheeled aircraft at low tide; boat access is not an option. A 0.2 mile trail connects the beach landing area to the cabin. The majority of the trail has a sand tread except for 150 feet of raised planking that spans an area that occasionally has standing water. The cabin is stud wall construction and sleeps 6 people. Recreational opportunities include beach combing, brown bear and deer hunting, fishing, and hiking on public lands accessible by traveling on the easement through private lands. The Beach River Streamside easement is reserved for access and recreation according to the CNI agreement. The cabin sits on a 57.5 acre inholding surrounded by CAC lands. Use is considered low to moderate.

Nellie Martin River Cabin

This Pan Abode style cabin sleeps 6 and was most probably built in the mid-sixties. Nellie Martin River is approximately one third of the way up Montague island from the southern end, on the Gulf of Alaska side. The cabin is about ¼ mile inland within 200 feet north of Nellie Martin River (N 59 54.781 W147 30.215). It is accessible by wheeled plane; boat access is not recommended. This site is well known for its coho salmon run and those wishing to reserve the cabin during this period must make reservation well in advance. A 0.3 mile trail follows the river from the beach landing area to the cabin. The cabin used to be on a lottery drawing until the lottery system was abandoned. It will most likely be back on a new lottery system within a year. The cabin is near CAC land. Several easement trails provide access to public lands. Opportunities include fishing, brown bear and deer hunting, beach combing and backcountry hiking. Overall use is considered moderate, however August occupancy is 100% .

Log Jam Bay Cabin

Log Jam Bay cabin is situated on the northeastern end of Stump Lake about ¼ mile inland from Log Jam Bay. The bay faces the Gulf of Alaska and the Wooded Islands. The cabin was one of two public recreation cabins on the lake until the Stump Lake Cabin was decommissioned in the early 1990s. The existing cabin was built around 1984 by two volunteers and District personnel. It is a Pan-Abode style cabin that sleeps six. The area can be accessed by float plane on the lake or wheeled plane on the beach. Freezing temperatures limit access to beach landings in the Fall and Spring. A 0.3 mile trail from the beach to the cabin traverses old log jams on the pre-1964 earthquake beach, forest, and muskeg. Approximately 500 feet of pressure treated planking is used as tread across the muskeg. The cabin is used mostly by deer hunters and beach combers; fishing opportunities are limited. Adjacent private lands are not an issue at this cabin. Use is considered low to moderate.

San Juan Bay Cabin

San Juan Bay is located on the southwestern end of Montague Island. The cabin is approximately ¼ mile inland, just behind the pre-1964 beach berm (N59 48.105 W147 53.264). In 1988, the stud wall style cabin was replaced with a spruce log cabin style structure and relocated approximately 80 yards north. The spruce log cabin proved flawed from the start and was replaced in the summer of 2004 with an accessible Pan Abode style cabin that sleeps six. This area is accessible via wheeled aircraft only; boat access is not recommended. A 0.3 mile trail leads from the landing zone on the beach to the cabin. There is one stream crossing that may require hip boots depending on amount of rainfall. The cabin is used primarily by deer hunters but other recreation opportunities include fishing, surfing, and beach combing. Use is considered low to moderate.

Port Chalmers Cabin

Port Chalmers is located on the Prince William Sound side of Montague Island, roughly 16 miles south of the northern end of the island. In 1986, the District relocated the old Canoe Pass cabin to the southwestern end of Port Chalmers (N 60 12.895 W 147 17.584). The Pan Abode style cabin sleeps six people. Visitors can access the cabin by float plane or boat, a high tide is recommended for both. At high tide the cabin is within 100 feet of the shoreline. Cabin users are primarily deer hunters or anglers although some come to beach comb and view scenery and wildlife. Use is considered low to moderate.

Green Island Cabin

Around 1966 a cabin was built in Gibbons Anchorage on Green Island to assist in a research project. At some point it was incorporated into the Public Recreation Program. In 1994, a new accessible Pan Abode cabin was built at the northern end of Gibbons

Anchorage approximately 1000’ from the old site (N 60 17.520 W 147 23.558). The cabin is accessible by both float plane and boat, high tide is preferable but an accessible ramp extends into the tidally influenced area approximately 100 feet which allows access for a greater portion of the tide cycle. A 200 foot raised wooden walkway leads from the beach ramp to the cabin and another 120 foot long wooden walkway goes from the cabin to the outhouse. The floor plan is larger than most cabins but still sleeps six. The primary purposes for visiting the site are fishing and deer hunting. Use is considered moderate.

Public Recreation Trails – The trails on Montague Island are associated with cabins or are easements through private lands accessing public land. The one trail on Hinchinbrook is the Hook Cabin trail and is included in the cabin description. OHV trail improvements were undertaken to minimize impacts to fisheries and are discussed in the fisheries section.

There are three trails on the Hawkins Island that were once part of the Cordova Ranger District’s designated trail infrastructure, Canoe Pass Trail, Hidden Cove Trail, and Makarka Lakes Trail.

The 1.8 mile long Canoe Pass Trail is an easement through State land and has received little to no maintenance since 1983 when the surrounding lands were selected by the State of Alaska. The trail starts near the southern end of Canoe Passage on the east side near the fish pass. The trailhead used to be at the Canoe Pass recreation cabin (since removed). The trail ends on the other side of Hawkins Island on the shore of Orca Inlet. It is maintained as a Class I trail easement and has very low use.

The 4.2 mile Hidden Cove Trail is in the same condition and status as the Canoe Pass Trail. Old reports identify this trail as the Hidden Creek Trail. It starts at the 0.7 mile mark of the Canoe Pass Trail, accesses a series of four lakes, then ends at Hidden Cove on Orca Inlet about one mile east of the Canoe Pass terminus.

Makarka Lakes Trail crosses National Forest System land on the northwest tip of Hawkins Island but has not been maintained for many years. The last recorded maintenance was in 1953. The 5.5 mile long somewhat U-shaped trail connects a series of five lakes.

CNI and ANCSA 17(b) Easements

With the passage of ANCSA in 1971, the Forest Service and other federal agencies in Alaska were to establish trail, site and road easements across the new private land holdings in order to access isolated parcels of public land. These site and trail easements are commonly referred to as 17(b) easements, a reference to section 17(b) of ANCSA. The federal agencies administer the 17(b) easements within their jurisdiction, and the Bureau of Land Management is responsible for the recording, final platting, and rule making. Trail and site easements are not recreational trails and sites. Trails are intended for access purposes only to public lands; they may not be used simply as hiking trails or for any other purposes unless authorized by the landowner. Similarly, sites may not be used for recreational purposes but may be used for day use or overnight camping if the user either intends to access public lands from the site and trail easement or is using a site for day use or overnight camping if it is adjacent to navigable salt or fresh waters.

The 1982 Settlement Agreement between Chugach Natives Inc. (CNI), now Chugach Alaska Corporation (CAC), and the Chugach National Forest established streamside, site, and trail easements similar to 17(b) easements for access to private lands. Access beyond the trail corridor is not allowed without a corporation permit. These easements are commonly referred to as CNI easements.

Typically the specific uses allowed on both CNI and 17(b) easements depends on the easement type. On 25-foot right of way trails, travel by foot, dogsleds, animals, snowmobiles, two and three-wheeled vehicles, and small OHVs less than 3,000 lbs gross weight (GVW) is allowed. On one-acre sites, vehicle parking (e.g. aircraft, boats, OHVs, snowmobiles, cars, trucks), temporary camping, loading or unloading shall be limited to 24 hours. On 60-foot road easements, travel by foot, dogsleds, animals, snowmobiles, small and large OHVs, four-wheel drive vehicles, automobiles and trucks is allowed.

Table 2.13 - Easement trails and sites within the Big Islands analysis area.

Name & Length (mi)	Easement ID #	Land Owner	Location
ANCSA 17(b)Trails			
Strawberry	EIN 102b	Eyak Native Corporation	Boswell Bay, Hinchinbrook Island
Hidden Creek (3 mi)	EIN 214G	Eyak	Hawkins Is.
Canoe Creek (1.4mi)	EIN 221 G	Eyak	Hawkins Is.
Cedar Creek (1.0 mi)	EIN 223 G	Eyak	Hawkins Is.
Boulder Creek (.8mi)	EIN 224d C5,D9	Eyak	Hawkins Is.
Windy Bay (.5mi)	EIN 225G	Eyak	Hawkins Is.
Boswell Bay	306 C4 L M	Eyak	Boswell Bay
ANCSA 17(b) Roads			
Boswell Airport Rd.	EIN 102c	Eyak	Boswell Bay
Strawberry Rd.	EIN 102d	Eyak	Boswell Bay
Pt. Bentick Rd.	EIN 102 G	Eyak	Boswell Bay
Boswell Bay Rd.	EIN 306a C4 L M	Eyak	Boswell Bay
ANCSA 17(b) Sites			
Boswell Bay (1ac.)	EIN 102a	Eyak	Hinchinbrook Is
Salmo Point (1ac.)	EIN 108cG	Eyak	Hawkins Is.
Hidden Cr East (1ac)	EIN 213 G	State of Alaska	Hawkins Is.
Hidden Cr West (1ac)	EIN 215 G	State of Alaska	Hawkins Is.
Cedar Creek (1ac.)	EIN 222 G	Eyak	Hawkins Is.
Mud Bay (1ac)	EIN224c C5,D9	Eyak	Hawkins Is
Windy Bay (1ac)	EIN 224 G	Eyak	Hawkins Is.
Pt. Bentick Airstrip (200' X 16')	EIN 236 L	Eyak	Hinchinbrook Is.
Boswell Bay 2 (1ac)	EIN 306b	Eyak	Boswell Bay

** Cordova Ranger District office has plats for site and easement locations.

ANCSA and CNI easements exist on Montague, Hinchinbrook and Hawkins Island. Streamside easements are the area of land constituting the bed and banks, and the area 50 feet upland of the Ordinary High Water mark on both sides of the stream unless other wise designated by agreement such as the CNI Agreement. In a few locations access easements to USCG navigational aids are present.

Most easements within this analysis area are not marked due to on-going negotiations regarding final approved locations. Other easements at Boswell Bay on Hinchinbrook Island are being used by local residents but are not marked. ANCSA easements existing on Hawkins Island either occur on State lands or on EVOS fee simple acquisitions and have not been marked since the lands are open to public access. The Forest Service however wishes to retain these easements because they provide some rights not acquired with the EVOS acquisition. The Forest Service and CAC have re-negotiated many easement locations on Montague Island. In 2005, the District will begin remarking and clearing public easements on Montague Island. It is expected to take two years.

Typically trail and site easements are marked with a mixture of signs, carsonite posts, 5" X 7" orange plastic diamonds and chainsaw blazes on trees greater than 6" diameter (along trail easements). Easement sites are normally marked and cleared along the site boundaries to 1 acre or less and located as near as possible to the legal reservation but with consideration for ease of public access, availability of fresh water and well drained, flat terrain for camping purposes. Easement trails are not constructed to normal Forest Service standards. They are cleared with chainsaws to a six-foot wide corridor and an 8 foot high clearing limit and do not have a tread. Easement trails and sites are located and designed for the least impact to the resources as possible with consideration for tread durability, erosion, wildlife and fish impacts, and heritage concerns. Easement trails are designed to a 20% grades or less wherever possible. Most easements are surveyed. Corner monuments are placed at sites and at the beginning and ending of trail and road easements. The District administers a total of 15 trail easements, 13 site easements, 4 road easements, and one streamside easement within the Big Islands Analysis Area.

Special Uses

There are 10 special use authorizations for commercial non-consumptive outfitter/guide activities and other uses and 5 for consumptive outfitter/guide activities in the analysis area. Some of these permits are administered by the Glacier Ranger District. The following organizations or groups are authorized use on the National Forest System lands within the analysis area:

Alyeska Pipeline Company (COR21) - This permit holder is authorized a communication site on Hinchinbrook Island on the mountain top adjacent to the Forest Service repeater site (SW1/4, NW1/4 sec 12, T17S, R8W). This site is an important link to the Trans Alaska Pipeline Ship Escort Response Vessel System (SERVS).

Auklet Charter Services (GLA264) - The permit holder is authorized use of numerous locations throughout Prince William Sound on the Glacier and Cordova Ranger District for conducting guided day-use hikes.

Babkin Charters (GLA101) - The permit holder is authorized to conduct guided and unguided day hikes, shore and stream fishing and low impact camping.

Cordova Wireless Communications (COR 34) - This permit holder is authorized three communication sites on the Cordova Ranger District. One of these sites, a cellular telephone site, is located at Johnstone Point on Hinchinbrook Island.

Montague Island Lodge (COR 100) - This permit holder is authorized a small resort/lodge at MacLeod Harbor on Montague Island. The holder offers small cabins and a lodge from which saltwater charters and a variety of upland activities are planned.

Prince William Sound Science Center (COR76) - This permit holder is authorized research repeaters or communication stations in numerous locations in Prince William Sound on both the Cordova and Glacier Ranger Districts. Two are on Hinchinbrook Island; one at English Bay and the other on the mountain top adjacent to the Forest Service repeater site (SW1/4 of NW1/4 sec 12, T17S, R8W, CRM).

United States Coast Guard (GLA000213) - The USCG is authorized numerous navigational aids and communications sites throughout Prince William Sound and many are within the analysis area.

University of Alaska, Fairbanks (COR30) - The University of Alaska - Fairbanks, Geophysical institute has developed an earthquake research project by conducting geodetic surveys and monitoring of 25 separate locations within Prince William Sound on the Glacier and Cordova Ranger Districts. Eight of the permitted locations are on Montague Island.

University of Alaska, Fairbanks (COR105) - The University of Alaska - Fairbanks, School of Fisheries and Ocean Sciences has a research project to monitor and record the dynamics of ocean currents and circulation within Prince William Sound. One of several research monitoring stations is located approximately ½ mile north of Shelter Bay on Hinchinbrook Island.

Vision Quest Adventures (GLA172) - The permit holder is authorized to conduct guided sea kayaking, hiking and camping throughout Prince William Sound. The permit includes authorized campsites or hiking areas on Green Island and Montague Island.

Federal Aviation Administration - The Federal Aviation Administration operates a VORTAC communications site at Johnstone Point on Hinchinbrook Island per a 1964 Memorandum of Understanding The site is vital to air communications within the Prince William Sound area. The Forest Service intends to terminate the MOU in 2005 and replace with a Special Use Permit.

Big Game Outfitter/Guides - The Cordova District currently authorizes five big game hunting guides to operate within the analysis area. Species hunted include brown bear and deer. The big game hunting guides currently authorized within the analysis area include: Woods Outfitting, Byler's Alaska Wilderness Adventures, Lonesome Dove Outfitters, Alaska Mountain Outfitters, and Turnagain Trails.

There are also a number of private sector recreation operations that do not require a permit from the Forest Service at this time. A 1987 sampling of 10 air taxi and charter boat operators reported taking approximately 2000 passengers to the analysis area. Deer hunting on Montague Island was the most frequently mentioned activity with the highest number of passengers (875 of the 2000). (USDA Forest Service 1989)

Cape Hinchinbrook Lighthouse Reserve

The Cape Hinchinbrook Lighthouse Reserve, located at the southern tip of Hinchinbrook Island, was withdrawn from public lands under Executive Order 525 in 1906 and set aside for lighthouse purposes prior to inclusion to the Chugach National Forest in 1925. The reserve includes 5661 acres of land. In 1910, the lighthouse was completed and the first lighting occurred. The lighthouse operated until the 1930s when it was abandoned. The site still has an active light and is an important Coast Guard communication and navigation aide installation.

The United States Coast Guard is actively using the area around the historic lighthouse for aide to navigation facilities. This use is expected to be maintained or expanded into the foreseeable future. The Forest Service is working with the Coast Guard and BLM to reduce the Lighthouse Reserve to the area needed for Coast Guard operations. If successful, this would reduce the reservation for the lighthouse to less than 60 acres.

Minerals

National Forest System lands in the analysis area have a low potential for leasable, locatable or common variety mineral deposits. With regards to leasable minerals, there is no known potential for oil and gas, and coal deposits within the analysis area. The most abundant known mineral deposits include metals such as copper and manganese (USDA Forest Service 1989).

Locatable Minerals – As of March 10, 2005, no current mining claims, either placer, lode, or millsite, exist in the analysis area. There have been three lode claims staked over the known manganese occurrence, named Hinchinbrook, Hinchinbrook No. 1 and Hinchinbrook No. 2. Hinchinbrook No. 1 and No. 2, located in 1986, were abandoned in 1993. The Hinchinbrook claim, located in 1992, was abandoned in 1994. The Forest has no approved mining plans of operations for proposed operations within the analysis area, nor have any been submitted for approval.

Two major rock groups dominate the analysis area, the Valdez and the Orca (Nelson et al 1985). Both groups consist largely of greywacke, siltstone, and shale. The Orca Group generally contains rocks that are less metamorphosed than the Valdez Group and contains mafic volcanic rocks and some beds of conglomerates. Copper in the form of chalcopyrite is the most abundant mineral found in the analysis area. It is associated with a prominent barite belt and with some mafic volcanic-bearing rocks on the eastern portion of Hinchinbrook Island. Chalcopyrite has also been identified in quartz veins north of Jeannie Cove on Montague Island and found at the head of Whiskey Cove on Hawkins Island. Hawkins has six known copper occurrences and Hinchinbrook has one.

Another mineral occurrence on Hinchinbrook Island may contain cobalt, chromium, nickel or molybdenum. (USDA Forest Service 1989).

Gold and silver occur in quartz veins located in shear planes, faults and localized fissures in the metamorphosed sedimentary host rock of the Orca Group (Hoekzema et al. 1987). All known gold deposits are small and scattered are located in a lineal trend that extends along the eastern shore of Hinchinbrook Island into the Heney Mountains and north of Cordova. (USDA Forest Service 1989).

The USGS assessed the mineral resource potential for the Chugach National Forest for the Forest Plan revision. Nelson and Miller (2000) focused strictly on metallic mineral resources and did not cover leasable resources such as coal, oil and gas, or salable resources such as common variety rock, gravel, and sand. The four deposit types evaluated in Nelson and Miller's report are as follows: 1) Cyprus-type massive sulfide (copper, lead, zinc, gold and silver); 2) Chugach-type low-sulfide gold quartz veins (gold and silver); 3) placer gold; and 4) polymetallic veins (copper, zinc, lead, gold and silver).

According to Nelson and Miller's report, there is one identified tract, the Hinchinbrook Island-Hawkins Island-Cordova tract (HI-HI-C), within the analysis area that was determined to have mineral resource potential. The remainder of the analysis area, outside this tract, is considered undesignated. This means the area either lacks geologic criteria indicating potential for resources, contains resources not addressed in the report, or contains deposits having a low probability of future development activity.

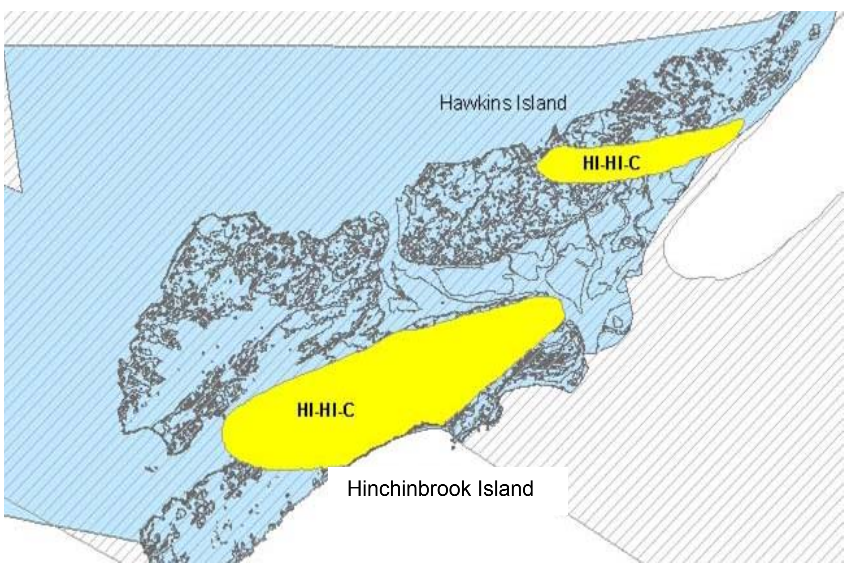


Figure 2.30 - Mineral Potential Areas for Big Islands.

The HI-HI-C tract is comprised of three separate areas, two of which are in the analysis area. Hawkins and Hinchinbrook areas of this tract are considered highly favorable for

containing undiscovered resources from Cyprus-type[5] deposits. Those areas are shown in yellow (fig. 2.30), and the grey diagonal lines indicate the undesignated area.
The analysis area contains six identified occurrences/prospects as shown in Table 2.14 and Figure 2.31.

Table 2.14 - Mineral Prospects and Occurrences

Location	ID	Name	Type	Commodity
Hawkins Island, northeast	1	Revenue	Occurrence	Copper
Hawkins Island, northeast	2	Hawkins Island 1	Occurrence	Copper
Hawkins Island, northeast	3	Hawkins Island 2	Occurrence	Copper
Hawkins Island, central interior	4	Kippin and Co.	Occurrence	Copper
Hawkins Is, south of Kippin & Co.	5	Flynn & Scott	Prospect	Copper
Hawkins Is, south of Flynn & Scott	6	Kelly & MacCormac	Prospect	Copper
Hinchinbrook Island, Port Etches	7	Hinchinbrook-Port Etches	Occurrence	Copper
Hinchinbrook Island, interior	8	Hinchinbrook Is. Manganese	Occurrence	Manganese

Occurrences[6] - The Bureau of Mines sampled Revenue, Hawkins Island 1, and Hinchinbrook-Port Etches in the early 1980s (Jansons et al. 1984). Sample results ranged from 10 to 150-ppm copper. They determined these occurrences had low mineral development potential. Hawkins Island 2 and Kippin and Company were not located and mineral development potential was determined to be “unknown”. The Hinchinbrook Island Manganese occurrence was sampled by the USGS. Their samples contained 29 to 30% manganese. The manganese-rich rock forms a 30 by 90-ft rubble area. Other minerals present include bementite, quartz, chalcedony, calcite, hematite, barite, rancieite, todorokite and birnessite. The mineral development potential is rated by the Bureau of Mines as “unknown”. Occurrences 1, 2, and 3 are may be located where surface estate is National Forest and subsurface is CAC.

[5] This type of deposit is generally found in volcanic/plutonic rocks. A geothermal system involving the igneous rock and circulating seawater produces submarine hot spring-type mineralization consisting of pyrite (iron sulfide), chalcopyrite (copper-iron sulfide), and galena (lead-silver sulfide). Gold sometimes occurs in these Cyprus-type deposits.
[6] An occurrence is a vein or other mineralized zone where no development work has occurred.

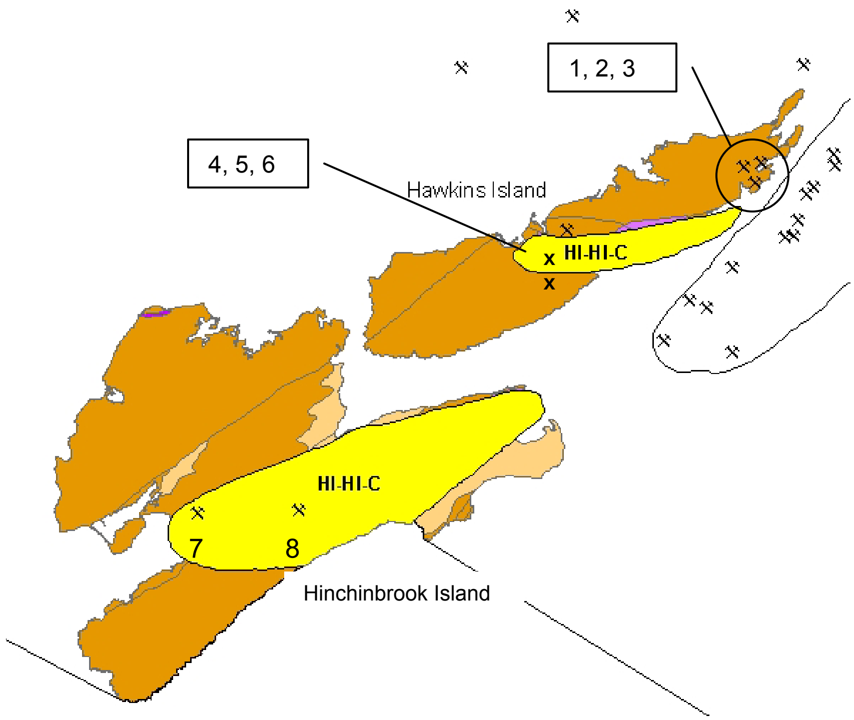


Figure 2.31 - Big Islands Mineral Occurrences and Prospects

Prospects[7] - The Flynn and Scott prospect consists of pyrrhotite disseminated in greenstone. Workings consist of one 30-foot open cut. The Kelly & McCormac prospect is a 3-foot wide shear zone through slate bedrock. A 15-foot long open cut is the only working. Both prospects contain low copper values and are rated as having low mineral development potential. The prospects (5, 6) are not on National Forest System lands.

Salable Minerals - According to the geology maps significant quaternary deposits (sand and gravel) occur primarily on Montague and Hinchinbrook Islands and are generally scarce on Green and Hawkins Islands. There is abundant resources of rock that could be used for general fill and road construction purposes. The potential for high quality rip-rap and armor stone is unknown, however massive meta-greywacke deposits are known to have produced quality rip-rap and armor stone in other areas.

Local National Forest mineral materials were used to construct and maintain the Montague Road, which was built in 1992/1993 for a timber sale on CAC lands. It was nearly 35 miles in length with 132 feet wide clearing limits and extended from MacLeod Harbor to Patton Bay. The road was closed in 1998. Some 30 pits were dug, subsequently reclaimed, and closed. CAC has indicated that they may wish to reopen and use this road sometime in the future. They would have to apply for a permit at that time.

Reserved/Outstanding Mineral Rights - CAC owns parcels of surface and subsurface estate on Montague Island, Hinchinbrook Island, and Hawkins Island (Figure 1.2). On Hinchinbrook Island, CAC's subsurface estate underlies Eyak Native Corporation surface

[7] A prospect is a mineralized vein or zone where some workings have occurred, such as an adit, open cut, shaft etc.

estate, but on Hawkins Island, CAC owns 11,600 acres underlying EVOS surface estate which is National Forest System land. CAC has the right to develop the mineral resources in their subsurface estate and their rights include title to the mineral and the necessary authority to enter upon and use as much of the surface overlying the mineral estate as is reasonably necessary to explore for, develop, extract, and process the minerals.

Visual Resources

The Big Islands analysis area is composed of a diverse range of scenic landscapes. These landscapes generally have a natural appearance with few human-caused alterations. The analysis area is characterized by irregular coastlines, steep U-shaped valleys, glaciers, and other evidence of current and past glaciation. Saltwater is a strong unifying factor, both as a means of access and a foreground feature in characteristic views of the area. Snowy glaciated alpine backdrops are also typical of Prince William Sound views. Vegetation between the water and the ridges exhibits diversity in patterns, textures, and species. (USDA Forest Service 1989)

Coastlines vary from sandy beaches, such as Patton Bay, to steep rocky cliffs common to much of the Gulf of Alaska side of Montague Island. While the ridgelines down the center of both Montague and Hinchinbrook islands have examples of the glaciated and snow-covered terrain common to the mainland north of the Sound, large, relatively flat areas are more prevalent in the analysis area than on the mainland. The muskeg and tundra pond complexes on the north end of Montague Island and over much of Green Island add to the islands' diversity and broad and relatively lengthy valleys like the Nellie Martin drainage also serve to distinguish the islands from the remainder of the Sound. (USDA Forest Service 1989)

Most use on the islands tends to focus on public recreation cabins. Thus the landscapes seen from the cabins are highly sensitive. Small boat anchorages not associated with cabins, e.g. Port Chalmers, Rocky Bay, and Zaikof Bay, are also landscapes that are commonly viewed and are moderately sensitive. Sport fishing areas like the Nellie Martin River and Shelter Bay are also often seen by the recreating public. The western coast of Montague Island from MacLeod Harbor north to Hanning Bay is a Sensitivity Level 1 middle ground based on high sensitivity viewpoints across Montague Strait. None of the area is subject to the intense level of visitation and visual scrutiny associated with the heavily-used transportation corridors or developed recreation sites located on the Kenai Peninsula. (USDA Forest Service 1989)

The highest use travel corridor near the analysis area , the Alaska Marine Highway route, skirts the periphery of the islands and offers travelers distant views of the islands. These views reveal little detail of the islands landscapes. The Scenic Integrity Objective for most of the analysis area is coded as High, while 12,309 scattered acres on Montague and Green Island, 1913 acres on Hinchinbrook and 1166 acres on Hawkins are coded as Moderate. The RNA portion of Green Island is coded as Very High. Private land is not coded. The Forest Plan provides standards and guidelines for meeting these objectives.

Because of the limited access, use, and habitation of the islands, their overall appearance is quite natural with relatively isolated cases of changes created by humans. Before the road was built and harvest took place on the private lands on Montague Island, it was determined that 98.5% of the analysis area was still natural in appearance. Only 1.5% of the landscape had been altered and only 0.3 % was dominated by human alterations. (USDA Forest Service 1989) The 34-mile road from MacLeod Harbor to Beach River has been decommissioned and recontoured and vegetation is growing back on the old road bed. Not much is noticeable from the shore, but it is visible from the air. Adding what can be seen of both the harvest and road, brings the altered state up to 2.5%.

Chapter 3 – Issues and Key Questions

Physical

What is the potential for flooding and debris flow events on the Big Islands? Extremely high precipitation and high flood flows per unit area are major driving forces that influence the geomorphology of the Big Islands analysis area. Data from several weather stations and two stream gauges are evaluated to address this issue.

How does tectonic uplift affect the morphology of stream channels and lakes? Uplift of the Big Islands during the 1964 earthquake resulted in considerable changes in stream channels and lakes in the area. These changes are evaluated using aerial photography prior to and after the 1964 earthquake.

What is the role of large woody debris in streams on the Big Islands? Large woody debris is essential for stream habitat and channel function on the Big Islands. Past human uses have affected the amount of LWD in streams.

What are the effects of motorized uses on soils, streams, wetlands, and water quality on the Big Islands? Off-highway vehicles have the potential to affect hydrologic processes and cause damage to streams, streambanks, and wetlands. These effects are evaluated using direct observations in areas where these activities are occurring. What is the likelihood that Hinchinbrook Island and other areas of Hawkins Island will develop the same level of use that is degrading soil conditions in the Canoe Pass area?

How does the obliterated logging road on Montague Island affect hydrologic processes? Lingering effects of the Montague Island logging road may continue to affect or may potentially affect hydrologic processes. These impacts are evaluated using direct observations.

Fish

What are the long term effects of the Exxon Valdez Oil Spill and the 1964 earthquake? What are the long term effects of these two events on salmon habitat and populations in the analysis area? Is oil still present on any beaches in the analysis area? What were the impacts of habitat improvement projects after the earthquake and oil spill? Refer to the fisheries section in Chapter 4.

What are the effects of commercial fishing, salmon farming and ranching? What impact might farmed or hatchery fish have on native and wild salmon populations? How are straying salmon from the remote release sites and other hatcheries in PWS affecting wild salmon in the analysis area? Are there genetic impacts? Reduced survivorship? Refer to Chapter 4 fisheries section.

Are farmed Atlantic salmon present in the Big Islands? See Chapter 4, fisheries section. It is desired that Atlantic salmon will not establish breeding populations in the freshwaters of the analysis area. An aggressive approach will be taken toward the prevention and extirpation of exotic Atlantic salmon. The ban on salmon farming will continue in Alaskan State waters.

How much OHV use occurs on Hinchinbrook and Hawkins Island and what effect is this use having on fish resources? Are exotic plant species being transported to and established in these areas and how do these species effect wetlands?

What are the effects of increased human use and remote floating lodges on fish habitat and populations? Will the outfitter guide lodge in MacLeod Harbor increase use on Montague Island? Will sport fish and other recreational use increase in the analysis area as the demand for remote wilderness experiences increases? Will a proposed lodge and gas station facility near Knight Island change recreation use patterns on Montague? What are the effects of an increased number of special use permits on fish populations and habitats?

How much and in what condition is the current fish habitat on the Big Islands for the key species? Where are the major spawning and rearing habitats for the key species? Refer to chapter 2 fisheries section.

Should the control structure at the outlet of Stump Lake be maintained? Would removing the structure drain Stump Lake and reduce habitat for sockeye and coho salmon? If the dike remains, should a more permanent structure be constructed to ensure long term structural integrity?

Vegetation

Could any Threatened, Endangered or Sensitive plant species occur in the area? Yes. Refer to Chapter 4, Vegetation section.

Are there any invasive plant species? It is unknown, but there is potential; see Chapter 4, Vegetation section.

Wildlife Issues

What are the Threatened, Endangered and Sensitive species in the analysis area and what is their status? How about invasive species? See Chapter 2, Wildlife section.

What is the distribution of game species in the analysis area? This includes those species popular for wildlife viewing. See Chapter 2, Wildlife section.

What habitats are important to brown bears on Montague, Hawkins and Hinchinbrook Islands? See Chapter 2, Wildlife section

Will human activity disturb nesting seabirds, Steller sea lions, or other wildlife? See Chapter 2, Wildlife section.

Heritage Resource Issues

There is concern that the tribes be consulted on all heritage resource questions and projects. In accordance with Section 101(d)(6)(B) of the NHPA, the Forest Service consults with any Indian tribe or Alaska Native corporation that attaches religious and cultural significance to properties in the area of potential effects for an undertaking. In accordance with this requirement, the Forest Service consults with the Native Villages of Eyak, Tatitlek, Chenega, and Yakutat and the Chugach Alaska Corporation. Consultation will be for the purpose of eliciting views of Indian tribes on all aspects of the Section 106 compliance process…during the earliest feasible steps of project planning. This consultation shall be initiated before any other public involvement procedures, in order to identify and resolve possible concerns about the confidentiality of information on historic properties. In addition, if projects will take place in the vicinity of known sites of Native cultural and religious significance, or within CAC 14(h)(1) selections, direct consultation regarding that particular project will occur. Currently, projects that would impact selected 14(h)(1) sites are being avoided.

Mining and minerals potential

Are the lands open to mineral entry? All public domain lands are open to mineral entry under the 1872 Mining Law unless specifically closed. On lands open to mineral entry, mining claims can be located and the mineral resources can be developed. On closed lands, leasing or sales of mineral materials may still occur. However, both leasing and mineral materials sales are discretionary. State select lands are closed to mineral entry.

How does CAC subsurface ownership affect management of National Forest System land? The area on Hawkins Island where CAC owns the subsurface estate and the surface estate is National Forest System land are generally called "split estate" lands. The Forest Service must allow CAC to develop the mineral resources of their subsurface.

CAC's rights described above are analogous to the rights discussed under "Are the lands open to mineral entry"? Generally, mineral rights include title to the mineral and the necessary authority to enter upon and use the surface overlying the mineral estate as much is reasonably necessary to explore for, develop, extract, and process the minerals.

Additionally, CAC has asserted that their mineral rights include sand and gravel. While sand and gravel have more often then not been considered belonging to the surface estate, some sand and gravel cases in Alaska involving ANILCA lands have been decided in favor of the subsurface estate owner. So, it is not entirely clear at this time, whether the surface estate owner (Forest Service) or the subsurface estate owner (CAC) owns the rights to the sand and gravel.

What is the potential for mineral development? The potential for mineral development is low in the analysis area. See chapter 4, mineral potential.

Is there a demand for sand and gravel from National Forest System lands? Where state and private sources are adequate to meet local needs then the Forest need not provide community pits or offer mineral materials sales. If such sources are not adequate, then the

Forest should make such resources available for local needs. Since the government does not sell mineral materials for profit, it is generally not appropriate to compete with private sources. It is the policy of the Forest Service to dispose of mineral materials in compliance with the Forest Plan and only when the authorized officer determines that the disposal is not detrimental to the public interest and that the benefits to be derived from a proposed disposal exceed the total cost and impacts of resource disturbance (FSM 2850). Mineral materials must be sold at fair market value.

Recreation, Easements, and Special Uses

Concerns were raised about increased hunting pressure on Green Island and Montague Island. Concerns were raised about increased trash left behind by people hunting and using cabins. Monitoring this use was suggested so we could get an idea of the impacts.

Concerns were raised about location of cabins near private land and the potential for trespass and vandalism, especially of cultural resources. A suggestion was made to move these cabins to areas surrounded by National Forest.

A concern was raised about location of cabins in bays where boats can anchor. A suggestion was made to locate cabins in bays or areas not used as anchorages to separate visitors.

There is concern about the increase in negative impacts of more users in the Sound as a result of the road to Whittier and high speed ferry to Cordova. This increase in use is expected to create a variety of recreation management problems related to over crowding and displacement of existing users, impacts on upland areas and coastlines, and public facilities throughout the Sound. In an APU survey conducted for the Forest Plan revision of Alaska residents in the 12 communities near or in the Chugach National Forest, nearly half of the respondents felt that the Forest Service should only create new facilities to mitigate expected adverse environmental impacts. Another 37% favored creating additional facilities to expand public recreation opportunities throughout the Sound besides mitigating expected impacts. (Crone 2002)

Concerns were raised about trespass on private lands as a result of cabins, easements, and special use permits on National Forest System lands. One of the main concerns is trespass occurring on Native corporation lands which, in part, is generated by the very existence of public access easements or special use activities authorized by Forest Service permits. This issue goes beyond Forest boundaries; it is the leading easement issue statewide. The Forest Service has increased efforts to ensure that the public is better educated to the legal uses of easements and ensuring easements are well signed with this information. Maps are left at the public recreation cabins at Beach River and Nellie Martin River to reduce trespass on CAC lands in the area. The Native corporations and the Forest Service communicate, coordinate, and consult regularly on easement issues.

The Cordova District is increasing its efforts to consult with the Native corporations when planning projects and considering special use permit activities. The Cordova

District and Eyak Native Corporation have cooperatively developed an Memorandum of Understanding (MOU) which highlights the ways they can work together.

There is concern about loss of easements due to river channel changes. Another issue occurring along the Beach River and Patton River easements as well as other locations on the district is the erosion or accretion of riverbank material which reduces or adds to the land base upon which access rights to easement sites and trails exist. By normal legal definitions for example, if a site easement is eroded, it is lost and there is no legal obligation by the landowner to replace it with another. The Forest Service and Native Corporations are addressing this issue on a case by case basis.

Chapter 4 – Conditions and Trends

Disturbance regimes and geomorphic processes

The disturbance regimes in the area include tectonic activity, wind and wave action, insect and diseases, erosion processes, and minor amounts of human caused disturbance. Glacial influence on the islands is confined to the past, since the glaciers that are present today are small remnants.

Climate

The climate throughout Alaska has gradually become warmer over the past century. Records show that the average annual temperatures at the Cordova airport have increased about 3^{o}F over the past 50 years (Western Regional Climate Center 2004). Climatic warming can have long-term effects on the hydrologic processes in the Big Islands area. During the most recent Pleistocene glaciation, glaciers covered most of the area. Glacial recession began in the Holocene about 12,000 years ago, and glaciers are currently almost completely absent from the Big Islands. The small glaciers on Montague Island have been receding over the last century, and only small remnant glaciers currently exist at high elevations. Only a few small permanent snowfields remain on the high peaks of Hinchinbrook Island.

Tectonic

The islands are located in a very active (Zone 4) seismic belt which rings the Pacific Ocean. This zone has the highest potential for earthquakes large enough to do structural damage. The greatest recorded movement was from the 1964 earthquake which uplifted the south end of Montague Island 38 feet. The uplift created low flat shorelines, especially on the southern half of Montague Island. Along the shore, there are smooth and rounded marine terraces that were lifted above the water by tectonic events. These terraces were smoothed and rounded by wave action before the uplift.

Hillslope erosion processes

Hillslope erosion processes can be looked at in terms of landslides and surface erosion. Surface erosion is normally not a problem in areas as well vegetated as the analysis area is, with the exception of recently exposed surfaces. Recently exposed areas can be found where there is continual frost shattering and sloughing off material at the higher elevations, particularly in the Mountain Summit Landtype Association on Montague Island. Avalanches can also remove the vegetative protective cover and contribute to surface erosion. Landslides are not common in the analysis area but when a management activity is considered, critical slope stability factors should be evaluated.

The potential for landslides on forested lands is dependent on several factors. Douglas N. Swanston (1997) developed a rating system for slope stability on the Tongass N.F., which factored in topographic attributes, soil properties, geology, and hydrologic conditions. Areas are evaluated based on their slope, topographic position, and any subsurface restrictions. These criteria are individually rated and the total score of a particular site can be used as an indication of its stability. This system was later modified for use on the Chugach N.F. by Dean Davidson (Appendix C). Slope gradient tends to be the most critical factor. Landslides most frequently occur on slopes greater than 72% (Swanston 1997) and between 72% and 56%, stability depends on other factors such as topographic position and restrictive layers. Slopes less than 56% are less likely to fail unless there are other critical limitations. The Mountain Sideslopes unit is particularly susceptible to landslides based on these criteria. Many of the soils in these units are underlain by compact glacial till that can serve as a slippery surface if water is restricted and starts to flow just above it.

Overlaying the Mountain Sideslopes LTA on areas with slopes greater than 56% gives a preliminary overview of potentially unstable sites. Hawkins Island has a few areas of potential problem sites, on the south facing slopes running east from Canoe Passage and just above Mud Bay on the southeast side of the island (Figure 4.1).

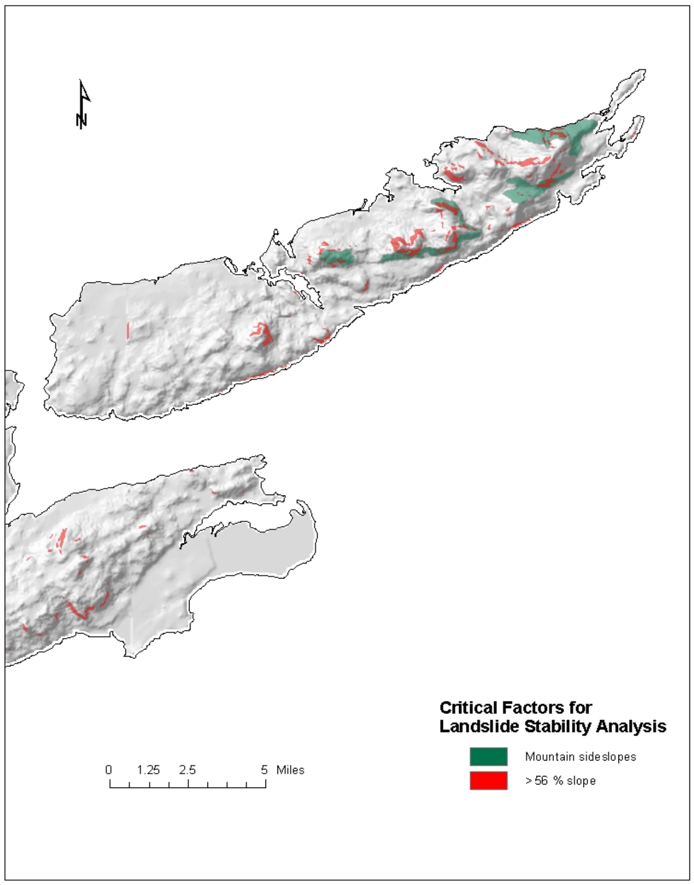
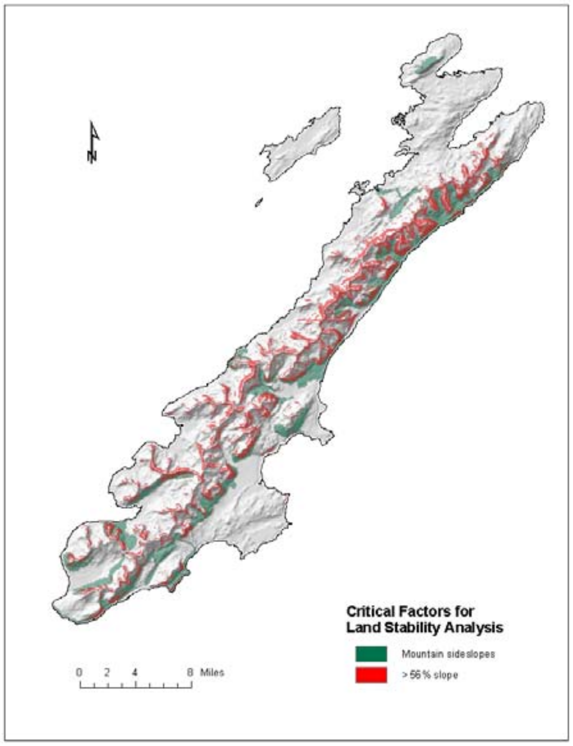


Figure 4.1 - Overlap of Mountain sideslopes LTA with slopes greater than 56 % on Hawkins Island.

Hinchinbrook Island also has several south facing slopes with similar characteristics running southwest above Honker Creek through the pass to Constantine Creek and just above Constantine Harbor (fig. 4.2). A similar overlap of critical factors occurs north of Nuchek Creek and along the southwest end of the Island. Montague Island exhibits similar features along many of its southeast facing slopes (fig. 4.2). All of these sites have the potential of being problematic but a final determination is made by carrying out a complete landslide stability analysis on any proposed project site.



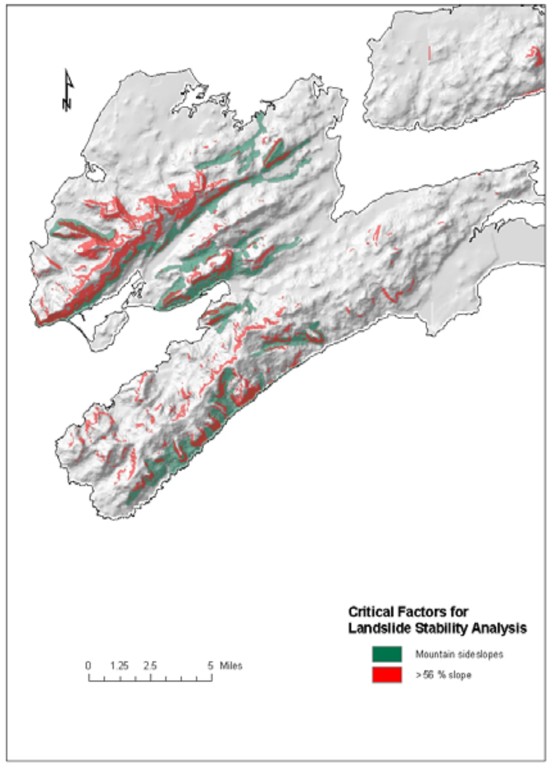


Figure 4.2 - Overlap of Mountain sideslopes LTA with slopes greater than 56% on Montague and Hinchinbrook Islands

General hydrologic trends

Streamflows

Very high precipitation and small, steep, flashy watersheds in this area result in extremely high unit streamflows. The highest streamflows per unit drainage area are on Montague Island, where a high potential exists for debris flows and high sediment loads. The flow regime has likely not changed during the past century, although no flow data exist prior to 1967. Floods do not have great impacts on human uses on the Big Islands because of the lack of human development, trails, or roads.

Stream Channels

Because of extremely high unit streamflows, the high relief, and the unstable geology, stream channels in this analysis area can be highly dynamic. High gradient channels that are confined in steep valleys do not migrate laterally, but are capable of transporting high sediment loads and debris during floods. Lateral channel migration is likely to occur in the areas of flat topography and on the uplifted beach terraces. Channel types have been verified on only a small percentage of the stream reaches of the Big Islands.

Tectonic uplift has occurred throughout the geologic history of the analysis area. Uplift from the 1964 earthquake caused major changes to stream channels, and the greatest effects were on Montague Island where the greatest uplift occurred. The uplift essentially lowered the base level of the streams, which resulted in channel steepening in the lower reaches and channel incision as the streams worked to re-equilibrate to the new base level. Channel incision led to increased sediment loads, and headcuts formed and migrated several miles up the channel during this transition process. Some channels also changed their courses as a result of the 1964 earthquake. The affected streams will become more stable over time until the next uplift event.

Lakes

Dramatic geomorphic changes have occurred on lakes on Montague Island as a result of tectonic uplift. Stump Lake was once an ocean bay, with a baymouth bar at its mouth deposited by sediment transported by wave action in the Gulf of Alaska. The baymouth bar sealed off the bay, creating a freshwater lake. Erosion from the outlet stream was balanced by sediment deposition from the ocean waves. The 17 to 18 feet of uplift from the 1964 earthquake disrupted this balance and allowed the outlet stream of Stump Lake to incise into the predominantly fine sediment, lowering the level of Stump Lake by 5 to 6 feet between 1964 and 1990 (Blanchet 1990).

In the 1990s, due to concern that continued incision would completely drain Stump Lake and negatively impact the sockeye population, a weir and a series of boulder drop structures were built on the outlet stream to maintain the lake depth and prevent further channel incision. A similar event occurred in San Juan Bay at the southwest end of Montague Island. At this site, the lake drained completely and was replaced by a wetland meadow. This process has likely occurred elsewhere on the Big Islands as a result of uplift in the past.

Large Woody Debris

Large woody debris (LWD) was physically removed from many streams on Montague Island from the 1950s to 1970s to facilitate transportation of logs down the streams during logging operations and to remove barriers to fish migration. No logging has occurred on National Forest System lands since 1978, and natural recruitment from the surrounding forest is returning LWD to these streams. Because high flows have the potential to flush logs downstream, generally only the largest wood stays in the streams. LWD is a vital component of these streams, as it regulates flow hydraulics and influences fish habitat and forms pools and depositional areas vital to the stability of a stream. It is unknown how much LWD is currently in the streams where it had been removed.

Abundant wood from numerous sources washes up on the southern coasts of Montague and Hinchinbrook Islands as a result of wave action from the Gulf of Alaska. This often results in enormous log jams at the mouths of streams. These log jams can control the morphology of stream channels and create barriers for fish. The log jam at the mouth of Stump Lake is hundreds of feet wide, and the stream meanders beneath the logs.

Effects of Human uses on Hydrology

Motorized use - Summer motorized use is permitted on designated routes on the northern portion of Hinchinbrook Island, and summer motorized use is allowed for subsistence uses on portions of all of the Big Islands. No routes are currently designated. Off-highway vehicle (OHV) use does not have a widespread effect on the resources, but severe erosion from vehicle tracks, as well as bank and channel damage at stream crossings have been documented in some areas (Farzan 2003). A high potential for increased resource damage exists if use increases. Designated routes and stream crossing structures are needed.

A preliminary partial investigation of the effects of OHV use on Hinchinbrook and Hawkins Islands was conducted to determine the extent of these effects (Farzan 2003). Little resource damage was observed on Hinchinbrook Island, but moderate to severe effects were observed in the Canoe Passage area on the north side of Hawkins Island. Resource damage occurs where motorized use is more concentrated, and in forested areas where use is confined to single trails and the ground cover is more sensitive to disturbance. User-made culvert structures have been constructed at small streams using logs and culvert pipe, but the stream banks at these locations have become muddy bogs.

Hydrological effects of OHV use occurs when the use becomes concentrated enough to damage the vegetative cover. Decreased vegetation causes infiltration rates to decrease, and runoff begins to accumulate. On steeper sections, rainfall runoff can cause rutting, erosion, and incision of channels into the road surface. This can affect water quality and sedimentation levels downstream. Stream crossings are particularly sensitive to OHV use. The stream banks, composed of mostly fine materials, are easily broken down, often turning into muddy bogs. This can cause considerable channel widening, water quality degradation, and degradation of fish habitat.

Winter motorized use is allowed on Montague Island, but use is very limited because of difficult access. Snow machine use in low elevation areas when snowpacks are thin can potentially cause resource damage.

Montague Island Road – CAC constructed a road from MacLeod Harbor around the southwestern end of Montague Island to access their lands in Beach River drainage. The road is on National Forest System lands and traverses mostly flat, uplifted beach terraces and muskegs, crossing numerous small drainages. The road was obliterated in 1998, and the log stringer bridges were removed. Currently, the old road is revegetating, although some bare areas are still present. Old bridge sites have eroding banks or eroding fill material that can deliver sediment to streams. Lang (2002) identified a few “problem areas” along the road. At Mile-25, up to 35 feet of fill exists over two small culverts. If these culverts were to become plugged or if the fill slope were to fail, a large amount of sediment would be transported downstream. In addition to potentially harming fish habitat, hydrologic effects of such a failure would include alteration of stream morphology and degradation of water quality. Other hydrological effects associated with this road include erosion on steeper gradient portions of the road that are not revegetated and bank erosion at stream crossing sites. However, the majority of the road is recovering well and will continue to improve over time.

Conditions and trends of fisheries resources

It is desired that Pacific salmon populations, keystone species in this ecosystem (Willson and Halupka 1995; Cederholm et al. 1999), be maintained at or above the levels documented in this analysis. Human induced impacts can reduce the ability of streams to express their full range of variability and experience all possible habitat states (Ebersole et. al. 1999). Recent management objectives at the landscape scale have stressed the importance of maintaining a historical range of natural variability (Swanson et al. 1994; Kaufmann et al. 1994). This analysis provides a recent, partial account by which to compare future fish population trends and habitat conditions.

The physical parameters that affect fish habitat are:

- Steep, flashy, headwater streams combined with low gradient, glacial-outwash flood plain channels.
- High rainfall/high flows, especially in the time period of August thru October.
- Channel morphology- uplift and subsidence.
- Cold winter temperatures – overwintering habitat for juvenile salmonids.

The biological parameters that affect fish habitat are:

- Alder presence in riparian vegetation – Nitrogen fixation, alder is likely an important source of Nitrogen to aquatic systems.
- Spawning salmon – provide food and marine derived nutrients in the form of carcasses and eggs. This food and nutrient source is important for juvenile salmonids and overall aquatic system productivity.

The human activities that affect fish habitat are:

- Commercial, sport, and subsistence harvest.

Population trends of the key fish species

Recent population trends for pink and chum salmon in the analysis area can be seen through harvest and escapement data collected for the Montague and Southeastern Districts (Figures 4.3 and 4.4). Salmon returns have been quite variable over time. This variability can most likely be attributed to many factors, both environmental and human-induced and their cumulative effects. Two major events in the Sound that appear to have negatively affected the abundance of salmon are the 1964 Earthquake and the *Exxon Valdez* Oil Spill.

Chum Salmon - Chum salmon appear to have been particularly affected by the earthquake. It is believed that the combination of the earthquake followed by severe cold winters from 1969 to 1973 caused the decline of wild chum salmon on Montague Island from the mid 70s to the 90s (fig. 4.3; Solf 1973). In the Southeast District (fig. 4.3) and other areas of PWS (Gray et al. 2003), chum salmon had recovered from the effects of the earthquake by the 1980s. This was not the case on Montague Island (fig.4.3), probably because stream habitat in the estuaries on this island were the most impacted by the earthquake (Roys 1971) and chum salmon depend on these habitats for spawning and early rearing.

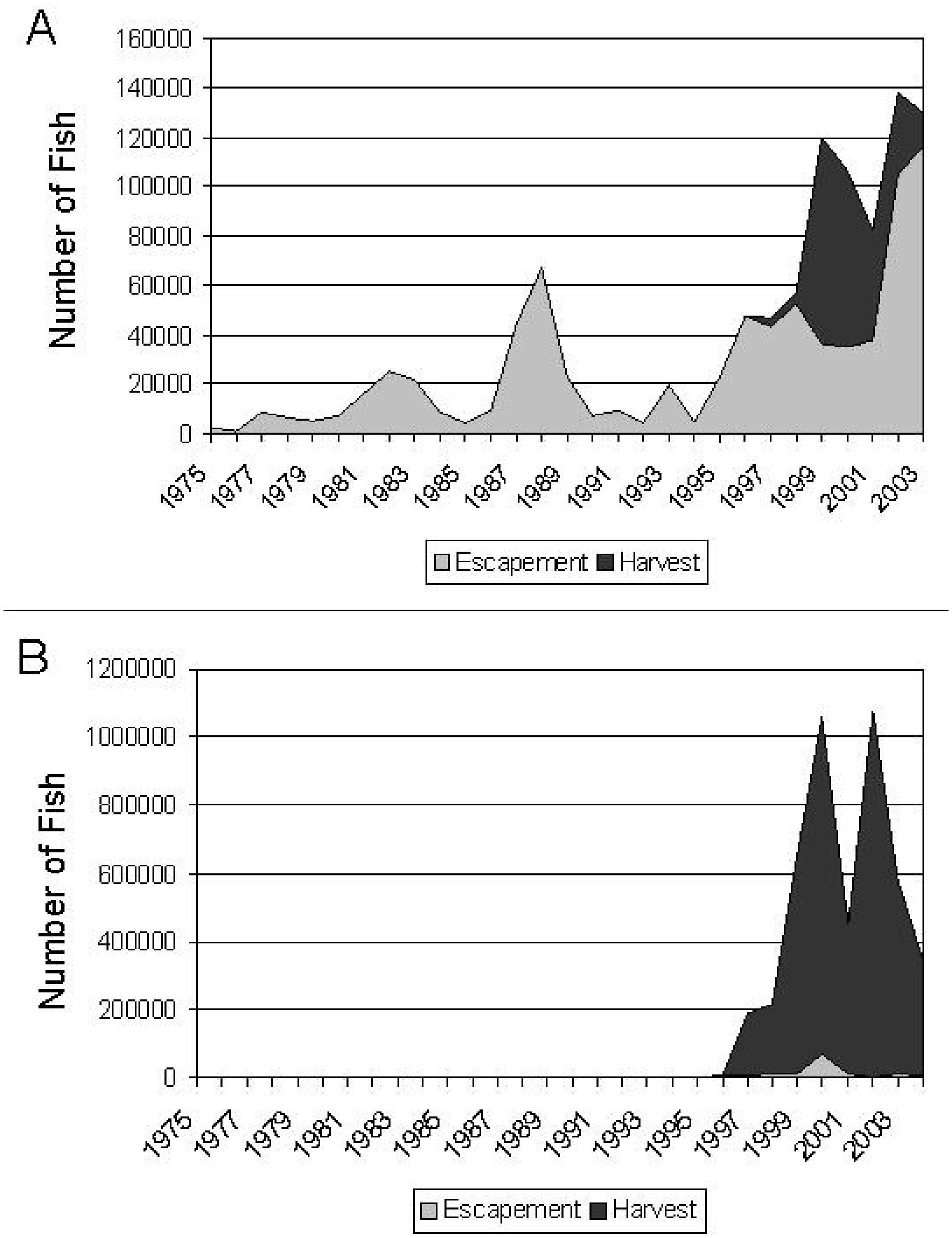


Figure 4.3 - Estimated return of chum salmon to the analysis area shown as the relative contribution of both commercial harvest and stream escapements of chum salmon from the Southeast (A) and Montague (B) Commercial Fishing Districts. Data from ADFG.

Logging and early stream enhancement projects may have hindered the recovery of chum salmon on Montague Island. Many of the streams on the north side of the island from Port Chalmers to MacLeod Harbor were logged after the earthquake (Table 2.12 in Chapter 2). Approximately 50% of the anadromous habitat (31 miles of stream) was impacted by timber harvest. These stream habitats included the riparian area adjacent to the harvest and the habitat downstream from the harvest. Also, early stream enhancement projects (Table 4.1) designed to improve habitat may have had the opposite effect. Removal of trees from the riparian areas and channels would be particularly harmful when streams were in an unstable state and attempting to re-establish equilibrium. Large wood plays an important role in channel stabilization processes and in creating spawning and rearing habitat for salmonids. The enhancement projects did not show short term benefits to survival of pink salmon alevins or escapement when comparing treated versus untreated streams (Solf 1973). These projects were joint Forest Service and ADFG operations (Solf 1973; USFS, Cordova Ranger District, unpublished data). Wood removal and stream cleanings were often done in conjunction with logging operations on National Forest System lands (Figs. 4.6 and 4.7).

Chum salmon escapement in streams on Montague Island has risen in recent years (fig. 4.3). From 1994 to 2003, the average annual escapement was 11,582. Although this escapement is below the 25,796 average level observed from the pre-earthquake brood years (1960 – 1966 returns; Pirtle 1977), it is encouraging to see the return of fish to these streams. The stream habitat impacted by the earthquake may be stabilizing enough to support natural reproduction again. Wild chum salmon returns in the Southeast District have increased greatly over the last 10 years (fig. 4.3).

Fry releases were used to boost production of chum salmon in Port Chalmers on Montague Island. In 1987, approximately 100,000 chum salmon fry from the Esther Hatchery (now Wally Noerenburg Hatchery, WNH) were released into Chalmers River (USFS, Cordova Ranger District, unpublished). Approximately 1% of these fish returned to spawn from 1990 – 1993 (ADFG escapement data; USFS, Cordova Ranger District, unpublished). In 1993, Prince William Sound Aquaculture Corporation (PWSAC) began the remote release operation at Port Chalmers. That year 12,000,000 fry from the WNH were released into the bay. The remote release has been very successful in terms of producing adult chum salmon. From 1998 to 2002, an average of 23 million fry were released annually from this site (PWSAC). Returns of adult chum salmon at Port Chalmers have averaged over 600,000 fish annually in that same time period (ADFG Annual Finfish Reports 1999 – 2003).

The origin of chum salmon returning to streams on Montague Island is unknown. They may be remote released fish straying from Port Chalmers since escapement increased. It appears more likely that they are of wild-stock lineage, probably established by strays from Hinchinbrook and Hawkins Island populations. Recent peak counts for chums in the Montague District occurred in late August (ADFG aerial surveys) and historically wild chum salmon in the analysis area were late-run fish (Pirtle 1977). The remote release fish are of early-run origin, with peak returns in June or July (Gray et al. 2003). The commercial season is over by the end of July. The early run timing was a strategy to allow independent harvest management between remote release hatchery fish and wild fish (Bert Lewis, ADFG Comm. Fish Biologist, pers. comm.).

It is desired that stream habitat on Montague Island again support natural reproduction of wild chum salmon. Escapement counts of chum salmon on this island will return to pre-earthquake levels. The remote release site in Port Chalmers will continue to provide an economically beneficial chum salmon harvest for the commercial fishery while minimizing the impact to wild chum salmon on Montague Island.

Pink Salmon - Pink salmon returns have been quite variable with the highest numbers observed during the 1980s in both Districts (fig. 4.4). Pink salmon escapement has been relatively constant through time while harvests increased greatly during big return years (fig. 4.4). Low returns occurred through the 1990s, possibly due to indirect and lingering oil contamination of juvenile pink salmon. Returns of pink salmon in the analysis area have been increasing more recently (fig 4.4).

Other salmon - Escapement data for the other species of salmon is limited. Some escapement data has been collected for species in streams where fish ladders were constructed (see Fish Habitat Enhancement Projects section of this chapter).

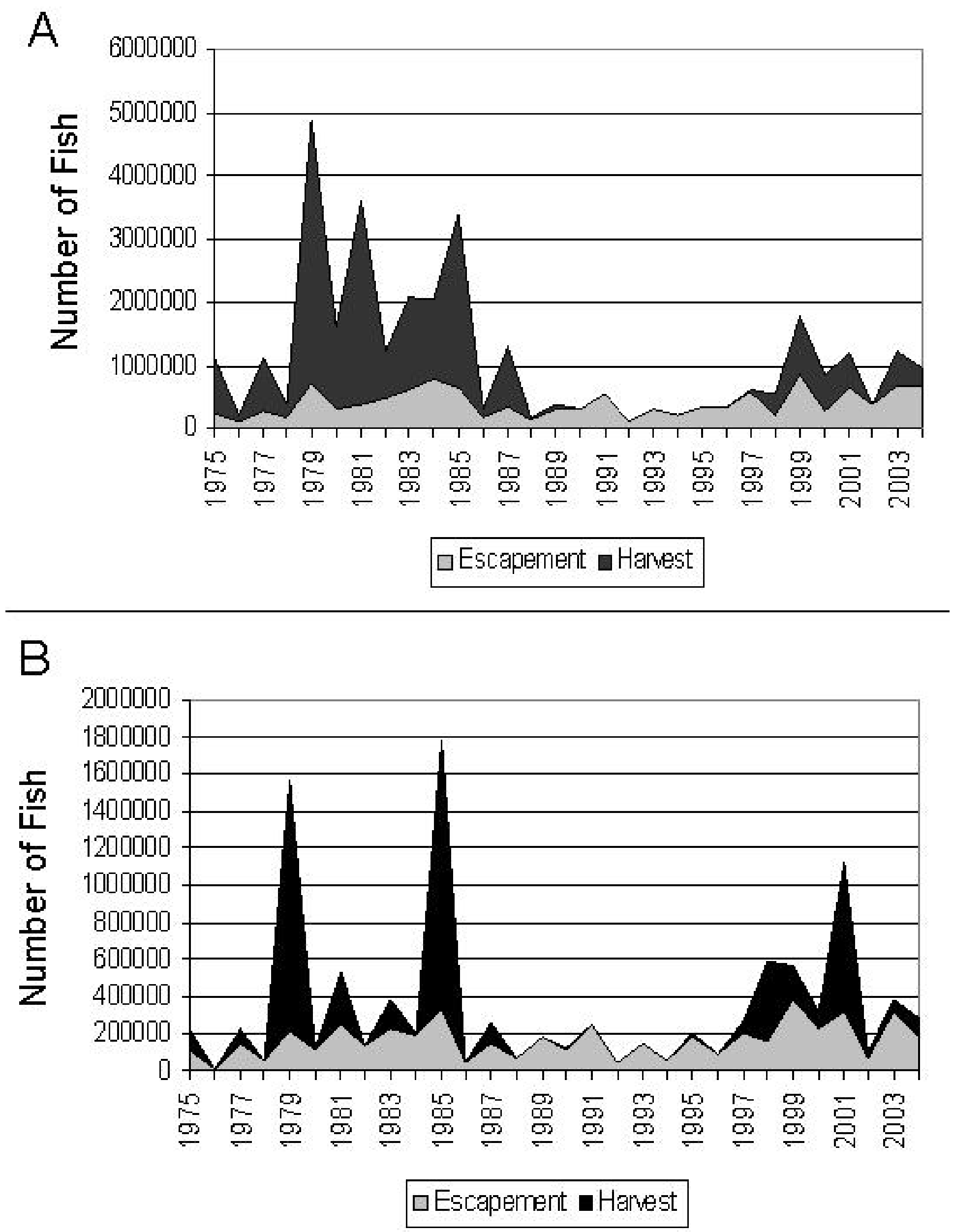


Figure 4.4 - Estimated return of pink salmon to the analysis area shown as the relative contribution of both commercial harvests and stream escapements of pink salmon from the Southeast (A) and Montague (B) Commercial Fishing Districts. Data from ADFG.

Human Influences on the fisheries resources

Commercial Fishing – Since 1889 when commercial fishing began in Prince William Sound, it has represented the largest and most persistent human-induced impact to fisheries resources in the analysis area (ADFG 1974). In the early years, sockeye, chinook, and coho salmon were the main species targeted and the Sound fishery was a secondary production zone to the Copper River Delta (ADFG 1974). From 1915 – 1959 canneries were built at Port Nellie Juan, Port San Juan, Port Ashton, Drier Bay, Unakwik, Valdez, Ellamar, Shepard Point, and Cordova (ADFG 1974) and they likely processed fish from the analysis area. Over this time period the targeted species shifted to pink and chum salmon because of the relatively large number of these salmon in the Sound and the fact that sockeye salmon populations were seriously depleted through aggressive fishing practices (ADFG 1974). Up to 1950, the annual historic catch of pink salmon averaged 6 million fish while the chum catch averaged 700,000 (ADFG 1974). However, by the late 1950s both pink and chum salmon populations were at about half of their historic averages (ADFG 1974).

After statehood in 1959, Alaska Department of Fish and Game was created and it began managing the commercial fishery in the Sound (ADFG 1974). The work included annual escapement counts of salmon in over 200 index streams throughout the Sound (Pirtle 1977) to ensure adequate escapement of brood stocks to the streams. By the mid-1980s the commercial harvest of salmon in the Sound had reached an all time high of over 20 million fish annually while at the same time maintaining a healthy escapement of salmon in the streams (Gray et al. 2003).

The PWS commercial salmon fishery is divided into distinct fishing districts that are regulated separately (Gray et al. 2002). Hawkins and Hinchinbrook Islands are in the Southeast District and Montague and Green Islands are in the Montague District (Gray et al. 2002). Currently, commercial salmon fishing only occurs in near shore waters around the islands and is done only by permitted purse seine boats. These boats target pink and chum salmon but a small number of other salmon species are harvested incidentally. In 2002, 231 chinook, 1,603 sockeye, and 149 coho salmon were harvested in the Montague District (Gray et al. 2003). Three chinook, three sockeye, and 33 coho were harvested in the Southeast District during the 2002 season (Gray et al. 2003). These fish were harvested in ocean waters and it is not known if they were destined for streams in the analysis area. Some sockeye salmon from the Boswell Bay area may be harvested in the Copper River District a few miles to the northeast.

The commercial harvest of salmon destined for streams in the analysis area can be seen through the ADFG harvest numbers for the Montague and Southeastern Districts. Chum salmon harvests have increased in recent years on both Districts (fig. 4.3). The harvest on the Montague District is composed entirely of hatchery fish released at Port Chalmers (Gray et al. 2003). Few chum salmon were harvested in these Districts prior to 1989 because of low escapement numbers. Pink salmon harvests were greatest in the 1980s when return numbers were greatest. Harvest declined significantly during the early and mid 1990s but have recently increased (fig. 4.4). Pink salmon harvest is small in these districts relative to the entire PWS where hatchery fish comprise most of the harvest (Gray et. al. 2003).

Non-salmonid fish species that have been historically harvested in the PWS include halibut (*Hippoglossus stenolepis*), sablefish (*Anaplopoma fimbria*), herring, and pollock (*Theragra chalcogramma*). Herring have not been commercially harvested in recent years due to low numbers (Gray et al. 2002).

Commercial fishing has been a major human influence on fish populations in the analysis area. Commercial fishing directly impacts populations by removing individual fish. These fish may be harvested as the target species or as by-catch during fishing for the target species. Fishing can indirectly influence populations in many complex ways that are not all fully understood. Some influences that have been documented in salmon populations include size selection (Hamon et. al. 2000), run timing (Merritt and Roberson 1986; Boatright et al. 2004), and age structure (Nordwall and Lundberg 2000). The Department of Fish and Game tries to mitigate these issues by staggering open fishing periods in an attempt to allow a representative spawning population.

Salmon Farming and Hatcheries –Salmon ranching occurs in most of the Sound. In ranching, salmon are hatched in an artificial environment (hatcheries) and then released as fry or smolts into the open ocean where they grow into adults. Returning fish are harvested aggressively by the common property fishery. The PWSAC operates 4 hatcheries in PWS where pink, chum, sockeye, coho, and chinook salmon species are ranched. The Valdez Fisheries Development Association operates one hatchery in Valdez. These fish are produced to maintain high commercial harvest levels during years of low natural production. Since the mid-1990s hatchery pink and chum salmon have comprised a significant portion of the total commercial catch (Gray et al. 2003). From 1999 – 2002 the estimated number of hatchery pink salmon contributing to the PWS commercial catch has ranged from 7.9 to 24.8 million fish (ADFG Annual Finfish Management Reports 1999-2002). Over the same period, the estimated chum salmon contribution has varied from 1.2 to 2.4 million fish (ADFG Annual Finfish Management Reports 1999-2002).

PWSAC operates a remote release site for chum salmon at Port Chalmers on Montague Island. Remote release is a form of ranching where fry hatched from a facility are transported to another area for release. The fry are held in net pens for a period of time so that they imprint on the local water. This allows them to return to the area for spawning. After imprinting, fry are released into the open water. Port Chalmers is considered a terminal commercial harvest area where the purse seine fleet attempts to harvest all returning fish.

The impact of hatchery production on wild populations is a topic of debate for fishery scientists and managers. Hatchery pink salmon can account for up to 70% of the return of pink salmon to PWS (Morstad et al. 1998). Recent returns of wild fish to streams in the Sound have been average during high levels of hatchery production (fig. 4.5). There is concern that hatchery production has begun to replace natural production in the Sound, likely through competition for resources in the estuary and ocean environment (Hilborn and Eggers 2000). Wertheimer et al. (2004) estimated that a relatively small replacement may have occurred (up to 4.6 million) in the Sound, but argued that the level of wild salmon production was more related to local fluctuations in climatic and other regional environmental factors. They also noted that hatcheries provide millions of dollars in economic benefits to the salmon fisheries of the region. The financial contribution of hatchery fish is significant; the hatchery value to the PWS commercial salmon catch in the 2002 season was over 9 million dollars (Gray et al. 2003).

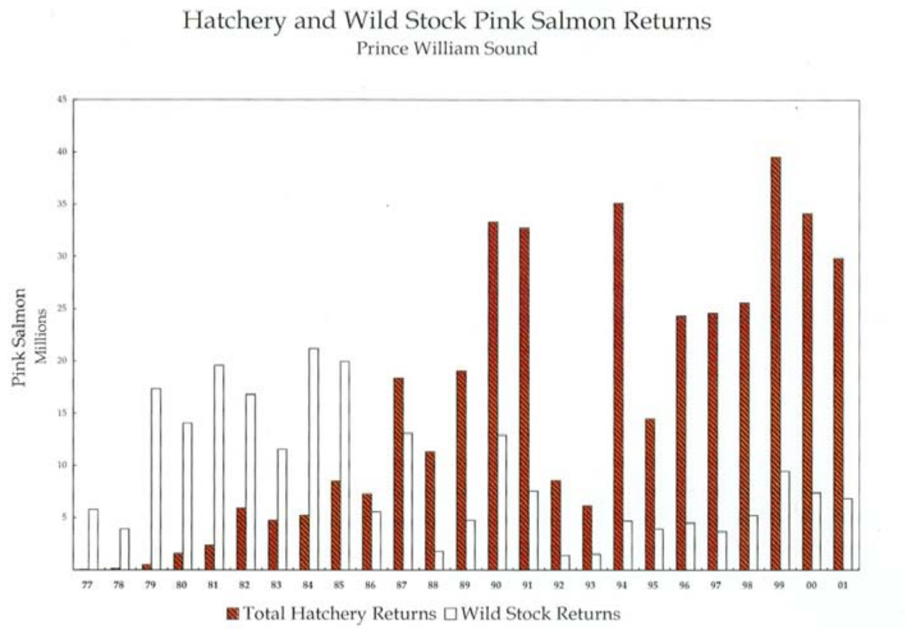


Figure 4.5 - Total return (escapement and harvest) of hatchery and wild pink salmon in PWS from 1977 – 2001. Data from ADFG (Gray et al. 2002).

The ecological factors associated with hatchery production in PWS are not known and may not be apparent for years. Interbreeding between wild and hatchery populations could occur (Joyce and Evans 1999). If interbreeding hatchery fish carry less fit genotypes that limit survival, wild fish populations may become less productive over time (Utter 2002). Upstream spawning populations of wild pink salmon in the Sound can be genetically distinct (Seeb et al. 1999) and likely adapted to local environmental conditions. For instance, on Montague Island, the small steep stream systems can have very low flows during dry periods in mid summer (June and July). The late-run timing of pink and chum salmon on Montague Island (August and September) probably is an adaptation to this local environmental condition. Interbreeding with hatchery fish could disrupt this adaptation in small, locally adapted populations.

In PWS wild fish genes have been incorporated into hatchery fish through brood stock recovery techniques (Habicht et al. 2000). Certain hatchery and wild stocks are more closely related depending on the initial brood stock collection, the location of the hatchery, and the migration path of the wild stocks (Templin et al. 1998; Seeb et al. 1999; Habicht et al. 2000). Genetic mixing occurs when wild salmon are captured during brood stock recovery in route to their spawning streams. Genetic analysis shows that there is little distinction between Armin F. Koernig hatchery fish and the wild even-year pink salmon stocks throughout the Sound (Seeb et al. 1999).

Salmon ranching in the Sound can have negative effects on wild salmon in the analysis area. Hatchery fish enhancement may lead to replacement of wild salmon through density dependent and mixed stock harvest interactions (Hilborn and Eggers 2000). Adult hatchery pink salmon have strayed into spawning streams of wild populations (Joyce and Evans 1999). Straying results in direct competition for spawning area with wild fish. More importantly, it can introduce hatchery genes into wild populations through reproduction and lead to decreased fitness and genetic diversity of wild salmon populations (Utter 2002).

Salmon farms in coastal British Columbia pose a great threat to wild salmon stocks in Prince William Sound and throughout Alaska. There are at least 90 operational farms in British Columbia, the most northern of which is in the Straight of Georgia at Bella Bella (ADFG 2002). Farmed salmon are hatched in artificial environments and then grown in near-shore net pens for their entire life until harvested. Since 1991, hundreds of thousands of farmed fish have escaped from these net pens. Escaped fish can have detrimental effects on wild salmon populations through competition, predation, disease transmission, and hybridization (ADFG 2002).

The possible spread of Atlantic salmon in Alaskan waters is of great concern. Chinook, coho, and Atlantic salmon have been farmed since the early 1970s. Atlantic salmon have become the most commonly farmed species since the late 1980s because of their adaptability to captivity, fast growth, and wide ranging spawn time that ensures year round availability to the market (ADFG 2002). A Canadian government moratorium on new farms was lifted in 2002 and the industry is expected to expand in the future (ADFG 2002). Atlantic salmon are an exotic species in the Pacific Ocean. Farmed Atlantic salmon have successfully reproduced in streams in British Columbia (Volpes et al. 2000).

Atlantic salmon have already been documented in PWS and the nearby Copper River Delta fisheries. One confirmed Atlantic salmon was captured by a seine boat in Valdez Arm in the early 1990s and two have been reported in the Copper River Delta gillnet fishery over the last 3 years (Steve Moffitt, ADF&G research biologist, personal communication). Atlantic salmon have been caught recently in a freshwater stream in the Yakutat area (NAS Database 2005). These juvenile salmon can compete for resources with wild fish (Volpe et al. 2001). Atlantic salmon may not have been caught in the analysis area yet because the streams are remote with limited access, and therefore, are rarely visited by recreational users.

Oil Contamination – the Port of Valdez is the terminus of the 800-mile trans-Alaska pipeline where millions of gallons of crude oil is stored, loaded onto tankers, and shipped through the Sound each year (http://www.alyeska-pipe.com/pipelinefacts.html). In March of 1989, 11 million gallons of oil was spilled when the tanker *Exxon Valdez* struck Bligh Reef (Spies et al. 1996). The spill contaminated hundreds of miles of coastline in western PWS and was the largest spill ever in US waters (Spies et al. 1996). Although safeguards have been enacted to prevent future spills, the possibility of another large spill is present.

The effects of the *Exxon Valdez* oil spill on salmon resources in the Sound have been well documented (Rice et. al. 1996). Commercial salmon fishing was essentially closed for the 1989 season in the western part of PWS (Spies et al. 1996). Oil contaminated both inter-tidal spawning and near-shore rearing areas of pink and chum salmon and had immediate and lingering effects. Two months after the spill, juvenile pink salmon rearing in near-shore areas exhibited slower growth at oiled versus non-oiled sites (Willette 1996). Pink salmon embryos and alevins from oiled sites had elevated hydrocarbon levels as long as 2 years after the spill (Wiedmer et al. 1996). From 1990 to 1992, wild pink salmon returns in western PWS were estimated to be reduced from 6 – 28% as a result of the spill (Geiger et al. 1996). Presumably chum salmon populations were similarly affected since they share the same spawning and rearing habitats.

In western PWS, the spill may have facilitated a replacement of wild fish due to low survivorship of wild fish and increased production of hatchery fish. Wild stocks were at a low abundance prior to the Spill and have remained low since the spill (Fig 4.5). Hatchery production had increased just before the oil spill and has continued to increase (fig. 4.5). Oil contamination in streams resulted in immediate and long term effects on the growth, survival, and abundance of pink salmon (Geiger et. al. 1996; Willette 1996; Bue et al. 1996; Heintz et al. 2000). The majority of oiled streams were in western PWS where most hatchery production occurs. During this time hatchery fish strayed into the streams with wild populations (Joyce and Evans 2000). It is not known how many of the fish spawning in the streams in western PWS are hatchery fish.

Oil may have impacted cutthroat trout and Dolly Varden in PWS. A study comparing growth and survival of these species between oiled and non-oiled streams was conducted from 1989 to 1991 (Hepler et al. 1996). The three oil-free streams were located at Boswell Bay, Makarka Creek, and Rocky Creek. The two oiled streams were Eshamy Creek and Green Island. From 1989 to 1990, growth was 43% greater for adult cutthroat trout and 24% greater for adult Dolly Varden captured in non-oiled sites. The growth differences persisted in cutthroat trout during 1990 to 1991, but not for Dolly Varden. The higher growth in cutthroat trout was attributed to the fish being at non-oiled sites and not exposed to oil over that time. However, the sites in eastern PWS (Boswell, Makarka) may be more productive systems regardless of the presence of oil. Pre-oil spill data for these populations would have been extremely beneficial in determining the impact of oil on the growth of these species (Hilborn 1996).

Oil products from combustible engines may be a source of contamination for the Sound. During the summer season there are a significant number of commercial and recreational boats operating in the Sound. Commercial fish tenders can carry large quantities of petroleum to sell to fishing boats. Oil contamination can occur during general operation or from boating accidents. There are high use areas in PWS where boat densities can be great, especially during fishing seasons.

Timber Harvest – Most recently, CAC harvested timber from their lands on Montague Island from 1993 to1997, while most timber harvest on National Forest System lands in the analysis area occurred from 1950 to 1978. None has taken place on public lands since 1978. The earlier harvests often occurred adjacent to streams. Skid trails frequently crossed streams. In some cases streams were used to transport logs to the beach where they could be loaded on boats and transported to markets. These harvests have impacted fisheries resources. On the north side of the island, between Port Chalmers and MacLeod Harbor, approximately 50% of the Class 1 anadromous stream habitat was affected by harvest (USFS GIS 2002). Many of these streams have poor habitat quality and exhibit channel instability (D. Lang, Cordova Ranger District Fisheries Biologist, personal observation). The streams are typically braided, down cut with bank erosion, have no large wood in the channel or in the riparian area, and have cobble and boulder sized substrates. There is very little spawning or rearing habitat, especially in the lower reaches. Including the recent harvest in Patton Bay, about 35% of the Class 1 anadromous stream habitat on Montague Island has been impacted by timber harvest in the last 60 years.

Timber harvest occurred on alluvial fans where Sitka spruce grows very well. Alluvial fan channels are shallowly incised and naturally subject to frequent migration. Logging likely exacerbated this situation. At Hanning Bay and Swamp Creek there is evidence that the streams jumped out of their channels and flowed down logging roads used to transport timber (Ken Hodges, USFS Cordova Ranger District Fisheries Biologist, personal communication.). Comparison of aerial photos before and after logging (1959, 1974, 1993) shows substantial channel widening and gravel bar formation in logged streams (Hodges 1998).

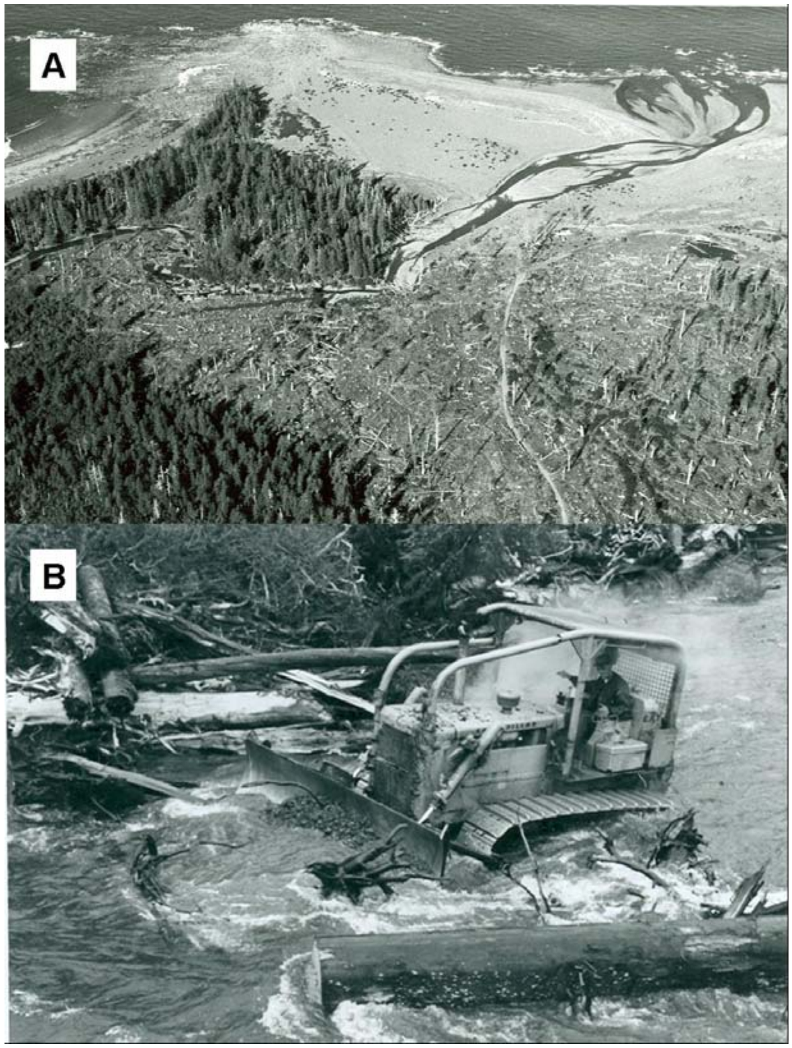


Figure 4.6 - 1971 aerial photo of Russell Creek on Montague Island showing the clear cut logging near the mouth (A). The channel through the estuary was dug out and bermed to prevent channel braiding (USFS Cordova R. D., unpubl.). Large wood was removed from the stream and the channel was dug deeper to improve fish passage (B).

Uplift from the earthquake led to channel instability, especially on the shoreline areas of Montague Island (Roys 1971). Logging in the riparian area and the removal of wood from streams (fig. 4.6; Table 4.1) limited channel re-stabilizing processes and reduced the habitat capability in these systems. Large wood in the channel, floodplain, and riparian habitat is an important component of the physical and biological processes that stabilize and create habitat in stream systems.

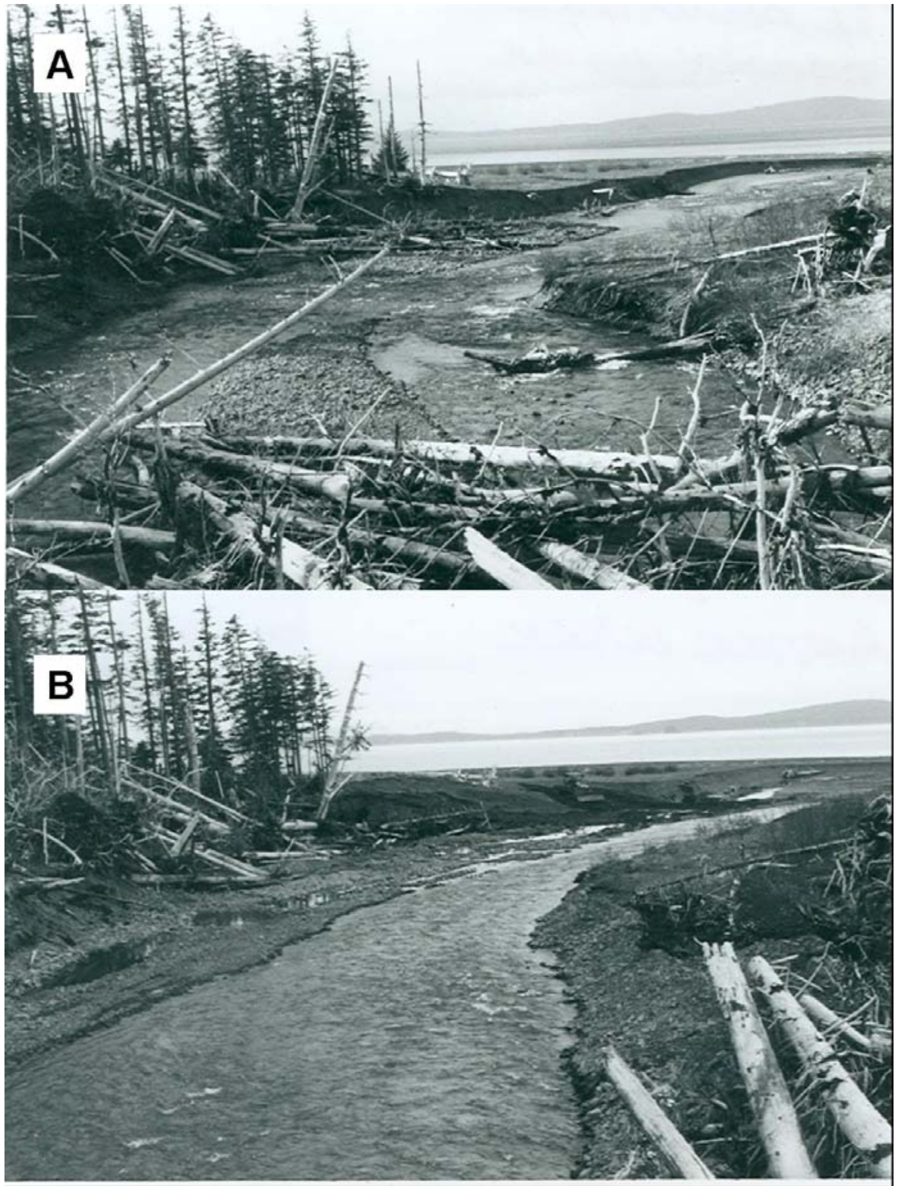


Figure 4.7 - Before (A) and after (B) log removal and stream cleaning project on Russell Creek (Montague Island) in 1971. The project was done to improve fish passage and coincided with logging operations adjacent to the creek (USFS Cordova Ranger District, unpublished).

Stream enhancement projects such as cleanings and log removals were often done in conjunction with timber harvest operations (fig. 4.7). These projects were done to improve fish passage in streams and at the time were sanctioned by fish biologists.

Timber harvest can negatively affect fish habitat and populations in a number of ways. Stream hydrology and channel morphology can be altered by removal of riparian and watershed vegetation (Chamberlin et al. 1991). Erosion and landslides resulting from timber harvest and the often associated road systems can increase the transport of sediment to streams impacting fish habitat and reducing water quality (Chamberlin et al. 1991). Removal of trees limits the future ability of the system to recruit LWD into stream channels. Fine sediment can clog interstitial spaces in streambed gravels and reduce oxygen flow that is important for egg to fry survival (Chamberlin et al. 1991; Bjornn and Reiser 1991).

Sport Fishing - The Big Islands analysis area provides world-class salmon fishing in a remote wilderness setting. Anglers can fish for coho, sockeye, pink, and chum salmon as well as Dolly Varden and cutthroat trout. However, access to the streams in the analysis area is limited. There are no roads that link the area directly to the mainland. Access to most streams is by boat or aircraft. Hawkins Island has the best access because it is a relatively short distance from Cordova.

Overall, sport fish effort and harvest in the analysis area is likely low since access to streams is limited to boat and float plane. The targeted fish include coho and pink salmon, cutthroat trout, and Dolly Varden. Some of the tidal lagoons and streams where sport fishing occurs include Shelter Bay, Nellie Martin River, Port Chalmers, Beach River, Hawkins Creek, and an unnamed creek on Green Island. Many of these areas have Forest Service cabins nearby. Sport fishers get dropped off and generally stay at the cabins, but sometimes tent camp.

Streams on Montague and Hinchinbrook Islands accessible by float plane can get substantial use during peak salmon runs. This use can be a concern when anglers target systems with small populations of coho salmon that are highly susceptible to angling. Harvest limits were reduced at Shelter Bay because of concerns about the number of anglers fishing this small run of coho salmon. Spawning fish numbers had declined to less than 20 fish during escapement counts conducted from 1998 – 2000 by the Forest Service. These counts prompted the recommendation to reduce harvests on this system.

Charter boats from Seward and Whittier are known to fish around the southern tip of Montague Island. Anglers generally fish from the boat and in salt water and probably target halibut off shore and salmon in the estuaries when they are returning to spawning streams. Charters from Valdez fish for halibut at Middle Ground Shoals and at the north end of Montague Island.

Data on sport fish effort, catch, and harvest is limited for streams in the analysis area. ADFG has conducted a statewide mail-in sport fish survey each year since 1983. These surveys show that angling effort has generally increased in the Prince William Sound Management Area over this time (Miller and Stratton 2001). However, information is not collected for individual stream systems in the analysis area.

Two private facilities planned in the future may increase sport fishing and other general recreation on Montague Island. A proposal by Water World LLC to put a floating gas station and lodge facility near Knight Island was denied by the State in April 2005, but still may be appealed. It could improve boat access to the southern tip of Montague Island. Currently small boats are usually unable to reach this area because of its distance from Whittier and the associated fuel limitations. Providing fuel for small recreational boaters could improve access. Transcripts of a recent public hearing on this facility are located at: http://www.dnr.state.ak.us/mlw/hottopics/WaterWorld120904.pdf. Another facility is an outfitter guide lodge located in MacLeod Harbor. This lodge will mostly be used by hunters but may include some sport fish users.

A permit is pending for an outfitter-guide who wants to provide salmon fishing in streams around the southern tip of Montague Island. The outfitter is requesting permits for six clients. Lodging for clients would be on a boat.

Sport fishing can have direct and indirect impacts on fish populations. Populations can be directly affected by harvesting fish (Clark and Gibbons 1991) or through handling stresses resulting from selective harvesting (Meka 2003). Fishing and other recreational activities, can affect populations indirectly through the destruction of habitat. Stream and riparian habitat are changed by excessive foot traffic and trampling. These changes can lead to increased erosion, loss of cover habitat, decreased food sources, and lower water quality (Clark and Gibbons 1991).

Outfitter-guide sport fish use can be relatively high near recreation cabins and/or popular fishing streams in the analysis area. In streams with small populations of fish, over harvest may be a concern. These sites are often fished repeatedly by groups of people throughout the summer months. Many users practice selective harvest of fish at these sites. Depending on the methods used, selective harvest can damage or kill some fish that are not taken.

Roads and OHV Use - At present, no Forest Service roads exist in the analysis area and no new roads are expected. There are short roads on private lands at Boswell Bay and Johnstone Point on Hinchinbrook Island and on Montague Island around MacLeod Harbor. Private lands on the southwestern tip of Montague Island had extensive road systems built during logging operations in the 1990s. The one road built around the south tip of Montague Island was obliterated in 1997 and 1998. Thus, the overall impacts to fishery resources due to roads are minimal.

CAC obliterated the road through National Forest System lands on Montague Island connecting their lands in MacLeod Harbor and Patton Bay during the summers of 1997 and 1998 (USFS, Cordova Ranger District, internal documents). During obliteration, most road fill and stream crossing structures were removed. The roadbed was also contoured to match the surrounding landscape. Recent surveys indicated that for the most part the road obliteration was successful in returning landscape contour, vegetation, and stream habitat condition to a more natural state (USFS, Cordova Ranger District 2001). There is one problem spot in the upper Strike Creek watershed where road fill and a culvert were not removed at a stream crossing. This site has the potential to significantly impact coho salmon habitat when the culverts eventually plug and road fill washes into the stream. The roads on private lands were closed according to State of Alaska regulations. The condition of these roads and their impacts on fish habitat or populations has not been determined.

The negative impacts that roads can have on salmonids and their habitat have been well documented (Furniss et al. 1991). Roads can affect salmon migration, spawning habitat, egg-embryo survival, and juvenile rearing habitat (Furniss et al. 1991). Ditch and gully erosion caused by road surface runoff can cause excessive sedimentation of spawning streams. Streams crossed by roads can experience unnatural changes in channel geometry and a subsequent channel adjustment when culverts or bridges are not properly installed (Furniss et al. 1991).

Improper culvert placement can lead to drastic channel adjustments that pose many problems to salmonids, especially in the passage of both adult and juvenile fish (Evans and Johnston 1980; Furniss et al. 1991).

OHV use occurs on Hawkins and Hinchinbrook Islands. Access to hunting areas during the deer season from August – November appears to be the driving factor for this use. This use causes soil and wetland erosion and can lead to sedimentation of streams at OHV crossings. The transfer of non-native seeds and plants can also be a problem associated with OHV use. Seeds of exotic plant species can be transported to these areas via mud stuck onto the vehicle or on rider's clothing. The disturbed soil on trails can give exotic species the opportunity to become established.

The Cordova Ranger District has worked with local hunters to identify potential routes in these areas. In 2000 and 2002, some of the identified routes were surveyed for potential damage to wetland and stream habitat (Cordova Ranger District 2003). These routes were in Cedar Bay (done in 2000), Andersen Bay, Canoe Creek, and Double Bay (the latter three done in 2002). The resource damage was minimal, except for Canoe Creek where significant soil and vegetation damage was documented (USFS, Cordova Ranger District, unpublished; fig. 4.8).

The Forest Plan authorizes motorized use only on designated routes in some of these areas. No routes have been designated. In the Canoe Pass area, there is a considerable amount of State and private land adjacent to the National Forest System land being used by OHV's. An inter-agency group with significant public involvement should be formed so that designated routes limiting resource damage can be established. The use of OHV's in these areas needs to be monitored including the potential spread of exotic species. OHV users need to be aware of the potential risks involved with the spread of undesirable exotic species and educated in the best ways to prevent their spread.

Figure 4.8 - Surface erosion caused by an OHV trail through a forested area near Canoe Pass on Hawkins Island.

Fish Habitat Enhancement Projects - Many fish habitat enhancement projects have been conducted on streams in the analysis area. These projects have focused on enhancing salmon production for harvest in the commercial fishery and restoring salmon habitat in streams impacted by the 1964 earthquake, historic logging, and the *Exxon Valdez* oil spill. Projects have consisted of three main types: fish ladder construction and stream habitat enhancement and restoration. Fish ladders were constructed over natural barriers to upstream migration, which allowed access to spawning and rearing habitat that was not previously available. Stream habitat enhancement and restoration projects have varied by site and the methods have included stream cleaning, log removal, log structure placement, channelization, channel stabilization, berms, and water control structures.

After the 1964 earthquake, stream enhancement projects were focused on improving spawning habitat and fish passage in the channels impacted by the uplift. Numerous stream channel stabilization projects were completed in the late 1960s and early 1970s. Spawning habitat was improved by channelization (deepening and braid removal) to reduce egg and embryo mortality from subsurface and low flows during the winter (Solf 1972) and fish passage was increased by removing logs and debris jams (Table 4.1). Most of these efforts were effective for only a short period because of the extreme channel instability caused by the earthquake.

It is unlikely that these projects were successful and they may have been detrimental to habitat and fish populations. Removing wood most likely increased down cutting and channel instability and limited the formation of new spawning and rearing habitat. Channelization alters flow regimes, which can negatively affect important stream habitat variables such as substrate composition. Results from some of these projects indicate that there were no immediate benefits to pink salmon alevins (Solf 1972). Recent channel stabilization projects have been more successful, but extreme flow fluctuations and inherent channel instability still limit the project life in most cases.

Three fish passes have been built at barrier falls to allow salmon access to upstream habitat. In the early 1980s several fish ladders were built to increase salmon production by allowing anadromous salmon access to spawning and rearing habitat above water falls. Salmon were in demand from a growing number of commercial, subsistence, and recreational users. During this time, fish ladders were constructed at Boswell Bay, Canoe Pass, and Rocky Bay (Table 4.1). All three ladders are still fully functional and passing anadromous salmon. The fish ladders are visited several times each year for general maintenance and monitoring. Monitoring includes on-the-ground adult escapement counts of fish species using the ladders. At Boswell Bay, sockeye salmon counts from 1992 – 2000 averaged 1550 fish (USFS, Cordova R.D., unpublished). This ladder may be providing a significant number of sockeye salmon for potential use.

It is not known how successful the other ladders have been. The Canoe Pass ladder was originally constructed to increase coho salmon production but escapement counts for coho salmon have not been done often. Coho salmon are rearing in habitats above the ladder (USFS, Cordova Ranger District, unpublished) but it is difficult to access this location when adults are in the stream during the fall because of weather. High water in the fall can also reduce what the observers can see. Pink salmon and Dolly Varden have also been introduced above the ladder. Resident cutthroat trout existed in this system before the fish ladder was constructed.

Coho and sockeye salmon have not been counted above the ladder at Rocky Bay but juvenile coho salmon have been trapped in the lake (USFS, CRD unpublished data). The production of these species in this system is unknown. Resident cutthroat trout and Dolly Varden existed in this system before the fish ladder was built.

Since the 1990s, enhancement projects in the analysis area have focused on streams that were impacted by past logging and the uplift from the earthquake. These projects have occurred on Montague and Hinchinbrook Islands (Table 4.1), and the success of these projects has been variable. A detailed description of these structures and a monitoring plan to assess them is currently being completed by the Cordova Ranger District.

Table 4.1 - Fish habitat enhancement structures in the analysis area. Amount of habitat is estimate of new habitat created by structures or made available to fishes. Information comes from USFS CRD reports and unpublished data as indicated by reference.

Stream	Year Completed	Structure Type	Target Species	Amount of Habitat			- Purpose - Current Condition - Reference [a]
				Spawn/ rearing (sq ft)	Lake - acres	Stream (miles)	
Hawkins Island							
Hawkins Creek #18470	1967 1968 1969 1984	-Channel stabilization -Log Removal -Stream grading -Instream spawning channel	pink chum				- improve migration & enhance spawning habitat - condition is unknown -USFS 1989
Canoe Cr #18500	1969	Stream widening	pink chum				- improve migration & enhance spawning habitat - condition is unknown - USFS 1989
Trail Creek #18520	1980	Fish Ladder					- improve migration and access to habitat - condition is unknown - USFS 1989
Canoe Pass	1980	Fish Ladder	coho		80	4	- increase spawning & rearing habitat - good - CRD 2004
Hinchinbrook Island							
Garden Cove Cr #18100	1970	- Log removal - Channelization	pink chum				- improve migration - condition is unknown - USFS 1989
Etches Cr	1969 1970	- Log removal - Debris removal					- Improve migration - condition is unknown - USFS 1989
Nuchek Cr #18120	1969 1970	-Channelization - channelization and revetment	pink chum				- Improve migration - condition is unknown - USFS 1989

Table 4.1 - Fish habitat enhancement structures in the analysis area. Amount of habitat is estimate of new habitat created by structures or made available to fishes. Information comes from USFS CRD reports and unpublished data as indicated by reference.

Stream	Year Completed	Structure Type	Target Species	Amount of Habitat			- Purpose - Current Condition - Reference [a]
				Spawn/ rearing (sq ft)	Lake - acres	Stream (miles)	
Constantine Cr #18150	1967 1968 1969 1970 1971 1984	- Deflector - Deflector & remove log - Deflector - Remove log & revetment - channelization - channel stabilization	pink chum				- improve migration & enhance spawning habitat - condition is unknown for all - USFS 1989
Cook Cr #18280	1968	- Log removal	pink chum				- improve migration @ Anderson Bay - condition is unknown - USFS 1989
Juania Creek	1998	10 instream log structures	coho, pink, chum	6000	0	1	- enhance spawning & rearing habitat - condition is unknown - CRD 1998
Boswell Bay	1981	fish ladder	sockeye		80	2	- improve access to spawning and rearing habitat - good - CRD 2004
Montague Island							
MacLeod Cr #17070	1972	Channelization	pink chum				- improve migration & spawning habitat - condition is unknown - USFS 1989
Hanning Cr #17100	1973	Debris Removal	pink chum				- improve migration - condition is unknown - USFS 1989
Russell Cr #17380	1971 1972	Log Removal	pink chum				- improve migration - condition is unknown - USFS 1989
Wilby Cr #17440	1967 1968	- Log & gravel revetment - rock barrier removal	pink chum				- improve migration & enhance spawning habitat - condition is unknown - USFS 1989
Wild Cr #17450	1967 1968	- Log & gravel revetment - rock barrier removal	pink chum				- improve migration & enhance spawning habitat - condition is unknown - USFS 1989
Shad Cr #17490	1967 1968	- Log removal & channelization - Log removal	pink chum				- improve migration - condition is unknown - USFS 1989
Udall Cr #17700	1967 1986	- Log removal - Debris dam removal	pink chum				- improve migration - condition is unknown - USFS 1989
Pautzke Cr #17750	1967	- channel thru berm	pink chum				- improve migration - condition is unknown - USFS 1989

Table 4.1 - Fish habitat enhancement structures in the analysis area. Amount of habitat is estimate of new habitat created by structures or made available to fishes. Information comes from USFS CRD reports and unpublished data as indicated by reference.							
Stream	**Year Completed**	**Structure Type**	**Target Species**	**Amount of Habitat**			**- Purpose - Current Condition - Reference [a]**
				Spawn/ rearing (sq ft)	Lake - acres	Stream (miles)	
Stump Lake outlet	1991	gabion weir	sockeye coho cutthroat	0	86	1	- To maintain historic water levels in lake - Rebuilt in 2002 - CRD internal files
Stump Lake outlet	2002	gabion weir	sockeye coho cutthroat	0	86	1	- rebuilt failing gabion - excellent - CRD 2002
Rocky Bay	1994	18 instream log structures	cutthroat	1088	0	1.5	- enhance spawning & rearing habitat - Variable, some still functional - Hodges & Buckley 1995
ADFG #17735	1993	1 instream log structures	chum	300	0	0.1	- enhance spawning & rearing habitat - non functional - CRD internal files
Quadra Creek	2001	10 instream log structures	chum, pink, coho		0	1	- enhance spawning & rearing habitat - unknown - CRD internal files
Hanning Creek	1994	31 instream log structures	chum, pink, coho	20,000	15	5	- enhance spawning and rearing habitat; 15 acres of riparian thinned - most are non-functional - Schmid et al. 1994
Rocky Cr #17590	1983	fish ladder	sockeye chum, coho		30	1	- enhance spawning & rearing habitat - good - CRD 2004

[a] USFS 1989 = Big Islands Management Area Analysis EIS

Factors affecting vegetation

Tectonic influences on vegetation succession

The areas uplifted during the 1964 earthquake that were conducive for conifer seedling establishment along the coast, now support thickets of pole size Sitka Spruce. Some of these bands of trees have over 2000 trees per acre. Water tables and drainage patterns have shifted in other areas changing site productivity for conifers.

Wind Influences

Wind influences forest structure and composition to varying degrees depending on the extent and severity of the disturbance. Some storm events can result in many acres being blown down or tree tops being snapped. Other wind events may only affect single trees or small group of trees altering the forest structure and composition on a much smaller scale. Often the wind generated from snow avalanches can blow trees over in front of the snow avalanche. Scattered windthrow commonly occurs along forest edges due to the high winds that frequent the area. The area has not been surveyed for extent of blowdown, but no large areas of blowdown have been reported. It appears most wind disturbance is confined to single trees or small groups of trees.

Insects and Diseases

Insects and diseases are two other disturbance regimes that can shape forest composition, structure, and development. In this area, these agents most commonly affect forest ecosystems on an individual tree or group basis, not on a landscape scale. Small outbreaks of western black-headed budworm (Acleris gloverana Walsingham) were recorded on Hawkins Island in 2001 (Wittwer 2002) and on Green, Hinchinbrook, and Hawkins Islands during the 2002 surveys (Wittwer 2003). An area of spruce aphid (Elatobium abietinum Walker) defoliation was observed on Hawkins Island in 2003 (Wittwer 2004). These outbreaks are cyclical in nature, characterized by a rapid increase in numbers followed by rapid declines 1 to 5 years later. Tree defoliators can weaken trees making then predisposed to secondary mortality agents. Black-headed budworm can influence stand composition and structure favoring small mammals and deer (Wittwer 2004).

Timber harvest and vegetation treatments

Trees have been harvested from the Big Islands analysis area since people first settled in the area. Until the 1950s, harvest was mainly small group select cuts or individual tree selection for boats, mining timbers, fox farms, canneries, fish wheels, fuel, and homes and occurred along the shorelines near settlements. From 1947 to 1978, the clearcut method was used to harvest a total of 2985 acres, with individual areas harvested ranging from 4 to 340 acres in size. About 496 acres was harvested on Hinchinbrook with the remaining 2489 acres harvested from Montague. Harvest records indicate that no commercial harvest has occurred on National Forest System lands in the analysis area since 1978. However, Chugach Alaska Corporation harvested timber from 4453 acres of their land in Patton Bay on Montague Island from 1993 to 1997. The timber was hauled by truck to MacLeod Harbor and then transported by barge. The access road across National Forest System lands was obliterated in 1998. Since then, no commercial harvest has occurred on the island, and none is planned in the future on National Forest System lands anywhere in the analysis area. Figures 2.26 to 2.28 and Table 2.12 in Chapter 2, and Table A.5 in appendix A display more detailed information about past harvest.

A total of 111 acres harvested in the 1970s on Montague Island were precommercially thinned in the 1980s and another 135 acres was let for contract in 1989 however it is unclear how much of that contract (Baseline TSI) was actually done. Most contracts were defaulted by the contractors, e.g. they never finished the work. The working conditions are harsh and the island is remote. Travel to and from the work site is expensive and remote camps are involved. People, food, fuel, saws, gear, camp supplies, and spare parts must be hauled in by boat or plane. No additional thinning contracts have occurred. Forest Service personnel thinned small areas in riparian areas in Hanning Bay and along Swamp Creek just south of Port Chalmers to improve future fish habitat and thinned about 12 acres in the Swamp Creek drainage to improve wildlife habitat. Monitoring plots were installed in two of these areas.

On Montague, Wooded, and Little Green Islands and the portion of Green Island that is not part of the RNA, the revised Forest Plan allows nonchargeable commercial timber harvest as long as it is consistent with the management intent, standards and guidelines specified for the area. Both commercial and personal use harvest of special forest products is allowed, as is personal use timber harvest. On Hinchinbrook and Hawkins islands, no commercial timber harvest is allowed, however personal use timber and both personal and commercial harvest of special forest products are appropriate. On the EVOS acquired lands, harvest of forest products is prohibited except for subsistence uses or for the purposes of access, exploration, and development of the subsurface estate.

There is a demand for firewood, house logs, and sawtimber from accessible National Forest System lands near Cordova and it is expected to increase as the material left on the harvested areas on Eyak Native Corporation lands on the Copper River Delta deteriorates and the wood cut and decked from around the airport is depleted. However, accessible timber is limited in the Big Islands analysis area due to the lack of roads and concerns about eagle nest trees and roosting habitat in the beach buffer.

Non-Native Plant Species

No basic inventory for non-native plant species (including invasive species) has been conducted in the Big Islands analysis area. The University of Alaska Herbarium database indicates *Achillea millefolium* and *Rumex crispus*, both non-native species, occur in the analysis area. The obliterated Montague Road was seeded in 1998. During the revegetation survey conducted in 2002 of the road, non-native species were not tallied. Other places where non-native seed could be introduced are by cabins, along OHV trails on Hinchinbrook Island, and adjacent to private lands with residences and gardens.

Threatened, Endangered and Sensitive Plant Species

There are no known threatened or endangered plants within the analysis area. The only known sensitive plant occurrences in the analysis area is *Romanzoffia unalaschcensis* on Hawkins Island and *Carex lenticularis* var. *dolia* on Montague Island. Sensitive plant locations are displayed in Figure 4.9.

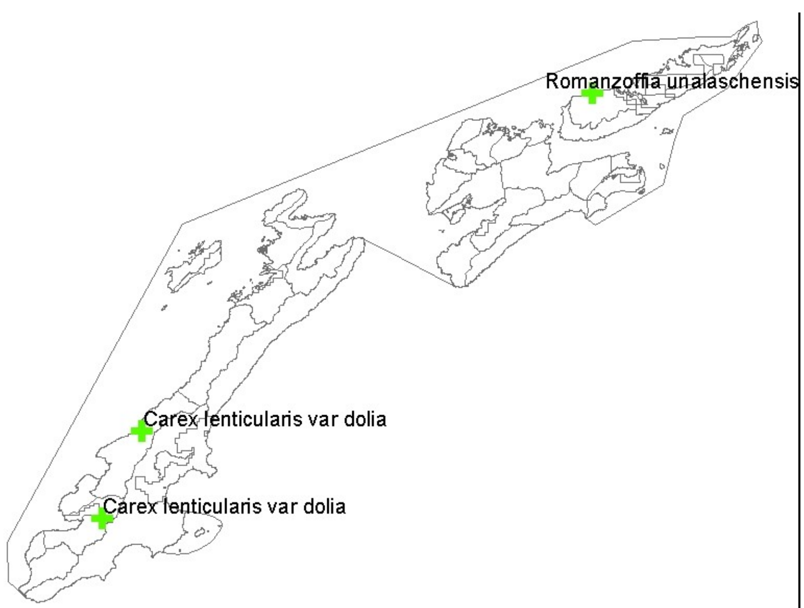


Figure 4.9 - Sensitive plant locations in the analysis area. Information from the USDA FS GIS database 2004.

The only federally listed plant in Alaska is *Polystichum aleuticum*, which is listed as endangered. It is only known from Adak Island and is not expected to occur in the Big Islands analysis area. The Regional Forester designated 19 vascular plants as sensitive in the Alaska Region. Of these, the following 12 species are known or suspected to occur on the Cordova Ranger District of the Chugach National Forest:

Eschscholtz's little nightmare (*Aphragmus eschscholtzianus*)	known
Norberg arnica (*Arnica lessingii ssp. norbergii*)	known
moonwort fern (*Botrychium tunux*)	suspected
moonwort fern (*Botrychium yaaxudakeit*)	suspected
goose-grass sedge (*Carex lenticularis var. dolia*)	known
truncate quillwort (*Isoetes truncata*)	known
Calder lovage (*Ligusticum calderi*)	suspected
pale poppy (*Papaver alboroseum*)	suspected
smooth alkali grass (*Puccinellia glabra*)	suspected
Kamchatka alkali grass *(Puccinellia kamtschatica*)	suspected
Unalaska mist-maid (*Romanzoffia unalaschcensis*)	known
circumpolar starwort (*Stellaria ruscifolia ssp. aleutica*)	suspected

Based on comparison of a matrix of general habitats for the each of the species listed above (Stensvold 2002) and known habitats within the analysis area, all 12 species potentially occur in the area in the following habitats:

Aphragmus eschscholtzianus - heath, alpine and subalpine habitats
Arnica lessingii ssp norbergii - tall shrubland, open forests, meadows, alpine and subalpine habitats
Botrychium tunux and *B. yaaxudakeit* - maritime beaches, upper beach meadows, well drained open areas
Carex lenticularis var. dolia and *Stellaria ruscifolia ssp. aleutica* - lake margins, marshy areas, alpine and subalpine habitats
Isoetes truncata - shallow freshwater
Ligusticum calderi - forest edges, wet meadows, alpine and subalpine habitats
Papaver alboroseum - well drained open areas, dry meadows, alpine & subalpine habitats
Puccinellia glabra and *P. kamtschatica* - maritime beaches, upper beach meadows
Romanzoffia unalaschcensis - forest edges, stream sides/riverbanks, rock outcrops

Conditions and trends of wildlife resources

Under the current Forest Plan, there is little reason to believe human related impacts will inhibit wildlife resources from expressing their full range of variability. Most of the analysis area will remain as a large, pristine and mostly roadless area. The area has a high degree of natural integrity with most long-term ecological processes intact. (USDA Forest Service 2002b).

Increased visitation of the Big Islands for fishing, hunting, hiking, wildlife viewing, solitude, and other reasons is likely in the future and impacts of these human uses will need to be monitored and mitigated if necessary. The opening of the Whittier tunnel, improved access to Cordova with the coming of the fast ferry in spring of 2005, and increasing ecotourism in general will likely bring more people to the Sound, including the Big Islands. Forest policy will need to keep pace with these changes in the future.

Condition and trends of heritage resources

Heritage resources have been increasingly protected over the past 50 years as non-renewable resources. The National Historic Preservation Act of 1966 requires the identification and preservation of significant historic and prehistoric sites on federal land, and the mitigation of both direct and indirect impacts of federal undertakings on sites that are eligible for the National Register of Historic Places.

Prehistoric archaeological sites in Prince William Sound date from within the past 4000 years and encompass three cultural phases. The Uqciuvit phase is identified with dates ranging from 4000-2500 BP., the Palugvik phase with dates ranging from 2500-900 BP., and the Chugach phase with dates ranging from 900-200 B.P. (Yarborough 2000). The protohistoric period dates between AD.1741, when Vitus Bering made landfall on Kayak Island, and AD.1778, when Captain James Cook made direct contact with Native inhabitants of Prince William Sound. The following period of time, through AD.1867, is characterized as the Russian Period.

Prehistoric and historically documented human use patterns of the area allow for the development of a predictive model of sensitivity zones for cultural resources. Since evidence indicates prehistoric use of the islands was generally limited to the littoral zones of less than 100 feet elevation above high tide level and historic use followed the same pattern, this strip of land is considered to have the highest potential for cultural resources. Prehistoric uses which differ from this general model include some hunting, gathering, and burial practices. Archaeological and geological documentation in 2003 of the existence of elevated Holocene beach ridges on Hawkins and Hinchinbrook Islands suggests that the predictive model should include land up to 140 feet above identified beach ridges in the high probability zone.

Historical mining activity frequently occurs outside of high probability zones of the predictive model. Mining activities typically occurred on all areas of the land base and were not restricted to concentrated areas of natural resource abundance necessary for survival. Areas of high probability include identified mineral deposits, recorded portages or corridors of human movement, and drainage systems identified as having or capable of having anadromous fish runs. The zone of low probability for cultural resources includes areas of permanent ice and snow, swamps, bogs, active stream channels and alpine rock fields. Areas of 1,000 feet elevation and higher are included in the zone of low probability, unless identified in one of the high probability zones, such as a portage or corridor. (USDA Forest Service 2002d).

Under the Programmatic Agreement between USDA Region 10, the State Historic Preservation Officer, and the Advisory Council on Historic Preservation, the high sensitivity zones for cultural resources are identified using a predictive model that describes areas where proposed development may have an impact on heritage resources. These areas include:

- River valleys, lake and river systems providing passes or portages across larger land masses;
- All areas between mean high water and 150 ft. in elevation above mean high water, regardless of slope angle;

- Areas of former lode and placer mining activity;
- Elevated/fossil marine, river, and lake terrace systems; Lake and stream systems containing or known to have contained, anadromous fish runs, including barrier falls locations;
- Caves, rock shelters, and igneous rock formations known for caves and rock shelters;
- Known sources of potential raw materials;
- Other areas identified through literature or oral history research/sources.

The ANSCA recognized the importance of Native Alaskan historic and cemetery sites which may be no longer be in use, but are culturally significant, and allowed for their selection by and conveyance to regional Native Corporations. CAC has more than 60 Cultural and Historical Site (paragraph 14(h)(1) of ANCSA) selections within the analysis area that have received a determination of either Pending and/or Eligible for conveyance by the Bureau of Indian Affairs (Phillips 2004). Although still in selection status, they are expected to be eventually conveyed. During the field season of 2005, BLM intends to conduct land survey of over 30 selection sites in the Montague Strait area, including all certified eligible sites on Montague Island.

Management of cultural resources is legislated by Acts of Congress and Executive Orders, which mandate inventories of cultural resources, and preservation and interpretation of all types of cultural resources for the benefit of the public for all federally funded undertakings. The National Historic Preservation Act (NHPA) requires consultation with Native tribes. In this area, that includes the Native Villages of Eyak, Tatitlek, Chenega, Yakutat, and CAC. In areas which are selected for land conveyance by CAC, the corporation will also be consulted as an interested party, and as the Regional Native Corporation cultural representative. Other local interested parties may include groups such as the Cordova Historic Society.

Cultural resources in project areas proposed by the Forest Service are inventoried under section 106 of the NHPA. Inventories of cultural resources on National Forest System lands outside identified project areas are regulated under Section 110 of the NHPA. Over 99% of the analysis area remains to be inventoried for cultural resources. Of the known cultural resources in the analysis area, many still need to be documented and evaluated for the National Register of Historic Places. The desired future condition of heritage resources in the analysis area is legal compliance, and achievement of all the obligations that the Chugach National Forest has under various laws. This includes completing a cultural resource inventory; documentation and evaluation of all known cultural resources for the National Register; rehabilitation of historic buildings, which would be available for administrative or public use; interpretation and signage of archaeological sites, archeological districts and cultural landscapes for the public; and archaeological site protection and interpretation through stewardship programs. The revised Forest Plan states that the desired future condition for cultural resources is that they remain in an undisturbed state with data recordation as the preferred method to mitigate their loss.

Increased recreation tourism and public use from the growing population in the City of Cordova and more people coming from other areas can result in direct, as well as cumulative and indirect impacts to cultural resources. The Forest Service is required by the rules and regulations that implement the NHPA to consider indirect effects, as well as direct effects, of projects and management actions on historic properties.

Although minimal management is desired for the area, the NHPA nevertheless requires that properties in the area which "may be eligible for the National Register are managed and maintained in a way that considers the preservation of their historic, archaeological, architectural, and cultural values in compliance with section 106 of this Act and gives special consideration to the preservation of such values in the case of properties designated as having National significance" (16U.S.C. 470-2(a)(2)(B)). Historic properties could not simply be neglected, because "Neglect of a property that causes deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe" is considered an adverse effect (CRF36 Part 800.5(2)(vi).

Conditions and trends of recreation resources

Cordova's tourism industry is growing at an estimated rate of 3 to 7% annually (Christensen and Mastrantonio 1999). Within the past 5 years a 35 bed lodge has opened as well as several bed & breakfasts and two rental car companies. With the advent of the daily high speed ferry connecting Cordova to Whittier and Valdez, scheduled to come online in 2005, it is anticipated that there will be a 600% increase in visitors to Cordova. Most use will be concentrated along the road system, however there may be more demand for remote cabins, camping, river trips, picnic sites, and the like. Visitors currently enjoy activities such as fishing, hunting, hiking, camping, bird watching, mountaineering, river rafting and sightseeing, and guided hiking.

Wildlife viewing, a recreational activity that has been occurring for years, has only recently been deemed viable as a commercial venture. For the most part viewing wildlife was a past-time of locals and visiting friends and relatives. As commercial development grew (outfitters, guides, and bed & breakfasts), watching wildlife became a secondary benefit to many primary activities.

The District is currently determining the recreation carrying capacity based on the newly revised Forest Plan direction. Part of the analysis will determine the capacity for the guided publics based on the 50% allocation from the Forest Plan.

Cabins

A total of nine public recreation cabins are distributed between Hinchinbrook, Montague and Green Islands. The Forest Plan calls for up to three new cabins to be built somewhere in Prince William Sound (could be on either Glacier or Cordova Ranger District) between 2005 and 2012 and to reconstruct/rehabilitate five existing cabins to reduce the backlog of deferred maintenance in that same time period. The San Juan Bay cabin was replaced in 2004 reducing this backlog. A possible cabin relocation project is the Nellie Martin River cabin. The river has changed its course forcing planes to land a 1½ mile north of the current cabin site. A new cabin site closer to the landing beach needs to be identified as well as determining whether or not to relocate the cabin further from private land.

The Recreation Facility master plan, completed in April 2005, noted that the cabin program, even though popular and fulfilling an important recreational niche, costs significantly more to operate than the income it generates. As a result, the Forest developed a 5-year plan to explore options to reduce expenses and generate more income so the cabins program can pay for itself.

Trails

Currently there are no Class III or higher trails on any of the three islands, only the cabin trails (Class II), easements, and the abandoned Makarka Lakes Trail (Class I). Other than OHV trails (which will be discussed separately) public demand for additional trails has been minimal. The concept of a trail providing access from the Prince William Sound side to the Gulf of Alaska side of Montague Island has been discussed but never pursued. Issues such as cost, user demand, rainfall (over 350 inches annually) and level of development remain to be agreed upon.

Reestablishing the Makarka Lakes Trail as part of the District's trail system would be another possible method of increasing recreation hiking/fishing opportunities for the analysis area. The trail accesses five small lakes and could provide remote sport fishing opportunities but has limited accessibility.

Motorized and non-motorized opportunities

The Forest Plan identifies areas available to winter and summer motorized use. Winter and summer motorized recreation access maps are displayed in Figure 1.5, Chapter 1. The majority of the area is closed to summer motorized use except for subsistence. There are two areas open for summer motorized use on designated areas only on Hinchinbrook Island. During winter, those two areas and Montague Island are open for motorized use while the rest is closed except for subsistence. The EVOS acquired lands are closed to motorized use all year round.

The use of OHV's on Hawkins and Hinchinbrook Islands has seen an increase in the number of individuals participating and an increased awareness of the negative impacts associated with their use. Areas and specific trails have been identified as legal OHV/motorized use areas. None of the OHV trails have been added to the District trails program. However, the District fisheries crew has surveyed several routes and constructed primitive structures that allow OHV's to cross streams with minimal adverse impacts to fish habitat. Areas such as Boswell Bay, Anderson Bay, and Canoe Pass are the most frequently used by OHV's. Both Boswell Bay and Canoe Pass are a conglomerate of federal, state, private and native corporation managed lands. This combination of varied management philosophies has led to confusion on the part of OHV users and frustration for land managers.

Outfitters and Guides

The demand for special uses in all areas such as outfitter/guides, electronic sites, research, photography and others is ever increasing. As the competition for use of National Forest System land increases so does the complexity of conducting environmental analyses and coordinating activities. Linked with demand are concerns with human carrying capacities especially relative to the outfitter and guide industry. Preliminary figures which in part have been generated by new Forest Plan direction indicate the carrying capacity could greatly increase in many areas. However, there is a concern that the new figures are too high, may have a negative impact on the recreation experience of Prince William Sound users, and may need to be revised through an amendment to the Forest Plan. At the heart of this concern are the new ROS designations in the revised Forest Plan for many locations in the Sound. Each ROS class has a multiplier which is used to determine the recreation carrying capacity for the area with that ROS class. In most

Prince William Sound areas, the multiplier increased from 0.002 to 0.008 resulting in approximately four times the carrying capacity as previously calculated (Table 4.2).

Table 4.2 - Comparison of 1984 and 2002 Forest Plan ROS and Potential Carrying Capacity

Location	1984 Forest Plan ROS[1] Designation	1984 Approx. Land base %	2002 Forest Plan ROS Designation	2002 Approx. Land base %
Green Island NW	P2 (.002)	70%	SPNM (.008)	70%
Green Island SE	P2	30%	P1 (.002)	30%
Montague Island	P1 (.002)	68%	-	-
Montague Island	P2 (.002)	19%	-	-
Montague Island	RM (.08)	8%	-	-
Montague Island	SPNM (.008)	4%	SPNM (.008)	100%
Montague Island	SPM (.008)	.004%	-	-
Montague Island	R (.08)	.0006%	-	-
Hinchinbrook Island	P1 (.002)	100%	P1 (.002)	90%
Hinchinbrook Island	SPM (.008)		SPM (.008)	10%
Hawkins Island	SPM (.008)	23%		
Hawkins Island	SPNM (.008)	77%	SPNM (.008)	100%

[1] P1 & P2 = primitive ROS classed; RM = roaded modified; SPNM = semi-primitive non-motorized; SPM = semi-primitive motorized; R = roaded.

In recent years public scoping conducted for various special use permit applications or amendments to existing applications which considered increases in consumptive uses such as hunting or fishing has resulted in strong public response opposing additional uses. Crowding, reduction in quality of recreation experience, impact to the guiding industry, and reduction of viable fish and wildlife populations are the four most common concerns raised.

As a result of the concerns stemming from potential carrying capacity increases in Prince William Sound and public input to recent special use permit requests for increased use suggesting that certain areas may already be at or near capacity especially for consumptive uses, the Forest is conducting a new carrying capacity analysis for Prince William Sound. In addition, no new consumptive outfitter guide special use permits will be issued on the Cordova Ranger District until this analysis is completed.

Another on-going issue is the illegal, non-permitted use of National Forest System lands by a variety of outfitter/guides (river rafters, heli-skiers, big game guides and fishing guides). With the addition of a full-time law enforcement officer to the Cordova District we are seeing a great improvement in our ability to prosecute violators and provide a Forest Service presence in the field which serves to curb the incentive to operate illegally.

Potential for Mineral Resource Development

All public domain lands are open to mineral entry under the 1872 Mining Law unless specifically closed. Bona fide mineral development cannot be prohibited where lands are open to mineral entry. The statutes also provide for a mining claimant's rights to reasonable access for prospecting, locating mining claims, and developing the mineral resource. Such activities must conform to the rules and regulations of the Forest Service; however those rules and regulations may not be applied so as to prevent lawful mineral activities or cause undue hardship on bona fide prospectors and miners (FSM 2810). On lands closed to mineral entry, leasing or sales of mineral materials may still occur, but these sales are discretionary. The Forest Service may limit or prohibit such activities.

The overall potential for mineral development in the analysis area is low. There is no history of minerals production and interest in prospecting in the area over the years has been minimal. Several small, low-grade mineral occurrences are known, however, these are not encouraging. Although there is high potential for “undiscovered” deposits, no significant deposits have been discovered to date. Although much of the land is open to mineral entry, there are no approved (or proposed) plans of operations, and no mining claims in the analysis area. This fact does not preclude some entity from locating a mining claim in the future, but it does indicate a general lack of interest.

Mineral development is often perceived as causing negative impacts to surface resources and conflicting with other uses of the land. It can be and is managed to minimize such impacts. Besides laws and regulations, the Forest Plan provides additional protection for wildlife and other resource values through standards and guidelines. In this analysis area, significant mineral development projects on National Forest fee and surface estate lands, private inholdings, or adjacent lands are unlikely given the current knowledge of mineral occurrences and prospects, lack of interest, lack of activity, remoteness of the area, and lack of infrastructure. Therefore, mineral development will likely not be an issue in the foreseeable future in the analysis area. The most likely development would be related to mineral materials for local use. The potential for mineral materials or common variety mineral development is low to moderate and depends on the need for roads and infrastructure. The Forest Plan generally restricts the development of mineral materials.

Reserved and Outstanding Mineral Rights

On September 8, 2004, CAC notified the Forest Service of their proposed exploration activities on EVOS subsurface lands. They indicated that no surface disturbance would be associated with these activities, which consisted of geologic mapping and occasional taking of small samples of rock, soil, or stream sediment. Additionally, geophysics would be used but not require digging or surface disturbance. They did not supply specific locations or dates. The Forest Service proposed that as CAC collects information and begins plans for future activities that may be more intrusive, that a meeting be held to discuss how best to address potential issues prior to any time constraints arising.

CAC published “Mineral Prospects on Chugach Alaska Corporation Lands” (1999), distributed at the Alaska Miners Convention in Anchorage and made available to mining companies. In this report, they identified a manganese mineral belt on Hinchinbrook and Hawkins Islands and a copper mineral belt covering the northeast tip of Hawkins Island. The report did not specifically mention potential for copper on Hawkins Island. It did, however, state that nodular masses that assayed from 29 to 35% manganese were found in a rubble area on Hinchinbrook. Presumably, these USGS samples were taken from the known occurrence shown in Figure 4.10. Additionally, they stated, “This occurrence could represent primary sea floor nodules that if preserved in sedimentary beds could be of economic interest.” The USGS determined that CAC’s reserved/outstanding mineral estate on Hawkins Island has low potential for mineral resource development but did not rate its potential for sand and gravel.

Figure 4.10 - CAC identified “mineral belts” on Hinchinbrook and Hawkins Islands

CAC has indicated to the Forest Service that they consider their subsurface estate to include sand and gravel resources and have identified possible sand and gravel resources on both Hinchinbrook and Hawkins Island. The Forest Service would be primarily concerned about development of these resources which underlie National Forest surface estate on the north end of Hawkins Island. The extraction of sand and gravel would be destructive to the surface estate. According to the geology map, there does not appear to be any extensive sand and gravel resources in that area. However, there may be potential for rock to be used as rip rap or possibly armor stone.

Chapter 5 – Recommendations for inventory, monitoring, and potential projects

Inventory and Monitoring

The Big Islands analysis area is experiencing dynamic changes as a result of climatic change, tectonic uplift, and stream processes. However, because of the lack of human development on the islands, these changes have relatively little effect on human uses. In some areas, these natural changes need to be monitored to determine how they will continue to affect human uses. Human uses are showing increasing effects on hydrologic processes on the Big Islands as levels of use increase. These effects need to be monitored, and in some cases managed.

Hydrology

Stump Lake Monitoring: Continue to monitor the depth of Stump Lake and the conditions of the outlet channel to determine if incision is occurring, if the weir structure is functioning, and if further incision is likely to occur in the future. Because Stump Lake remains one of the few sites to land a floatplane on Montague Island, it is important for providing access to this area, as well as to the public use cabins at Stump Lake.

OHV routes on Hawkins and Hinchinbrook Islands: Continue to monitor the condition of the user developed OHV routes on Hawkins and Hinchinbrook Islands, particularly those already showing signs of degradation and resource damage. Routes should be designated to protect soil, vegetation, and water resources, and these routes should have appropriate drainage and stream crossing structures. Geosynthetic materials could be used to reinforce sections through sensitive areas. These designated routes should adhere to the Best Management Practices in the Region 10 Soil and Water Conservation Handbook (USDA Forest Service 1996b). Monitoring to ensure that BMP's are in place along these routes should continue as directed by the Forest Plan (USDA Forest Service 2002b). Inventory OHV use and collect baseline data on wetland condition, vegetation condition, and presence of exotic species

Montague Island Road: Continue to monitor "problem areas" identified by Lang (2002) along the obliterated Montague Island Road for resource damage, and particularly for sources of sedimentation into salmon streams.

Fish

Identify spawning, rearing, and overwintering habitat on the Islands: Streams and islands could be classified in order of importance based on relative fish distribution and adult escapement documented in this analysis. ADFG has established index streams used for pink and chum salmon escapements; habitat for coho, cutthroat, and Dolly Varden have not been identified.

Collect genetic data on pink and chum salmon in the analysis area. Identify stock origin of chum salmon on Montague Island. Monitor for straying fish in wild stock pink and chum salmon populations in streams of the Southwest and Montague Commercial Fishing Districts of Prince William Sound.

Collect data on egg size and number of resident and anadromous Dolly Varden char in cooperation with PNW to study differences in reproductive energy strategies between the two.

Monitor potential long term effects of oil spill. Monitor oil presence at sites previously used to measure oil contamination in the analysis area. Measure oil contamination levels in fish tissues and fish food chain. Monitor cutthroat trout and Dolly Varden growth at sites used in previous study.

Maintain and monitor stream enhancement structures. Maintain fish passes and conduct escapement surveys for coho and sockeye salmon to determine benefits of passes. Monitor Rocky Bay enhancement structures for cutthroat trout. Determine the use of structures by the target species and re-evaluate habitat produced by the structures. Monitor enhancement projects designed to improve fish passage and stream habitat after the 1964 earthquake.

Monitor stream and riparian habitat in streams on Montague Island that have been impacted by timber harvest.

Distribute Atlantic salmon identification materials to commercial fishers, cannery workers, and sport fish users in PWS. Coordinate with ADFG to monitor commercial salmon harvest for exotic Atlantic salmon.

Survey streams in the analysis area for Atlantic salmon and collect suspected specimens for genetic analysis.

Survey stream habitat and fish populations in the Green Island RNA. Document current conditions so that natural changes through time can be assessed.

Collect baseline data on sport fish use at the stream system level in the analysis area. Prioritize streams based on potential increase in use. Streams on southern end of Montague would be high priority given the potential for increased sport fish pressure if the two lodges in the area are permitted.

Establish an accurate, updated stream layer for the corporate GIS database. Verify channel types for streams in this layer.

Monitor coho salmon escapement at Shelter Bay to determine if reduced limits have improved spawning numbers.

Vegetation Resources

Continue to monitor permanent monitoring plots installed on Montague Hinchinbrook Islands. Permanent monitoring plots were installed in two areas on Montague Island so changes in stand structure and understory can be tracked for several kinds of stand treatments including different thinning intensities and pruning efforts. One was installed in Hanning Bay along Quadra Creek in 1995 (Kesti 1995, 2000b) and the other installed in 1998-2000 near Swamp Creek on Montague Straits just south of Port Chalmers (Kesti 1999, 2000a, 2001). Another plot located in Port Etches on Constantine Harbor was established by H. G. Lutz in 1926 in a stand believed to have originated from a harvest in 1835. District crews found the plot in 1997 and trees were retagged and remeasured in 2002 (Kesti 2003). Several annual reports and raw data for all these monitoring efforts are available at the Cordova R.D. Information will be collected from these plots every 5 years until 20 years after treatment, then every 10 years. Information can be used to determine how to treat other young growth stands in the Sound.

Update the Forest GIS database to reflect past harvest and stand conditions. In 2005 and 2006, the Forest GIS database will be updated with harvest information and current size class for National Forest System lands in the Sound administered by the Cordova Ranger District.

Wildlife

Identify key habitats for breeding, feeding, shelter, and resting, for all species known to exist in the analysis area, with priority places on threatened and endangered species, species of special management concerns, and game species. Table 3-5 on page 3-28 of the Forest Plan describes important habitat sensitivity and seasonality for sea otter, river otter, harbor seal, Steller seal lion, brown bear, Sitka black-tailed deer, black oyster catcher, pigeon guillemot, seabird colonies, shorebirds, Kittlitz and marbled murrelets, harlequin ducks, Peale's Peregrine, Bald eagles, goshawks, and waterfowl.

Collect baseline data on timing of use by migratory species, such as shorebirds, and species that use the area, or specific habitats, seasonally such as sea lions at haulouts, etc.

Develop list of mammal and amphibian species on the Big Islands. Includes surveys for Montague Island hoary marmots, European rabbits, and amphibians.

Heritage Resources

Cultural resources in project areas proposed by the Forest Service are inventoried under section 106 of the NHPA. Other inventories of cultural resources on National Forest System lands outside identified project areas fall under Section 110 of the NHPA. These inventories could involve partnerships. The State of Alaska's Office of History and Archaeology staff has partnered with the Forest in the past and is a likely future partner for historic research, as are the departments of Anthropology and History of the University of Alaska. Depending on funding, two options to inventory the cultural resources of the area and develop a database are:

Option 1 (High funding)- Showcase Forest Service management of historic sites, complete the inventory and evaluation of cultural resources of the analysis area over a period of 20 years and refine the predictive model after completing archaeological survey of 25% of the analysis area. It would take an estimated 5 years to complete the sample.

Option 2 (Moderate funding)- Complete the inventory and evaluation of cultural resources of the analysis area over a period of 40 years and build a predictive model after 25% of the analysis area was surveyed. It would take about 10 years to complete the sample. Interpret cultural resources only if necessary for mitigation of adverse effects.

Recreation Use

Monitor recreation use of Green island and other islands in conjunction with other surveys. Concern was raised of increase use on Green Island in particular during hunting season and the resulting trash left by visitors. Another place where this is a problem is on Montague Island, in particular Jeannie Cove and the cabins frequented by hunting parties.

Easements

Monitor conditions of easements and maintain on a 3-5 year rotation.

Special Uses and Outfitter/guides

Monitoring special use permits primarily through field inspections and information from the public that we receive. In recent years we have also become more active in conducting evaluations of most of the permitted outfitter/guides.

Potential projects to consider in the Big Islands analysis area

The revised Forest Plan lists potential projects for the Prince William Sound area in Appendix C on pages C10 -11. Table 5.1 displays those projects not yet completed that may include activity in this analysis area. Each would be further analyzed through the NEPA process and additional public involvement, before a decision is made whether or not to implement.

Table 5.1 - Potential projects from revised Forest Plan – Prince William Sound.

Project	Year planned	Est. cost (thousands)	Description
Trail Construction			
Prince William Sound Trails	2008-11	$900.0	Provide new trails to meet demand and prevent resource damage.
Cabin Construction and Reconstruction, recreation site construction			
New cabins in Prince William Sound	2005-12	$350.0	Provide three new cabins to help meet demand.
Rehabilitate cabins in Prince William Sound	2004-12	$300.0	Reconstruct 5 cabins to reduce backlog of deferred maintenance.
Prince William Sound Campsites	2004-12	$700.0	Protect soil and vegetation in high use areas by providing hardened campsites.
Fish habitat monitoring, inventory, and enhancement			
Montague Island Riparian Thinning	2002-04	$14.0	Thin 6.5 miles of young growth riparian spruce, monitor results and report for adaptive management. Ongoing Project.

The IDT and public identified other potential projects for the analysis area. These projects also would be further analyzed through the NEPA process and additional public involvement before a decision was made to implement or not.

Fisheries

1. Form interdisciplinary group in cooperation with hunters and State agencies to designate OHV routes on Hawkins Island near Canoe Creek to minimize impacts to fisheries resources. Protect and restore wetlands, sensitive plants, and soil damage currently present on the OHV paths by constructing hardened surface and bridges at appropriate stream crossings.

2. Thin 2nd growth riparian areas on Montague Island streams in order to boost tree growth and potential LWD recruitment. Put LWD into these stream channels and floodplains to enhance stream rearing and spawning habitat. LWD could be obtained from outside beaches on Montague Island and placed via helicopter.

3. Survey relationship between water level and down cutting in the Stump Lake system. Evaluate the control structure and remove or rebuild the structure using more permanent materials.

4. Rebuild administrative cabin at Rocky Bay so that crews have lodging when conducting projects on the north tip of Montague Island to provide for a safer work environment.

5. Establish information board and OHV cleaning stations at Whittier, Valdez, and Cordova to ensure weed-free vehicles entering Prince William Sound and the islands.

Wildlife

1. Place interpretive signs at places used for recreation, hunting or fishing such as USFS cabins. Signs could educate visitors about avoiding disturbance to wildlife, importance of habitats, or the history of local wildlife populations.

2. Develop research studies to examine effects of human disturbance (on foot, by boat, or passes by airplanes, etc.) on seabirds, oystercatchers, and on sea lions at haulouts.

3. Educate Forest visitors about the behavior of oystercatchers and sea birds and how they may avoid or reduce disturbing nest sites.

4. Document timing and use of feeding sites by brown bears on Hawkins, Hinchinbrook, and Montague Islands.

Heritage Resources

1. Partner with interested entities for documentation, preservation, and interpretation of prehistoric and historic sites, cultural landscapes, and rehabilitation of historic buildings.

2. Develop collaborative stewardship relationships for protection and interpretation of cultural resources; partner with university programs for research work to provide background information for management and interpretation. Stewardship partners have been established for historic sites in western Prince William Sound on Glacier Ranger District and have proven to be successful in monitoring archaeological sites. Similar stewardship partners could be established in the analysis area. Potential future partners in historic research and documentation are both the State of Alaska's Office of History and Archaeology and the departments of Anthropology and History at the University of Alaska.

3. At the minimum, evaluate and maintain historic properties, but do not rehabilitate unless necessary for maintenance.

Recreation – Cabins and trails

1. The team received some comments about building cabins in Prince William Sound. Folks were concerned about placing cabins in bays that are used as anchorages since that concentrates use in the area, especially during hunting season. It would be more desirable to locate cabins in other areas. It is unlikely however, that any additional cabins will be constructed on National Forest System lands until the nationwide Recreation Site Facility Master Planning Process is completed. It is anticipated that it may take 3 years to develop the final strategy. The Forest Service is requiring that all facilities open to the public be maintained or managed at higher standards than in the past. Previously facilities were maintained at different levels depending on use. Not all facilities currently open to the public can be maintained to the required level with the existing limited funding available for maintenance.

2. Other concerns were raised about existing cabins that are adjacent to private lands and the potential for trespass and vandalism to cultural resources. CAC requested that we consider moving these cabins to reduce the potential of trespass and vandalism. They suggested two other locations on Montague Island and recommended relocating the Beach River cabin to one of them. Although the land relinquishment decision is a separate issue the concept of relocating the cabin to their suggested site at Montague Lagoon (sec 21 & 28, T1N, R12E, SM,– N60 09.667 W147 21.626) has merit. The second suggested site near Montague Point (T3N, R13E, SM, N60 22.241 W147 09.231) has access problems but another area on Montague Island, Jeanie Cove (T4S, R11E, SM) could be considered as a second alternative. Other Montague Island locations for new cabins include the administrative cabin site in Rocky Bay (Sec 33, T3N, R13E,SM, N60 20.143 W147 07.825), and Stockdale Harbor (T3N, R13E, SM, N60 19.620 W147 11.729).

3. As stated in Chapter 4, another possible cabin relocation project is the Nellie Martin River cabin. The river has changed its course forcing planes to land 1½ miles north of the current cabin site. A new site closer to the landing beach needs to be identified as well as determining whether or not to relocate the cabin.

4. The concept of a trail providing access from the Prince William Sound side to the Gulf of Alaska side of the Montague Island has been discussed but never finalized. Issues such as cost, user demand, rainfall (over 350 inches annually) and level of development remain to be addressed.

5. Reestablishing the Makarka Lakes Trail as part of the District's trail system would be another possible method of increasing recreation hiking/fishing opportunities for the analysis area. The trail access five small lakes and could provide remote sport fishing opportunities but has limited accessibility.

6. Complete recreation carrying capacity analysis to determine amount of guided public to permit in the Sound.

7. Determine need or desire for mooring buoys to disperse users. Previous scoping has indicated that people do not want mooring buoys in all the bays. Also installation and maintenance can be quite expensive.

Minerals Development

1. A formal Office of General Council opinion is sought concerning CAC's rights as the EVOS lands subsurface estate owner regarding the common variety minerals (stone, sand and gravel) and other mineral resources.

2. The Forest should work closely with CAC in order to determine if, when, and how, any CAC exploration activities might impact National Forest Surface estate.

3. Consider purchasing the subsurface estate of the EVOS lands. This would ensure the protection of the surface as was intended when the government purchased these lands. As acquired lands, they would be withdrawn from mineral entry.

4. Monitor the manganese occurrence site on Hinchinbrook Island periodically for activity. There has been mining claims staked on it in the recent past.

5. Withdraw Green Island RNA from mineral entry to protect the surface for the designated use. Although highly unlikely a "prudent" miner would be interested in Green Island, which has no identified mineral occurrences – there is always potential for the not-so-prudent miner. On the other hand, the remote nature of the RNA lessens that likelihood.

Project implementation recommendations

Fisheries

It is desired that commercial fishing and hatchery production in PWS will be done in an ecologically sound manner that does not compromise the long term sustainability of wild salmon populations. Genetically distinct wild populations will be protected and genetic diversity of populations will be maintained throughout the region. The current ADFG management strategy and recent genetic studies will be important components in ensuring the protection of wild salmon stocks.

Heritage Resources

Manage cultural resources in conjunction with other resources. Human use of any area is generally due to the presence of various biological, botanical, geological, and hydrological resources. Managing and interpreting heritage resources simultaneously with other resources can provide a holistic view of the natural resources important to the people associated with the cultural resources of a site.

Consider indirect effects to cultural resources when designing and proposing projects. Indirect effects are those effects that may occur outside the direct footprint of a proposed project. An example is the creation of a new recreation trail which passes by a historic cabin or an archaeological site. By increasing the ease of access, and routing the public into the vicinity of the cultural resource, the integrity of the resource is put at risk of either purposeful vandalism or accidental disturbance by the public, and must be addressed by the project.

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Appendix A – Additional Maps, Tables, and Graphs

Vegetation

The following tables are based on information generated from the USDA Forest Service GIS data base 2004.

Table A.1 - Summary of acres of each cover type for the Big Islands analysis area

Vegetation Type	Acres	Percent of Area
Alder	1,172	0.3%
Brush - other	15,002	4.0%
Cottonwood	50	~%
Grass and Alpine	61,988	16.7%
Hemlock	153,622	41.2%
Hemlock-Spruce	44,668	12.0%
Sitka Spruce	29,057	7.8%
Muskeg	16,593	4.4%
Willow	13	~ %
Rock	13,428	3.6%
Snow and Ice	24,117	6.5%
Other Nonforest	8,552	2.3%
Water	3,922	1.0%
Willow	13	~%
No Data	191	~%
Total Area	372,505	100%

Table A.2 - The 272 vascular plant species documented in the Big Islands analysis area based on DeVelice et al. 19998 (ecoplot), Forest Inventory & Analysis plots (FIA), and University of Alaska Herbarium database (ALA).

Scientific Name	Notes	ecoplot	FIA	ALA
Trees				
Chamaecyparis nootkatensis	in Windy Bay on Hawkins Island	x		
Picea sitchensis		x	x	
Tsuga heterophylla		x	x	
Tsuga mertensiana		x	x	
Tall Shrubs				
Alnus crispa ssp. sinuata		x	x	
Cladothamnus pyrolaeflorus		x	x	x
Crataegus douglasii			x	
Echinopanax horridum		x	x	
Kalmia polifolia	questionable ID (large range extension)		x	
Malus fusca		x		x
Menziesia ferruginea		x	x	
Myrica gale			x	
Physocarpus capitatus		x		
Ribes bracteosum		x	x	x
Rubus spectabilis		x	x	
Salix sitchensis		x		
Sambucus racemosa		x	x	
Sorbus sitchensis		x	x	x
Vaccinium alaskaense				x
Vaccinium ovalifolium		x	x	x

[8] USDA Forest Service, Chugach National Forest, Alaska Region Technical Publication R10-TP-76.

Table A.2 - The 272 vascular plant species documented in the Big Islands analysis area based on DeVelice et al. 19998 (ecoplot), Forest Inventory & Analysis plots (FIA), and University of Alaska Herbarium database (ALA).

Scientific Name	Notes	ecoplot	FIA	ALA
Vaccinium parvifolium	questionable ID (large range extension)		x	
Subshrubs and Dwarf Shrubs				
Andromeda polifolia		x	x	x
Cassiope mertensiana		x	x	
Cassiope stelleriana		x	x	
Diapensia lapponica			x	
Empetrum nigrum		x	x	
Loiseleuria procumbens		x	x	
Luetkea pectinata		x	x	
Oxycoccus microcarpus		x	x	x
Phyllodoce aleutica		x		
Phyllodoce glanduliflora			x	
Rhododendron camtschaticum			x	
Salix arctica				x
Salix reticulata			x	
Vaccinium caespitosum		x	x	x
Vaccinium uliginosum		x	x	
Vaccinium vitis-idaea		x	x	
Forbs				
Achillea millefolium	non-native species			x
Achillea millefolium var. borealis			x	
Aconitum delphiniifolium		x	x	
Actaea rubra		x		
Adoxa moschatellina			x	
Anemone narcissiflora			x	
Angelica genuflexa			x	x
Angelica lucida			x	
Apargidium boreale		x	x	x
Aquilegia formosa		x		x
Arabis lyrata				x
Arnica lanceolata				x
Arnica lanceolata ssp. amplexicaulis				x
Arnica latifolia			x	
Artemisia arctica			x	x
Artemisia tilesii			x	
Aruncus sylvester		x		x
Aster sibiricus			x	
Aster subspicatus				x
Atriplex gmelinii var. alaskensis				x
Barbarea orthoceras				x
Bistorta vivipara			x	x
Caltha leptosepala				x
Caltha palustris		x		
Campanula lasiocarpa				x
Campanula rotundifolia			x	
Cardamine bellidifolia				x
Cardamine oligosperma var. kamtschatica			x	
Cardamine umbellata				x
Castilleja unalaschcensis			x	x
Cicuta virosa				x
Circaea alpina		x	x	
Claytonia sibirica			x	x
Cochlearia officinalis				x
Conioselinum chinense		x		
Conioselinum gmelinii			x	
Conioselinum pacificum				x

Table A.2 - The 272 vascular plant species documented in the Big Islands analysis area based on DeVelice et al. 19998 (ecoplot), Forest Inventory & Analysis plots (FIA), and University of Alaska Herbarium database (ALA).

Scientific Name	Notes	ecoplot	FIA	ALA
Coptis aspleniifolia		x	x	x
Coptis trifolia		x	x	x
Corallorrhiza trifida		x		x
Cornus canadensis		x	x	
Cornus suecica			x	
Dactylorhiza aristata			x	
Dodecatheon jeffreyi			x	x
Dodecatheon pulchellum		x	x	
Drosera anglica			x	x
Drosera rotundifolia		x	x	x
Epilobium adenocaulon		x		
Epilobium anagallidifolium				x
Epilobium angustifolium			x	
Epilobium ciliatum			x	
Epilobium ciliatum ssp. glandulosum				x
Epilobium hornemannii			x	
Epilobium hornemannii ssp. behringianum				x
Epilobium latifolium				x
Epilobium luteum				x
Epilobium sertulatum				x
Erigeron peregrinus		x	x	x
Fauria crista-galli		x	x	
Fritillaria camschatcensis			x	
Galium aparine				x
Galium kamtschaticum			x	
Galium trifidum		x		
Gentiana douglasiana		x	x	
Gentiana platypetala		x	x	
Geranium erianthum			x	
Geum calthifolium		x	x	
Geum erianthum				x
Geum macrophyllum		x	x	
Glaux maritima				x
Heracleum lanatum		x	x	
Heuchera glabra		x	x	x
Hieracium triste			x	
Hippuris montana			x	
Hippuris vulgaris				x
Honckenya peploides				x
Iris setosa			x	
Lagotis glauca	questionable ID (range extension)		x	
Lathyrus maritimus				x
Leptarrhena pyrolifolia		x	x	
Ligusticum scoticum		x	x	x
Listera caurina		x	x	
Listera cordata		x	x	
Lupinus nootkatensis			x	
Lysichiton americanum		x	x	
Maianthemum dilatatum		x	x	
Menyanthes trifoliata			x	
Mertensia maritima				x
Mimulus guttatus				x
Mitella pentandra				x
Moneses uniflora		x	x	
Osmorhiza chilensis			x	
Osmorhiza depauperata			x	

Table A.2 - The 272 vascular plant species documented in the Big Islands analysis area based on DeVelice et al. 19998 (ecoplot), Forest Inventory & Analysis plots (FIA), and University of Alaska Herbarium database (ALA).

Scientific Name	Notes	ecoplot	FIA	ALA
Osmorhiza purpurea		x	x	x
Pedicularis lanata				x
Pedicularis oederi			x	
Pedicularis parviflora		x	x	x
Petasites frigidus			x	
Petasites frigidus var. nivalis			x	
Petasites nivalis				x
Pinguicula vulgaris		x	x	
Plantago macrocarpa				x
Plantago maritima				x
Platanthera chorisiana				x
Platanthera dilatata		x	x	
Platanthera saccata		x		
Platanthera stricta			x	
Polygonum fowleri				x
Potentilla egedii				x
Potentilla villosa				x
Prenanthes alata		x	x	
Primula cuneifolia ssp. saxifragifolia				x
Primula eximia				x
Prunella vulgaris				x
Pyrola minor		x		x
Pyrola secunda		x		
Ranunculus bongardii		x		
Ranunculus cooleyae			x	x
Ranunculus cymbalaria				x
Ranunculus eschscholtzii				x
Ranunculus orthorhynchus				x
Ranunculus trichophyllus				x
Rhodiola integrifolia ssp. integrifolia			x	
Romanzoffia sitchensis				x
Romanzoffia unalaschcensis	sensitive plant			x
Rubus arcticus			x	
Rubus chamaemorus		x	x	x
Rubus pedatus		x	x	
Rumex crispus	non-native species			x
Rumex transitorius				x
Sanguisorba canadensis			x	
Sanguisorba officinalis		x		
Sanguisorba stipulata		x		
Saxifraga ferruginea				x
Saxifraga flexuosa				x
Saxifraga lyallii				x
Saxifraga mertensiana				x
Saxifraga nelsoniana				x
Saxifraga nelsoniana ssp. nelsoniana			x	
Saxifraga punctata		x		
Saxifraga tolmiei			x	
Senecio pseudoarnica				x
Senecio triangularis			x	
Sparganium minimum				x
Spiranthes romanzoffiana		x		
Stellaria borealis			x	
Stellaria borealis ssp. borealis				x
Stellaria borealis ssp. sitchana				x
Stellaria calycantha			x	

Table A.2 - The 272 vascular plant species documented in the Big Islands analysis area based on DeVelice et al. 19998 (ecoplot), Forest Inventory & Analysis plots (FIA), and University of Alaska Herbarium database (ALA).

Scientific Name	Notes	ecoplot	FIA	ALA
Streptopus amplexifolius		x	x	
Streptopus lanceolatus var. roseus			x	
Streptopus roseus		x		
Streptopus streptopoides		x		
Swertia perennis			x	x
Tellima grandiflora		x		
Tiarella trifoliata		x	x	
Tofieldia glutinosa		x	x	x
Trientalis europaea		x	x	x
Triglochin maritima				x
Valeriana capitata			x	
Valeriana sitchensis		x	x	
Veratrum viride		x	x	
Veronica wormskjoldii				x
Viola glabella		x	x	x
Viola langsdorfii		x	x	
Viola sempervirens				x
Graminoids				
Agropyron subsecundum		x		
Agrostis exarata				x
Calamagrostis canadensis		x	x	x
Calamagrostis nutkaensis		x	x	
Carex anthoxanthea		x		
Carex aquatilis var. dives			x	
Carex dioica spp. gynocrates				x
Carex gynocrates			x	
Carex kelloggii				x
Carex laeviculmis			x	
Carex lenticularis var. dolia	sensitive plant			x
Carex lenticularis var. lipocarpa			x	
Carex lyngbyei				x
Carex macrochaeta		x	x	
Carex mertensii		x	x	
Carex micropoda				x
Carex nigricans		x		x
Carex pauciflora		x		
Carex phyllomanica		x		
Carex pluriflora		x	x	
Carex podocarpa			x	
Carex rostrata		x		
Carex sitchensis		x		x
Carex stylosa			x	
Deschampsia beringensis				x
Deschampsia caespitosa		x		x
Eleocharis mamillata				x
Elymus arenarius		x		x
Eriophorum angustifolium		x	x	
Festuca rubra				x
Hordeum brachyantherum				x
Juncus arcticus				x
Juncus drummondii				x
Juncus ensifolius				x
Juncus mertensianus			x	x
Juncus oreganus				x
Luzula parviflora			x	x
Luzula wahlenbergii				x

Table A.2 - The 272 vascular plant species documented in the Big Islands analysis area based on DeVelice et al. 19998 (ecoplot), Forest Inventory & Analysis plots (FIA), and University of Alaska Herbarium database (ALA).

Scientific Name	Notes	ecoplot	FIA	ALA
Phleum alpinum			x	
Poa eminens				x
Poa leptocoma				x
Poa stenantha var. vivipara				x
Podagrostis aequivalvis		x	x	
Podagrostis thurberiana				x
Puccinellia hultenii				x
Puccinellia nutkaensis				x
Trichophorum caespitosum		x	x	x
Vahlodea atropurpurea		x	x	x
Ferns and Fern Allies				
Asplenium viride			x	
Athyrium distentifolium ssp. americanum				x
Athyrium filix-femina		x	x	
Blechnum spicant		x	x	
Cryptogramma acrostichoides			x	x
Cystopteris fragilis		x	x	
Dryopteris dilatata		x		
Dryopteris expansa			x	
Equisetum arvense		x	x	
Gymnocarpium dryopteris		x	x	
Lycopodium annotinum		x	x	
Lycopodium clavatum		x	x	
Lycopodium sabinaefolium		x		x
Lycopodium selago		x	x	
Matteuccia struthiopteris				x
Polypodium glycyrrhiza			x	
Polypodium vulgare		x		
Polystichum braunii				x
Selaginella selaginoides			x	
Thelypteris limbosperma		x	x	
Thelypteris phegopteris		x	x	

Table A.3 - Clearcut harvest locations, dates, and size in Big Islands Analysis area. Compiled by Susan Kesti 1992

Stand no	Sale name	Harvest end date[1]	Year of origin[2]	Harvest acres[3]	Location & notes
4.00.0	Port Chalmers Area	1949		150	
4.00.0	Port Chalmers – Right Arm	1949		`	Small cut
4.33.1	Zaikof Bay	1950	1947	90	Montague
4.00.0	Port Chalmers NE side	1950		50	Montague
4.12.1	MacLeod Harbor 315	1952	1952	201	Montague, transferred to CAC
5.10.1	Midway Bay	1952	1955	95	Hinchinbrook, Port Etches, State select
4.33.2	Zaikof Bay	1956	1956	4	Montague
4.33.3	Zaikof Bay	1956	1956	14	Montague
4.33.4	Zaikof Bay	1956	1956	4	Montague
5.10.4	Port Etches	1956	1959	41	Montague
4.34.1	Zaikof Bay #2	1956	1956	10	Montague
4.10.1	Hanning 316	1959	1958	206	Montague
4.10.2	Hanning 316	1959	1958	74	Montague
4.10.3	Hanning 316	1959	1958	16	Montague
4.10.4	Hanning 316	1959	1958	50	Montague
5.14.13	Juania Bay	1959	1962	90	Hinchinbrook

Table A.3 - Clearcut harvest locations, dates, and size in Big Islands Analysis area. Compiled by Susan Kesti 1992

Stand no	Sale name	Harvest end date[1]	Year of origin[2]	Harvest acres[3]	Location & notes
4.12.2	MacLeod Harbor 320	1960	1961	10	Montague
4.13.2	MacLeod Harbor 317	1960	1961	196	Montague
4.13.3	MacLeod Harbor 317	1960	1961	52	Montague
4.13.4	MacLeod Harbor 317	1960	1961	72	Montague
4.13.1	MacLeod Harbor 320	1961	1961	38	Montague
4.14.1	MacLeod Harbor 319	1961	1961	15	Montague
4.11.3	MacLeod Harbor 312	1962	1962	56	Montague
4.24.10	Nellie Martin #1	1964	1966	72	Montague, transferred to CAC
4.5.7	Montague Straits #1	1965	1967	21	Montague, part PCT[4] 1987
4.5.4	NW Montague #1	1966	1973	166	Montague, part of PCT 1987
4.5.9	NW Montague #1	1966	1969	75	Montague
5.14.17	Rube Point	1966	1969	7	Hinchinbrook
4.12.3	MacLeod Harbor 320	1967	1961	5	Montague
4.11.1	Hanning Bay #2	1970	1972	111	Montague, 9 ac PCT 1987
4.11.2	Hanning Bay #2	1970	1972	18	Montague 45 ac PCT 1986
4.6.4	Montague Lagoon	1971	1972	64	Montague
4.6.1	NW Montague #2	1972	1969	54	Montague part of Baseline TSI (89)[5]
4.6.2	NW Montague #2	1972	1971	53	Montague part of Baseline TSI (89)[5]
4.6.3	NW Montague #2	1972	1972	40	Montague part of Baseline TSI (89)[5]
4.6.5	Montague Lagoon #2	1972	1972	10	Looks like channel moved
4.9.1	Needles	1972	1970	70	Montague
4.12.4	MacLeod Harbor 85	1973	1975	24	Montague, transferred to CAC
4.12.5	MacLeod Harbor 85	1973	1974	58	Montague, transferred to CAC
4.5.1	Montague Straits #2	1976	1974	53	Montague
4.5.2	Montague Straits #2	1976	1974	20	Montague
4.5.3	Montague Straits #2	1976	1973	16	Montague
4.7.4	Westside	1978	1980	35	Montague
4.7.5	Westside	1978	1980	39	Montague
4.7.6	Westside	1978	1980	39	Montague
4.7.7	Westside	1978	1980	34	Montague
4.7.8	Westside	1978	1980	24	Montague
4.7.9	Westside	1978	1980	12	Montague
4.7.10	Westside	1978	1980	31	Montague
4.7.11	Westside	1978	1980	38	Montague
4.7.12	Westside	1978	1980	50	Montague
4.8.1	Westside	1978	1980	17	Montague
4.8.2	Westside	1978	1980	24	Montague
4.8.3	Westside	1978	1980	39	Montague
	Total Acres Harvested			**2703**	

[1] harvest end date is from Cordova Sale Record Book

[2] Date of origin is date trees regenerated on the site from Cordova Silviculture TSI "Black Book"

[3] Acres harvested from Silviculture black book circa 1980, if italicized is from another source, may not match GIS layer acreage.

[4] PCT = Precommercial Thin

[5] Baseline TSI was a Timber Stand Improvement contract of 135 acres let in 1989.

Cultural Resources

Table A.4 - List of sites within the Big Islands Landscape Analysis Area					
AHRS #	**FS#**	**BIA#**	**Site Name**	**Description**	**Category**
None	FS#733		Notched Trees I		Native
None	FS#825		Bureau of Mines #C-49		Mining
None	FS#824		Bureau of Mines #C-48		Mining
None		AA010779b	Nagaa'ulek (Nayanlik)		Native
None	FS#877	AA10727	AA10727		Native
None	FS#887	AA10729	AA10729		Native
None	FS#883	AA10728	AA10728		Native
None	FS#775		Alaska California Mining Co.		Mining
None	FS#788		Anita Barnes Cabin Ruins		Cabins/ Buildings
None	FS#755	AA010983	North Coast Sea Otter Camp		Subsistence
None	FS#667		Bark Stripped Trees	bark stripped trees	Native
None	FS#645		CNI Survey, Stockdale Harbor 1982	village	Native
None	FS#868	AA12446	AA12446		Native
None	FS#736		High Potential		Other
None	FS#771		Mine Shaft	historic lode mine	Mining
None	FS#734		Notched Trees II		Native
None	FS#732		Pottery Creek		
None	FS#735		Sea lion bones		Subsistence
None	FS#766		Bark-stripped trees II (greenstone debitage)		Native
None	FS#791		Green Island Fish Camp		Subsistence
None	FS#772		Lower Village Site		Native
None	FS#764		NE1/4SW1/4,SEC5,T 2,R12E,SM		Other
None	FS#613		Otter Bay Drill Holes	other	Mining
None	FS#752	AA011013	Box Point Sea Otter Hunting Camp		Subsistence
None	FS#751	AA011012	Jeanie Point sea otter Hunting Camp		Subsistence
None	FS#583	AA012548	Montague Gulf Island Site		Native
None	FS#900	AA11018	AA11018		Native
None	FS#668		Disturbed soils	fish or temporary camp	
None	FS#589		USC&GS Marker "Horn" Port Etches	historic monument	Exploration
None	FS#902	AA11133	AA11133		Native
None	FS#903	AA11134	AA11134		Native
None	FS#864	AA11137	AA11137		Native
None	FS#798		Point Steele Bidarka Portage		Native
None	FS#612		Otter Bay Cabin, Bay of Isles	other	Cabins/ Buildings
None		AA011019	Shirttail Point Summer Village (Aqllutuli)(Aqtatula)		Native
None	FS#901	AA11131	AA11131		Native
None	FS#586		Fish Trap Anchor,	historic fish trap	Subsistence
None	FS#588		Garden Cove Fish Trap (anchor/piling)	historic fish trap	Subsistence
None	FS#878	AA11010	AA11010		Native
None	FS#817		Rock Circle Site		
None	FS#867	AA11052	AA11052		Native

Table A.4 - List of sites within the Big Islands Landscape Analysis Area					
AHRS #	**FS#**	**BIA#**	**Site Name**	**Description**	**Category**
None	FS#889	AA010735, AA010997	AA10735, AA10997		Native
None	FS#882	AA10790	AA10790		Native
None	FS#876	AA10994	AA10994		Native
None	FS#880	AA10993	AA10993		Native
None	FS#862	AA10769	Little Woodshed AA10769		Native
None	FS#875	AA10954	AA10954/AA10777		Native
None	FS#859	AA10736	AA10736		Native
None	FS#888	AA10780	AA10780		Native
None	FS#884	AA10776	AA10776		Native
None	FS#785		Mountain Top Goat Camp		Subsistence
None	FS#881	AA10760	AA10760		Native
None	FS#861	AA10744	AA10744		Native
None	FS#860	AA10743	AA10743		Native
None	FS#872	AA10742	AA10742		Native
None	FS#886	AA10738	AA10738		Native
None	FS#866	AA10990	AA10990		Native
COR-00001	FS#001, FS#325	AA011132	Palugvik (Paluyvik, Paluwiks) [Palugvik Arch Dist]	Village site consisting of two middens. Four irregular layers were discerned by de Laguna during her extensive excavation.	Native
COR-00009	FS#355		Nuchek (Redoubt Constantine And Helen)	The principal village of the sound during historic times. In 1794 Vancouver found only a few natives at the Lebedef-Lastochkin Company post at or near the present site.	Exploration
COR-00013	FS#594	AA012440	XI YDLIAQ (Anderson Bay Summer Village)	Village site reported to, but unverified by, de Laguna. CPSU reported a shell midden, artifacts eroding onto the beach & historic remains assoc. with a floating fish trap.	Native
COR-00027	FS#349	AA010766	Possession #8 (Discovery Plate Is., Sapuulut Mell'at Bocharov Is.)	In 1788 Bocharov and Izmailov reportedly placed an iron possession marker here. A smokehouse may have existed.	Exploration
COR-00028	FS#348	AA010788	AN ITVQ (ANG'ILLEQ, Double Bay Northwest)	de Laguna reported midden eroding and several huts belonging to Fred Chimovitski, who died in 1930. CPSU reported eroding midden, remnants of two houses and a smokehouse.	Native
COR-00029, COR-00161	FS#351	AA010786, AA010781, AA010782	Nunaktvq (Nunakchak AK, Big Village, Rock Circle Site)	Site with 30m x 40m x 1m deep midden tested by de Laguna in 1933.	Native
COR-00030	FS#326	AA011019	Aqlatuli (Shirttail Point)	de Laguna reported village site. Midden may have been washed away.	Native
COR-00031	FS#327		Boswell Bay Pinnacle Rocks (Napalayeaq)	Large gull rocks.	Native
COR-00032	FS#328	AA011036	Qayuaviyat	Campsite; no midden found. An abandoned cannery is located here. On the rocky cliff at the eastern side of the beach are red pictographs.	Native

Table A.4 - List of sites within the Big Islands Landscape Analysis Area					
AHRS #	**FS#**	**BIA#**	**Site Name**	**Description**	**Category**
COR-00033	FS#329		Tu Tliyalik	Large cave above the beach. de Laguna found the remains of numerous fires, many animal and bird bones, and part of a torsion trap in it.	Native
COR-00034	FS#330	AA011017	TIKVXTAYUAQ (CIKURTARUAQ, Strawberry Point Camp)	de Laguna reported this summer campsite where Teddy Hoek had a cabin & garden in 1930. A reported barabara foundation.	Native
COR-00035	FS#331	AA011025	Qucuyvli (Qusugeli Rock-Shelter, Qucuyvli, Quswarliq) [Palugvik]	De Laguna reported this cave w/ disturbed remains, 2.5' of midden, a barbed slate blade, & several rock paintings. CPSU reported midden up to 1.2m deep in the rock shelter.	Native
COR-00036	FS#332	AA011024	UN ILIN UAQ (ENGLUNGUAQ) [PALUGVIK]	de Laguna reported pictographs on the face of a cliff/rock shelter. CPSU reported 14 pictographs in 3 groups & an additional 5 amorphous smudges.	Native
COR-00037	FS#333	AA011145	TULUYLIN UACAQ (CULURTELLENGUA SAAQ)	de Laguna reported cave with remains which were removed. CPSU confirmed the existence of the cave.	Native
COR-00038	FS#334 & FS#335	AA011021	TAUXTVIK VILLAGE (COCKLE PLACE)	Village on top of a 250' long and 30-40' high cliff. The clearing, overgrown with vegetation, suggests the site extends about 150-200' back from the cliff. Midden was noted from 1-2' thick.	Native
COR-00039			TAUXTVIK BURIAL CAVE (COCKLE PLACE NE - NORTH OF MIDDEN)	Cliff with south facing cave. The mouth of the cave had been blocked by earth and boulders, which had been partially moved by looters who rifled the cave before 1930 visit by de Laguna	Native
COR-00040	FS#336	AA011021	TAUXTVIK ROCK-SHELTER (COCKLE PLACE NE - NE OF MIDDEN)	Under a small overhanging rock, facing southeast and sheltering a space about 6' long, de Laguna found a few shells, fire cracked rock, and remains with a splitting adze and a stone saw.	NATIVE
COR-00041	FS#379	AA010996	QI AYVIK (QIAWIK)	de Laguna reported village site consisting of midden up to 3' deep & two rows of shallow probable house pits.	NATIVE
COR-00042	FS#380	AA010779a	NAYA ULIK	Reported to de Laguna as a former refuge island. BIA-ANCSA found 1 piece of FCR & 1 adze on beach of island.	NATIVE
COR-00043	FS#381	AA010778	NUN AQ	Camp or village site reported to, but unverified by, de Laguna. CPSU reported pitch-cut trees & a victor metal trap.	NATIVE

Table A.4 - List of sites within the Big Islands Landscape Analysis Area					
AHRS #	**FS#**	**BIA#**	**Site Name**	**Description**	**Category**
COR-00051	FS#369		AXILINAYUAQ	Shell midden up to 2' deep, but of only a few yards extent. Excavation produced only a piece of cut whale bone. A splitting adze was on beach.	NATIVE
COR-00080	FS#358	AA011049	NUNALVQ (NUNAKCAK, NUNALLEQ, Chemavisky cabin)	Reported to be oldest village in the Sound according to de Laguna's informant. The last living inhabitant is said to have founded Nuchek (COR-009).	NATIVE
COR-00081	FS#352	AA010767	NUJIN UACAQ LITTLE NUCHEK, NUUCINGNASAAQ	Several depressions, some opening into each other, which may have been house pits. Fire cracked rock was found in the bottom of two of them.	NATIVE
COR-00082	FS#353	AA010762	UQCILINUACAQ (UKSILLEKCAK, Port Etches Winter village)	Reported to de Laguna as a winter village in Port Etches. CPSU located a surface scatter of artifacts in the intertidal zone.	NATIVE
COR-00094	FS#354	AA010763	QIL A N AL IK (Johnstone Point Refuge Rock)	Village (probably a fort) reported to de Laguna, but not verified. CPSU reported cultural material. Site disturbed by lighthouse installation.	NATIVE
COR-00119, COR-00120	FS#590	AA012547	Nuchek Island Petroglyph / Garden	petroglyph	NATIVE
COR-00121	FS#814		Constantine Harbor Cache Island		
COR-00122	FS#802		Constantine Harbor Seasonal Village Site		NATIVE
COR-00124	FS#800		Zapor River Site		NATIVE
COR-00125		AA010769	SALA'ANGUASAAQ (Little Woodshed)	Brick making site marked by a patterned arrangement of 20 pilings indicating a 6.2m x 10.6m structure reported to be a brick storage platform, & a steep-walled depression, measuring 5.5m x 11.9m, interpreted as the remnants of a brick kiln.	NATIVE
COR-00126	FS#805	AA010770	Pt Etches Garden/bidarka		NATIVE
COR-00127	FS#803		Port Etches Winter Village		NATIVE
COR-00128	FS#796		Nuchek Creek		
COR-00129	FS#801		Port Etches Winter Site		NATIVE
COR-00130	FS#807		COPPER PLACE		
COR-00133	FS#356		Moonshine Cabin	other	CABINS/ BUILDINGS
COR-00134	FS#815		Pt. Barber Complex Site		
COR-00138		AA010768B	TWIN LAKES SMOKEHOUSE	Reported site of a smokehouse. Bark stripped trees were reported in the site area by Johnson.	NATIVE

Table A.4 - List of sites within the Big Islands Landscape Analysis Area					
AHRS #	**FS#**	**BIA#**	**Site Name**	**Description**	**Category**
COR-00141	FS#593	AA010784	YELPER COVE	CPSU reported fire cracked rock, stone wood-working tools, and historic debris. Reported village site.	NATIVE
COR-00144	FS#595	AA010787	DOUBLE BAY NORTHERN SITE	Artifacts reported found in intertidal zone, as well as pitch-cut trees in the area.	NATIVE
COR-00145	FS#350	AA010786, AA010789	ANDERSON BAY HUNTING CAMP	A 2.2m x 2.3m cabin, in disrepair & remains of an outhouse. Cabin was built using 3 trees for structural support at the corners.	NATIVE
COR-00147	FS#812		Shelter Bay		NATIVE
COR-00148	FS#811	AA011056	SHELTER BAY SOUTH TRAVEL CAMP	Moonshine site. Small log cabin overlooking sound, a log structure straddling the stream, barrels, iron hoops, buckets, hoses, & a small dam were observed. A modern hunting camp just to the east was also noted.	NATIVE
COR-00149	FS#850	AA012570	HAWKINS CREEK	Ruins of a 3m x 3m cabin, barrel stove, skin stretchers, and tin roofing. Reportedly used by non-Natives from Cordova. Johnson reported that bark-stripped trees were present in the site area.	NATIVE
COR-00150	FS#783	AA011146, AA010731	ANGIK VILLAGE AND CEMETERY (MAKARTA POINT)	Three or 4 houses, 2 smokehouses, 3 or 4 boat ramps, & a cemetery with at least 10 graves marked by fallen crosses.	NATIVE
COR-00153	FS#809	AA011136	ARCTIC REDFISH CAMP	CPSU reported remains of 2 smokehouses: Reportedly used by residents of Angik & source of prized variety of red salmon.	NATIVE
COR-00155	FS#816	AA011020	Boswell Bay Portage Site (QAPAAKAAQ)	"Large foundation, made of logs up to 80cm across."	NATIVE
COR-00157	FS#804		Hinchinbrook Bidarka Trail Site		NATIVE
COR-00158	FS#799	AA010761	Hook Point Sea Otter Camp		Subsistence
COR-00159	FS#818	AA010783	Dan Bay Camp	Non-Native trapper's cabin, 4m x 5m, reportedly built circa 1920s.	NATIVE
COR-00162	FS#808	AA010773	Horn Creek Smokehouse		NATIVE
COR-00163	FS#813	AA011055	DEER COVE CAMP	A non-Native hunting cabin was located near the spit. Today there are just a few boards left.	NATIVE
COR-00164	FS#848	AA012571	Bidarka Playhouse Camp	Reportedly the site of a moonshine operation during prohibition. Johnson reported bark-stripped trees.	NATIVE
COR-00174	FS#587		DEER POINT MIDDEN	Large but thin midden on a high sandy spit. No visible structures. Several notched trees, rusted tin cans, and other debris were noted by Mitchell and Johnson.	

Table A.4 - List of sites within the Big Islands Landscape Analysis Area					
AHRS #	**FS#**	**BIA#**	**Site Name**	**Description**	**Category**
COR-00280			PALUGVIK Archeological District	Archaeological district including Palugvik (COR-001), Englunguaq (rock shelter) (COR-036), and Qusugeli Rock Shelter (COR-035). Palugvik is the largest & longest occupied Pacific Eskimo village in Prince William Sound.	NATIVE
COR-00284		AA010768A	Twin Lakes Trapping Cabin (Port Etches Winter Village)	Theodore F. Chemavisky's 3m square log trapping cabin built in 1929.	NATIVE
COR-00285		AA010765	Constantine Harbor Village (Little Nuchek)	Site of reported pre-1910 smokehouse which may have been destroyed by the 1964 earthquake.	NATIVE
COR-00286		AA010764B	Zapor Creek Complex AA010764B (Formerly COR-00124)		NATIVE
COR-00287		AA010772	GARDEN ISLAND	Site of N. Portlock's 1787 garden. Island also reported to have served as a tool cache & refuge during conflicts with neighboring Eyak or Tlingit.	
COR-00288		AA010774	HINCHINBROOK BIDARKA TRAIL CAMP	Reported site of a camp at the midpoint on the trail from Port Etches to Dan Bay. CPSU found a faint trail marked by trees w/ tops chopped off. Site formerly listed as COR-157.	NATIVE
COR-00289	FS#647		COR-00289	Two stone adzes, a hammerstone, and a piece of hematite.	
COR-00290		AA010786	DOUBLE BAY NORTHEAST VILLAGE	Stone adzes were found on the west shore.[The site was formerly listed as COR-143, then COR-144.]	NATIVE
COR-00291		AA010787B	COR-00291	More than 26 notched trees, over 20 sawed trees, & 30 crab apple trees (an imported species).	NATIVE
COR-00292	FS#646	AA010789B	CNI Survey, Anderson Bay 1982	Two halves of a stone "pick" about 100m apart in intertidal zone. Pick measures 35cm x 4cm x 5cm and has two knobs on its dorsal surface.	NATIVE
COR-00293		AA010771	Nuchek Creek Site	Reported site of 3 smokehouses & a barabara at west end of trail to Dan Bay.	NATIVE
COR-00294		AA010773	Kenai Beach (KENAA'URTELLEQ)	Reported site of a smokehouse. Johnson reports bark stripped trees.[Site formerly listed as COR-132 and COR-162.]	NATIVE
COR-00295	FS#596	AA010785	DOUBLE BAY SOUTHERN SITE	Reported smokehouse site. Johnson reported bark stripped trees.[Site formerly listed as COR-142.]	NATIVE
COR-00296		AA011057	Shelter Bay Summer Village	In 1791 Sarychev and Sauer documented a summer fish camp in Shelter Bay.	NATIVE

Table A.4 - List of sites within the Big Islands Landscape Analysis Area					
AHRS #	**FS#**	**BIA#**	**Site Name**	**Description**	**Category**
COR-00297	FS#810	AA011058	Seven Sisters Smokehouse	Reported site of a smokehouse & trapping cabin. Johnson reported bark stripped trees. [Site formerly listed as COR-146.]	NATIVE
COR-00298		AA010764A	SAPUULUT AA010764A (Formerly COR-00123)		NATIVE
COR-00299		AA010772B	BIA AA010772B Three Localities Formerly Part of COR-00131		NATIVE
COR-00300			Armeria Lighthouse Tender 1889, NAID #2051		Exploration
COR-00301			Oregon, NAID #2544		Exploration
COR-00304		AA011050	Constantine Harbor Cache Island		NATIVE
COR-00305		AA010772A	Copper Creek Falls Copper Mine		MINING
COR-00310		AA011053	30 Russian Orthodox Grave Posts		NATIVE
COR-00311		AA011051	PICTOGRAPH		NATIVE
COR-00312	FS#845		Boswell Bay While Alice Communication System (WACS)	Tropo station 15 mi SW of Cordova, opened on 11/29/1956, was one of the first WACS. The 2 30' antennas link Middleton Island, 69 mi. away with Neklasson Lake, 133 mi. away.	Engineering
COR-00317			CANNERY		CABINS/ BUILDINGS
COR-00318			SHIPWRECK		Exploration
COR-00320	FS#863	AA011021	Tauxtvik Archaeological District COR-00038 - COR-00040		NATIVE
COR-00321	FS#869	AA012568a	Windy Bay 1 (AA012568A)		NATIVE
COR-00322		AA012568b	WINDY BAY 2 (AA012568B)		NATIVE
COR-00323	FS#865	AA012448	AA012448		NATIVE
COR-00401			CMTS		NATIVE
COR-00402			Sea Otter Hunting Cabin		Subsistence
COR-00404			Historical Structural Remains		CABINS/ BUILDINGS
COR-00405			Prehistoric Debris		NATIVE
COR-00406			Prehistoric Debris (Near Private Rec Cabin)		NATIVE
COR-00407			Prehistoric Refuge Rock – De Laguna		NATIVE
COR-00436			COR-00436		
COR-00437			COR-00437		
COR-00541			Hinchinbrook FAA BLDG 200 [Aerial Navigation]	Building 200 built in 1952 as a non-directional beacon. It is steel-framed on a concrete foundation w/ "L"-shaped floor plan, metal siding, and a metal standing-seam gable roof.	Engineering

Table A.4 - List of sites within the Big Islands Landscape Analysis Area					
AHRS #	**FS#**	**BIA#**	**Site Name**	**Description**	**Category**
COR-00542			Hinchinbrook FAA Bldg 600 [Engine Generator]	Building 600 built in 1948 as an engine generator building.	Engineering
SEW-00079	FS#347	AA011045	MATAN KANAT (MATYANGKNAT)	Makari told de Laguna of a permanent village, matan kanat, mentioned also in a legend, on north shore of Zaikof Bay.	NATIVE
SEW-00080	FS#294	AA011047, AA011046	Nanucyanaq (Tayuanaq, Nanuaganaq)	De Laguna reported a site on a 200' long gravel spit.	NATIVE
SEW-00081	FS#295	AA011047, AA010720	UQCILCQ I (UQCILOQ)	De Laguna reported a nearly completely eroded midden.	NATIVE
SEW-00082	FS#795 & FS#296	AA011047, AA010720	UQCILCQ II (UQCILOQ)	De Laguna reported this site as being a few 100 yds southwest of SEW-081.	NATIVE
SEW-00083	FS#297 & FS#794	AA011033	Nunatunaq (Puyuycnit, Nunatungaq, Gilmour Point)	Two of de Laguna's informants mentioned a village.	NATIVE
SEW-00203	FS#720	AA010723	SUKLLUQ (SOOKLYOOT)	CPSU investigators located a log cabin, rusted metal, & glass bottles on the gravel spit. Fire cracked rock was also observed. Historic sources indicate the Chugach used a site named Suklluq.	NATIVE
SEW-00203	FS#857? ?	AA010723	Zaikoff Bay Cabin: Kamneya Trapping Camp		Subsistence
SEW-00204	FS#719	AA010721	GRAVEYARD POINT	CPSU investigators located eight pitch cut trees.	NATIVE
SEW-00207	FS#763	AA011034	Green Island Fish Camp	CPSU investigators noted about 12 notched (pitch-cut) trees near the mouth of the creek, but found no traces of former structures.	NATIVE
SEW-00208 & SEW-00209	FS#790	AA012585	Gibbon anchorage	CPSU investigators noted the remains of a former fox farm, consisting of the ruins of 3 houses, dock cribbing, ditched meadows, a plank dam, and a small road/trail.	NATIVE
SEW-00221	FS#754	AA010973	Purple Bluff Sea Otter Camp		Subsistence
SEW-00222	FS#855	AA012566	PUYURNIT (BOYOHONIT FISH CAMP)	CPSU investigators recorded a 2.3m x 2.7m tent frame w/ a plywood floor & 1.2m high plank walls on the west side of a lagoon outlet. Reportedly 3 smokehouses had at one time been located at the site, but were destroyed following abandonment.	NATIVE
SEW-00223	FS#856	AA-12567	Boyohonit Island site		NATIVE
SEW-00224		AA012624	Anderson Cabin site		NATIVE
SEW-00234	FS#793 & FS#663	AA012462	Rocky Bay Site	A log structure, with 3 courses of logs still standing. Teddy Chimovitski reported that the structure was used in the late 1800's by Nuchek people as a "shala".	NATIVE

Table A.4 - List of sites within the Big Islands Landscape Analysis Area					
AHRS #	**FS#**	**BIA#**	**Site Name**	**Description**	**Category**
SEW-00240	FS#762/ 792	AA012624	KEGAXTOLOK (QIKERTUURLUQ, ANDERSON CABIN SITE)	The remains of a notched log structure 3 courses high apparently a fox feeding station assoc. w/ Gibbon Anchorage Fox Farm (SEW-208)] & recent hunting camp debris - a tarp frame.	NATIVE
SEW-00292	FS#666	AA012462	STEVEN R. THOMAS SITE	Mattson reported midden deposits on the south side of a gravel spit. 7 tests were excavated. 3 - 4 cultural layers were ID'd & a variety of stone, bone, & shell artifacts recovered. Deposits dated to BP 315, BP 695, & BP 95.	MINING
SEW-00293	FS#665		QUTUURLUQ (OLD BEACH SITE)	Originally reported by Mattson, USFS archaeologist, as being a "old habitation area" & departure point for overland portage to Stockdale Harbor by a Native informant.	NATIVE
SEW-00294	FS#669		PORTHOLE SITE		OTHER
SEW-00295	FS#684		J.L. BURGESS SITE	As described in 1980, site consisted of a fragment of a splitting adze in the intertidal zone. This artifact may have been collected in 1980, as no artifacts were found here in 1990 by Exxon investigators.	NATIVE
SEW-00296	FS#683		K.E. Holbrook site		OTHER
SEW-00306	FS#727	AA012463	Port Chalmers Bidarka Trail Camp	Informants reported this as the site of a smokehouse.	NATIVE
SEW-00333	FS#728	AA010720	Stockdale harbor Archaeological District	Archaeological district containing SEW-080, SEW-081, SEW-082, SEW-543, and SEW-544.	NATIVE
SEW-00333		AA010720	UQCLIOQ VILLAGE		NATIVE
SEW-00334	FS#731		SEW-00334	Several cut and sawn trees were located on the beach near the lake here.	OTHER
SEW-00335	FS#730		SEW-00335	Several cut and sawn trees near the lake.	OTHER
SEW-00336	FS#729		SEW-00336	Four notched trees found on a gravel beach.	
SEW-00386			10 Notched Trees		NATIVE
SEW-00387			10 Notched Trees		NATIVE
SEW-00388		AA012567	BOYOHONIT ISLAND CAMP (PUYURNIT)	Informants reported that Boyohonit Island was a part of a system of travel camps on Montague Island, used by Chugach Eskimo when trapping and hunting.	NATIVE
SEW-00389			Collapsed Cabin		Cabins/ Buildings
SEW-00459			Putnam Point Fox Farm Structure #1	At the southwest end of a beach ridge, 6m back from the uplands & 35m back from the beach, is a small 1.5m x 2.5m cache structure five logs high.	CABINS/ BUILDINGS
SEW-00460			Putnam Point Fox Farm Structure #2	This site consists of a small structure located behind the uplifted beach berm.	CABINS/ BUILDINGS

Table A.4 - List of sites within the Big Islands Landscape Analysis Area					
AHRS #	**FS#**	**BIA#**	**Site Name**	**Description**	**Category**
SEW-00487			UNIMAK SHIPWRECK	This site consists of a long stern section of a wooden fishing vessel lying in the upper intertidal zone, partially buried in silty-sand. The stern, which is lying hull-side up, reads: UNIMAK SEATTL	Exploration
SEW-00521			Green Island Cabin	Collapsed cabin remains consisting of nine structural logs (obscured by thick moss cover) which form a roughly square outline.	CABINS/ BUILDINGS
SEW-00528			Middle Point Shipwreck	Site consists of the wreck of a large (82m estimated by skipper Jim Nardelli) steam driven vessel.	Exploration
SEW-00529			Green Island Pinnacle VI	A stone tablet with consistent rounding on 3 margins, was observed protruding from the ground on the highest and westernmost of six small islets in Gibbon Anchorage.	
SEW-00540			Rocky Bay Archeological District		NATIVE
SEW-00543		AA010720, & AA011047	SEW-00543		NATIVE
SEW-00544		AA010720, & AA011047	SEW-00544		NATIVE
SEW-00545			SEW-00545 Rocky Bay		
SEW-00546			SEW-00546		
SEW-00614			FCR and Adze Fragment (Mattson 85, Johnson 93)		NATIVE
SEW-00639			FCR		NATIVE
SEW-00977		AA011033B	NUNACUGAQ	This site on the SW end of a small island, is largely an intertidal area consisting of numerous lag artifacts and abundant FCR.	NATIVE
XBS-00002	FS#300	AA011144	QAUYUIA (NANWARNUURLUQ, KOHXYAQ, San Juan Bay Camp)	Remnants of a probable smokehouse and over 100 pitchcut trees. Reported 5 smokehouses located in area, used by people from Nuchek. Reported village site, but unconfirmed by visit in 1933.	NATIVE
XBS-00003	FS#301	AA011014	UQCI-UVIT (OKSIWIIT, Wooded Island Sea Otter winter camp)	Remains of small log cabin without roof. Sawn logs, corners square notched. Reported to de Laguna to be camp of Black Stephan's grandmother's father.	NATIVE
XBS-00004	FS#750, & FS#854	AA012435	PATTON BAY TRAPPING CAMP	Remains of a single log structure, with door on S. side facing Patton Bay.	NATIVE
XBS-00007	FS#852	AA012433	KAWOOLAH (SAND BEACH SITE)	Remains of 4 cabins of frame or frame & log const, an overgrown structure of squared timbers & large square spikes, a plank boat 3m long, a caterpillar-type tractor, & a recent hunting camp.	NATIVE

Table A.4 - List of sites within the Big Islands Landscape Analysis Area					
AHRS #	**FS#**	**BIA#**	**Site Name**	**Description**	**Category**
XBS-00008	FS#851	AA012434	WALYIA BIDARKA TRAIL CAMP	Reported site of a trail head camp. CPSU found no camp remains, but found a rock cairn located in the saddle of a 46m high pass ~ 3.7km SE of the reported trail camp site.	NATIVE
XBS-00009		AA011011	KWEEXLAK Smokehouse (KUIYURLUQ)	Reported site of smokehouse. Only 2 recent hunting camps & a USFS cabin. Johnson reported bark stripped trees in the site area.[Formerly listed as XBS-004.]	NATIVE
XBS-00010			30 Notched trees		NATIVE
XBS-00011			Tree with 1919 WGM/VV carved on it		OTHER
XBS-00012			Landing Craft		OTHER
XBS-00019	FS#300		XBS-00019		

Appendix B – List of available resource reports and GIS products

All reports and GIS products are electronically filed at the Cordova Ranger District office in J:\fsfiles\office\1900_planning\land_ass\big_islands\. Hard copy reports are also available at the district office.

Separate resources reports (\big_islands\resource_rpts\) include:
Fisheries Report – Dirk Lang
Heritage Resource report – Heather Hall
Hydrology Report – Bill MacFarlane
Lands Resource report – Bruce Campbell
Minerals and Geology report – Carol Huber
Soils and Wetlands report – Ricardo Velarde
Subsistence Fisheries input – Tim Joyce
Wildlife Assessment report – Milo Burcham

GIS products: (big_islands\gis)
Several ArcMAP projects are located in the gis folder for big island. The main project is big_islands2.mxd. The corporate database layers have been clipped to the analysis area boundary for lands status, Forest Plan direction, watershed boundaries, cover type, timber type, recreation polygon and point layers, streams, roads, trails, and bald eagles. JPEGs have been created from the information and the resulting maps are in the maps and figures folder.

Appendix C – Land Stability Analysis Process on the Chugach National Forest

Assembled by Dean F. Davidson, Forest Soil Scientist

A land stability analysis is done on all major land disturbing activities proposed for sites that contain properties that frequent landslides. Red flags are fine texture soils of lacustrine origin, soils in or underlain with glacial till or outwash, poorly drained soils on slopes over 56 percent, shallow soils over an impermeable layer such as bedrock or compact glacial till.

The Standards and Guidelines in the Chugach Land Management Plan state “an analysis will be done for all major soil-disturbing activities greater than one-half acre in size, proposed on slopes from 56 to 72 percent and one-tenth acre in size on slopes greater than 72 percent. Initially a preliminary analysis is done in the office using available information. If sufficient indicators are thought to be present on the site, the office analysis will be followed with an on-site inspection and analysis. The analysis process used on the Chugach NF was developed by Hicks, B.G. (1982). This system uses the presence of features characteristic of landslides for the identification of landslides of all relative ages.

The Hicks risk assessment consists of identification of the presence of past and present landslides or landforms and soils with characteristics that normally contribute to a landslide. Aerial photography and available soils and landform data are good sources for information to help make the determination. The following categories are used to identify the risk for a landslide. Some characteristics for landslide identification are also included in the definitions.

Levels of Landslide Activity and Indicators

Active Currently active or active in the very recent past. May have fresh scarp or cracks. Leaning trees may indicate recent movements; such as a straight, healthy conifer leaning from the base can dictate recent movement. Broadly bowed, living conifer indicates movement over a period of time. Hummocky terrain with terrace-like slopes which are not deeply weathered may indicate recent movement.

Possibly Active No clear indications of recent movement but landforms indicate movement in the past. Landslide features not so heavily weathered as to indicate long-term stability. More subtle features often without obvious scarps or cracks. Possible low, constant creep rate that is currently creeping at a rate sufficiently slow that obvious cracks do not form.

Inactive No indication of movement is discernable from aerial photo interpretation or from field observation. However, significant soil removal, deep cuts from roads, tree removal or increase in water content because of management activities could accelerate or increase the potential for landslides or soil creep.

Stable No indication of movement is discernable from aerial photo interpretation or field observation. Landform and soil factors are not conducive to landslides or soil creep.

The more analytical Forest-wide standardization approach used by Douglas N. Swanston (1997) for hazard assessment for the Tongass Land Management Plan is used, with some minor adjustments, for on-site analysis on the Chugach NF. This system uses data that is easily collected in the field; such as soil properties including soil texture, parent material, depth, drainage; and specific topographic characteristics such as slope shape, length, gradient, and drainage density. The risk assessment weighs each of the characteristics as to their relative importance in landslide production and provides a relative numerical landslide failure rating for the site.

Risk Assessment Categories

High to Extreme Natural failures are often frequent and large, and there is a high risk of management-induced failure. Standard management practices can be expected to have only limited success, and on-the-ground assessment is necessary to determine the need for mitigating measures.

Moderate Natural failures are usually small and infrequent, but there is a moderate risk of management-induced failure. Standard and the best management practices are usually successful but on-the-ground investigation is still recommended. Mitigation measure may occasionally be needed.

Low Natural failures are usually rare or small. There is a low risk of management-induced failures except on unstable micro-sites such as scarps, V-notches, and stream banks. Standard best management practices that control stream flows and surface disturbances can be expected to be highly successful.

Used together the Hick and Swanston risk assessment systems provide a solid basis to determine the potential for a landslide. One system is based on visual characteristics used to identify landslides and other system uses the analytical approach with data easily collected at the site.

The spreadsheet below shows the different criteria and the weighting that is used on the Chugach NF. The numerical rating is categorized into four ranges to give a relative potential derived from a repeatable process. The spreadsheet allows you to adjust a value and see what it would take to increase or reduce the potential for landslide occurrence, and hence estimate the effects of the proposed management activity.

Criteria	1	2	3	4	Criteria Value	Weighting Factor	Rating
Landform							
Slope shape	Vertical	Broken	Convex	Concave-straight	x	5	=
Slope length (ft)	0-300	301-700	701-1500	>1500	x	5	=
Slope gradient (%)	0-35	36-55	56-72	>72	x	20	=
Drainage features:							=
Drainage density (% of area)	0-10	10-129	20-39	>40	x	10	=
Soils and Geology							
Soil drainage class	WD	MWD	SPD	VP,PD	x	10	=
Soil Depth (inches)	>40	not applicable	20-40	<20	x	5	=
Parent material	Carbonate, colluvium, alluvium	Noncarbonate, granitics, glacial till	Compact till, marine sediments	Volcanic ash	x	5	=
Textural class	Sand, gravel, fragmental loam	loam	silt	silty clay	x	5	=
Total of Ratings							
Failure Hazard Rating							*

* ≥ 63 - High; 62-50 - Moderate; 28-49; low; <28 - None

Appendix D – Public Involvement

During this analysis effort, notices were posted in the local paper and letters and emails were sent to 120 individuals, organizations, landowners, and Native, State, Federal and City agencies soliciting input in the winter of 2004. Four responses were received and used to develop key questions, issues, and potential projects. Public comments received during the Big Islands Management Area Analysis effort in 1989 and the Forest Plan revision in 2002 were used as well to focus discussion and develop key questions, issues, and potential projects.

Request for input was sent to the following people:

Name	Name	Name
Native Village of Eyak	Eyak Native Corporation	Chugach Alaska Corp.
City of Cordova – Mayor, City Planner, Museum	Cordova Historical Society	Cordova Audubon Society
City of Seward – Mayor	City of Valdez - Mayor	Eyak Preservation Council
Cascadia Wildlands Project	Tatitlek Native Corporation	Cordova Chamber of Commerce
Alaska Dept of Fish and Game – Cordova office	Alaska State Department of Natural Resources	Cordova Fish and Game Advisory Board
Alaska Association for Historic Preservation	Forestry Sciences Lab, Bill Van Hees	Prince William Sound Science Center
City of Whittier - Mayor	Wilderness Society – Alaska	Copper River Watershed Project
National Wildlife Federation	Dick Groff	Dick Shellhorn
George Covel	Valdez H20 Heli-guides	Sierra Club – Alaska
Cordova ORV Group	Cordova Air	Fishing and Flying
Tom and Barbara Bailer	Osprey Expeditions	North American Outfitters
Lonesome Dove Outfitters	Eric and Denny Weathers	Acord Guide Service
Bylers Alaska Wilderness Adventures	Ellis Big Game Guides and Outfitters	Prince William Sound Aquaculture Corporation
Tatitlek Village IRA Council	Copper Oar	Alaska Hunting Adventures
Alaska Mountain Adventures	Vision Quest Adventures	Fejes Guide Service
Alaska Miners Association	Susan Ogle and Kelley Weaverling	Exposure
Points North	Alaska Center for the Environment	Sundog Expeditions
Alaska Pacific University	Kayak Adventures Worldwide, LLC	Invasive Plant Group - UAF
Alaska Canoe Base and Kayak	Ecotrust	Alaska Outdoor Adventures
Alaska Sea Kayakers	Alaska Two legged tours	Anadyr Adventures
Backcountry Safaris	Cordova District Fisherman United	The Nature Conservancy
North Star, Inc	Pangaea Adventures	Wilderness Adventures
Wilderness Alaska	Wilderness Ventures	Alaska Good time Charters
Babkin Charters	Discovery Voyages	Halberd Charters
New World Ship Mgmt Co.	Over the Seas Expeditions	Solstice, Inc
State Historic Preservation Office	National Outdoor Leadership School	Alaska Safari and trading Company, LLC
Bearman Adventures	Alaska Conservation Alliance	Whittier Marine Charters
Turnagain Trails	Chenega Corporation	Valdez Native Association
Quetkcak Native Tribe	Alaska Historical Society	Mt Marathon Native Assoc.
Chenega Bay IRA Council	Alaska River Rafters	Alaska Mountain Safaris
Booke and Gayle Adkinson	Jack Jr. and Heidi Babic	Warren and Theresa Chappell
Victor Hottinger	Auklet Charter Service	Sheep River Hunting Camps
Woods Outfitting	Cordova Coastal Outfitters	Alaska Alpine Adventures
Alan and Jane Jensen	Robert and Carol Maxwell	Jim and Patti Kallander
Carl Becker and Nancy Bird	Federal Aviation Administration	United States Coast Guard
Robert and Fran Evanson	Dan Hull	Danny Glasen
Dale and Susan Muma	Jim and Peggy McDaniel	US Fish and Wildlife Service
Glenn Juday, University of Alaska - Fairbanks		

Table D.1 - Winter 2004 comment summary for Big Islands Analysis

#	issue - type	issue/service/ project description	concern	level to address	how to address
1	Hunting	Impacts of Deer hunting on Green Island	Tremendous upswing in hunting activity on Green Island. A lot of trash/ garbage left behind. Specific areas – Gibbons anchorage. Preferred hunting area because flat and no bears.	ID in LA & project scoping	Educate hunters about pack it in and pack it out. Monitor and clean up sites.
1	Other work on going in area	Harlequin, oyster catcher surveys, USGS work	Include in assessment	Existing conditions/ projects	
2	keep informed	interested in project as it relates to Nuchek Island and historic sites	historic sites	ID in LA & project scoping	at project level - heather to contact (11/11/04)
3	cabin locations	locate new cabins away from anchorages.	increased traffic has made it a problem when deer hunting where cabins and boats are at same place, i.e. Green island - Gibbon Anchorage. Had to go twice as far to find deer.	ID in LA & project scoping	when considering new cabin locations, locate where boats cannot anchor.
3	other improvements in sound	leave sound without manmade intrusions for future generations to enjoy.			
3	number of cabins	3 more cabins in sound - ok	Prefer they be placed in areas that are not good anchorages to spread people out	ID in LA & project scoping	cabin site selection
4	timbered private lands on Montague	keep option open for reconstructing access road to Patton Bay	any projects along road corridor should consider that right	ID in LA & project scoping	inform in letter about road use.
4	trespass	trespass occurring where FS has cabins in Patton Bay, Beach River	no cabin user has obtained permits to be on CAC lands, concern about managing visitors on private land, visitor safety, and protection of sensitive sites	ID in LA & project scoping	consider moving beach river cabin, inform public on private land locations and necessary permits. Suggests Hanning Bay and other areas on west side of Montague Island.
4	easement locations	CAC and FS negotiating final easement locations	CAC considering exclusive lease to a hunting and fishing guide in Patton Bay to decrease trespass issues		guide would need permit from USFS for activities on NF lands
4	14h1 sites	BLM cadastral survey of pending and eligible sites scheduled for summer 2005	located on Montague, Green and other islands		
4	CAC subsurface estates on Hinchinbrook Island	identified sources for sand, gravel and rock	FS should recognize these resources and rights of corporation to develop them without encumbering the private estates through designations that conflict with this type of development	ID in LA & project scoping	display in existing resources.
4	Nuchek camp development	primary intent to develop and protect its cultural resources in the area	recommend focusing unsupervised visitors to other areas in Big Island group.	ID in LA & project scoping	cabin/trail locations
4	CAC subsurface	identified sources for sand, gravel and rock	FS should recognize these resources and rights of	ID in LA & project	display in existing resources

#	issue - type	issue/service/ project description	concern	level to address	how to address
	estates on Hawkins Island	and other mineral resources	corporation to develop them without encumbering the private estates through designations that conflict with this type of development	scoping	
4	Green Island 14(h)1 sites	3 sites selected on Green Island	scheduled for survey in summer 2005	ID in LA & project scoping	display in existing resources
4	Wooded Island 14(h)1 site	1 site on wooded			
4	additional cabins or infrastructure	location should consider 14(h)1 sites and other archeological sites.	past cabins built on top of or near historic or cultural sites	ID in LA & project scoping	conduct archeological surveys especially if new structure near 14(h)1 site or archeological or cultural site.
4	Nellie Martin and San Juan Bay cabins	built in immediate vicinity of pending or eligible 14(h)1 selections.	necessary to conduct archeological surveys and research in order to give these areas special protection and consideration from looting, vandalism, or desecration.		
4	new cabin construction sites	potential sites CAC feels would be good - Montague Lagoon (T1N,R12E,sec 21&28, SM), Montague Point (T3N, R13E, sec11, SM) old cabin site, & Cape Hinchinbrook - "lands ends" experience.		ID in LA & project scoping	verify access to potential sites.
4	consideration to private landowners	concern with Forest Plan direction	Do not focus activities that would encourage trespass or land management conflicts.		explain Forest Plan made designation, not landscape analysis
4	potential places of Refuge	id's potential docking/anchoring, mooring and grounding locations for disabled vessels	CAC wants to be included in final plan (Prince William Sound Citizens Advisory council)	outside scope of analysis	forward letter to appropriate person (12/10/05 - check with Andy Schmidt)
4	cultural and historical sites	protection of the sites	public to be made aware of penalties associated with theft or desecration of these sites	ID in LA & project scoping	placards, information to visitors

The following two tables summarize comments received about the area during the previous two planning efforts.

Table D.2 - 1989 Big Islands MAA Chapter 5 (Comments grouped by issue)

Issue	Concern
Oil Spill Effects	Need a sanctuary for wildlife so they can escape oil spill industry
Brown Bear	Mainly road and harvest impact concerns
Marbled & Kittlitz Murrelet	Preservation of critical habitat crucial
Deer	Winter range, beach fringe, thinnings, effects of harvest
Fish	Effects of roads and harvest
Eagles	Effects of roads and harvest
Hunting and fishing	Impacts with increased access

Table D.2 - 1989 Big Islands MAA Chapter 5 (Comments grouped by issue)

Issue	Concern
Soils	Susceptible to erosion, debris torrents , surge releases
Water quality standards	Make sure they are met
Recreation	No need for more shelters, cabins, platforms and trails. Plenty of beaches and room for tents.
Recreation	There is a need for more cabins and shelters, record has # of requests turned down.
Recreation	Put cabins in places not already a boat anchorage since most are dropped off by plane.
Recreation	Put cabins in bays with anchorages to concentrate use
Recreation	No new cabins in Zaikof or Rocky bays (page 5-26 for more info)
Wilderness	Port Etches, Zaikof, & Rocky core wilderness for eastern PWS, hunting and camping. Already other areas for semi-developed recreation.
Subsistence	Zaikof Bay – not benefit from cabin since it would attract nonrural fly-in hunters and increase competition. Look at specific uses of area by Chenega, Tatitlek and Cordova, species harvested, modes of access, seasonality, and levels of harvest. Include marine mammals.

Table D.3 - Forest Plan Revision Comments received pertaining to Big Islands Analysis Area (from Public Content Category Report - Working Papers, Forest Plan Revision Team, March 1998)

Page	#	Comment
4-89	135-001	Administrative – turn land over to the State (Weathers – who live on Hawkins Island)
8-89	179-001	Tatitlek Corporation – manage for multiple use, timber and habitat mgmt for high level of hunting, fishing, gathering and destination recreation
	179-003	Tatitlek Corporation – cooperate with adjacent Native Corporation landowners especially concerning access.
	179-004	Tatitlek Corporation – recognize communities of PWS depend on NF land for existence
	191-002	Balance uses
10-13	810-016	Wildlife – whales, seabird observations
	817-020	Habitat needs of Seabirds
	817-021	Habitat needs of Murrelets
	817-022	Habitat needs of Harlequin ducks
	817-024	Habitat needs of shorebirds & black oystercatchers
	817-025	Habitat needs of raptors
	817-026	Habitat needs of songbirds
	817-027	Habitat needs of Steller Sea lions
	817-028	Impacts to Sea lions from transportation/ recreation & tourism, Education needed.
	817-034	Habitat needs of river otter
	836-005	Impacts to seabird colony from boat activity.

Appendix E - Copy of the Research Natural Area Establishment Record: Green Island Research Natural Area

INTRODUCTION

The 2,861 acres (1,158 ha) Green Island Research Natural Area (RNA) is in the Chugach National Forest in southcentral Alaska (fig. 1)[figures and photos not included in this copy]. Green Island was named by Captain James Cook on May 18, 1778 during his voyage of discovery around the Pacific Ocean (Orth 1967). Little Green Island, a much smaller island directly southwest, derives its name from the larger island. Orth (1967) quotes Captain Cook's log, "...being entirely free from snow, and covered with wood and verdure, on this account they were called Green Islands." When approached from sea level, Green Island stands apart from the nearby late-lying snowfields and extensive tundra of Montague Island that reach nearly to tidewater (Photo 1). In reality Green Island has extensive treeless blanket bogs and appears forested mainly because trees cover the well drained slopes that are visible from the ocean surface (Photo 2). Although there are five officially named Green Islands in Alaska (Orth 1967) the Green Island Research Natural Area retains the name in recognition of its first use in Alaska here.

Land Management Planning

Green Island was nominated as an RNA during the land and resource planning process for the Chugach National Forest (USDA Forest Service 1984). Green Island was identified as an area inhabited by part of the remnant sea otter population that repopulated Prince William Sound after near-extinction of the species in the late 19th century, and a site containing:

(a)important haul-out sites for harbor seals and Steller sea lions, marine bird colonies, and several significant shorebird populations;

(b)beaches uplifted in the 1964 Great Alaska Earthquake;

(c)sites with some of the highest forest productivity and best-developed old-growth stands in the Chugach National Forest;

(d)shorelines that exhibit classic marine erosional features; and

(e)close linkages between terrestrial and highly productive marine ecosystems.

Green Island was initially identified by Chugach National Forest staff as an alternative to a proposed Coghill Lake RNA, which was judged to have too large an impact on timber, aquaculture, and recreation development options. Green Island was suggested instead as an area that contained pockets of productive forest sites with some of the largest trees in the Chugach National Forest. Green Island was proposed as one of nine RNAs in the draft Chugach Forest Management Plan. No major issues or conflicts specific to Green Island were identified during the public review and comment period for the draft plan. Green Island RNA was incorporated into the final Forest Plan (USDA Forest Service 1984).

OBJECTIVES

The objectives of establishing Green Island RNA are to:

1. Maintain an undisturbed upland around a marine intertidal and subtidal refugium from which sea otters repopulated Prince William Sound after their drastic population reduction during the Russian era in Alaska, and provide for the study and monitoring of recovery of the sea otter population after it was decimated in the Green Island area by the 1989 *Exxon Valdez* oil spill;
2. Monitor and document the structure of productive forests of outer Prince William Sound and maintain examples of these forest types in an unmanaged condition as a control for managed areas of Prince William Sound and the Chugach National Forest and as a major global change research installation;
3. Study and monitor the long-term effects of the 1989 *Exxon Valdez* oil spill and associated cleanup measures on beach fringe and upland ecosystems that are linked to marine study sites;
4. Protect seabird colonies and marine mammal haul out grounds, including a large colony of the federally Threatened Steller sea lions, and provide a site for monitoring their recovery from the 1989 *Exxon Valdez* oil spill;
5. Study and document ecological succession on beaches uplifted during the 1964 Great Alaska Earthquake;
6. Protect upland habitat adjacent to a rich shellfish and kelp forest marine area in order to cooperate with a potential state tidelands reserve and promote its recovery from oil damage;
7. Provide for study and monitoring of natural coastal erosion and associated rates of landform change and biodiversity on a medium-sized and a small island in Prince William Sound; and
8. Provide a well-documented site containing examples of the natural diversity features of outer Prince William Sound for educational and scientific use.

JUSTIFICATION STATEMENT FOR ESTABLISHMENT OF AREA

The elements of natural diversity that form the basis for selecting RNAs in Alaska are called type needs (Underwood and Juday 1979, Juday 1983). The type needs list for the Chugach National Forest is given in Appendix A of the Alaska Regional Guide (USDA Forest Service 1983). Type needs from the Alaska Region list that occur in Green Island RNA are shown in Table 1.

Table 1. Alaska Region Guide Research Natural Area type needs that occur in Green Island Research Natural Area.

ANIMAL SPECIES	
1.	Sea otter haul-out sites adjacent to important marine habitat (a species nearly extinct in the 1800s; population recovered strongly by mid-1980s, then was significantly reduced by 1989 *Exxon Valdez* oil spill).

2.	Steller sea lion haul-out and beach pupping site (Threatened species under Endangered Species Act).
3.	Bald eagle shoreline habitat with nest trees (special management under Bald Eagle Protection Act).
PLANT COMMUNITIES	
Closed Coniferous Forest	
4.	Sitka spruce (outer coastal fringe type)
5.	Western hemlock-Sitka spruce (oval-leaf blueberry type)
6.	Western hemlock-mountain hemlock (low elevation type)
Open Conifer Forest	
7.	Mountain hemlock (high elevation type)
Shrubland	
8.	Sitka alder
Herbaceous	
9.	Dunegrass (coastal gravel/boulder shores)
10.	Dunegrass-beach pea
11.	Halophytic herb (coastal)
Aquatic Vegetation	
12.	Marsh marigold
13.	Pondweed
GEOLOGIC FEATURES	
14.	Coastal Tectonic Uplift - An area where sub- or intertidal habitat was uplifted several meters in the 1964 earthquake. The area should be above high tide and undergoing plant colonization and geomorphic change.
15.	Small Islands and Rocks in Prince William Sound - Small islands and rocky islets illustrating differential rates of coastal erosion.

Green Island RNA contains some of the most significant marine mammal habitat in the National Forest system. Prince William Sound is one of the most intact areas of highly productive and naturally functioning marine-freshwater-terrestrial ecosystems in the world. The primary productivity (photosynthesis) of the marine ecosystem of southcentral Alaska is among the highest in the world (Kennish 1989). The abundant food resources and the largely intact and uninhabited upland, shoreline, and nearshore habitats provide for a notable number and diversity of large marine animals. Many of the animals in this system seek out small, predator-free islands such as Green Island for resting, breeding, or other special needs.

The Prince William Sound area, including Green Island RNA, is one of the most northerly migratory bird overwintering areas in North America (Kessel and Gibson 1978). At least 40 species of birds have been seen within the RNA or immediately adjacent to it, and 23 other species are common in the region and almost certainly occur in the area. Many birds use the RNA and its surrounding waters for breeding or as a seasonally important staging habitat during migration. Sitka black-tailed deer from southeast Alaska were introduced into the Prince William Sound region in the early 20th century. Deer have colonized Green Island but not Little Green Island; the browsed versus unbrowsed shrub understories of the two islands make an interesting contrast (Photo 3).

PRINCIPAL DISTINGUISHING FEATURES

The southwest Prince William Sound region was one of nine areas in the world where sea otters, Enhydra lutris, survived near-extinction in the early 20th century (Chanin 1985). Green Island and Little Green Island have provided important habitat for sea otters for many years, and numerous studies of sea otters have been conducted there (Kenyon 1969, Pitcher and Vania 1973, Garshelis 1983, Garshelis and Siniff 1983, Garshelis 1984, Garshelis and Garshelis 1984, Garshelis et al. 1984, Garshelis et al. 1986, Johnson 1987, VanBlaricom 1987, Irons et al. 1988). The islands are surrounded by shallow bedrock shelves that support highly productive and species-rich intertidal and subtidal kelp forest ecosystems (Photo 4). Kelp forest production is the basis for the food web that supports sea otters (Duggins et al. 1989). The RNA also provides isolated islands used as haul-out sites for the Steller sea lions, Eumetopias jubatus, a federally Threatened species, and pupping and resting sites for the harbor seal, a declining species (Pitcher 1989) of management concern. The islands are particularly attractive to marine mammals because they are exposed to few or no land predators yet have easy access to productive marine foraging habitat.

Green Island is covered with a mosaic of closed canopy Sitka spruce-western hemlock-mountain hemlock forest (Photo 5, 6), dwarf mountain hemlock forest and mountain hemlock woodland (Photo 6), and treeless muskeg or blanket bog (Photo 2, 7). Several other unclassified wetland types may exist on Green Island, but to date they have not been recognized in the type needs list. Society of American Foresters (SAF) cover types represented include western hemlock-Sitka spruce, Sitka spruce, Picea sitchensis, western hemlock, Tsuga heterophylla, and mountain hemlock, Tsuga mertensiana. Little Green Island supports some of the largest trees on the Chugach National Forest (Photo 8).

Old-growth forest indicator bird species such as the brown creeper, Certhia familiaris, inhabit both islands. Marbled murrelet are common on marine waters around Green Island and presumably nest in old-growth forest in the RNA. The marbled murrelet, Brachyramphus marmoratus, is a Threatened species in California, Oregon, and Washington and it's status in Alaska is C2. A few bald eagles, Haliaeetus leucocephalus, nest on Green Island in tall old-growth trees near the shoreline. Spruce and hemlock forests on Green Island experienced moderate to severe defoliation from 1988 through 1991 as the result of an outbreak of the western black-headed budworm.

Green Island RNA provides habitat for many marine and shorebird species (Isleib and Kessel 1973). Black oystercatchers, Haematopus bachmani, nest on open gravel beaches in the RNA. Black turnstones, Arenaria melanocephala, and surfbirds, Aphriza virgata, forage on the eggs (roe) of spawning Pacific herring, Clupea harengus pallasi, deposited in the early spring on offshore kelp and rocks (Norton et al. 1990). Nesting colonies of tufted puffin, Lunda cirrhata, and pigeon guillemots, Cephhus columba, occupy nearby Channel Rock (Sowls et al. 1978).

Green and Little Green Islands are underlain by vertically tilted sandstones and shales of the Orca Formation (Photo 9) (Dumoulin 1987) and exhibit several features of turbidite rocks including sole markings, rip-up, load casts, and conglomerates. Wave erosion of coastal bluffs on Green Island maintains bedrock exposures and illustrates particularly well the differential erosion resistance of the turbidite units. The islands were uplifted over six feet (two meters) by the 1964 Great Alaska Earthquake (Plafker 1969, 1990). A zone of forest and beach succession on the uplifted terrace parallels the shoreline (Eyerdam 1971, Juday 1987). The rocks, coastal erosion, and uplift features are particularly suitable for educational use because they are easily visible and readily accessible to visitors along the beach.

The marine environment surrounding Green and Little Green Islands is closely linked to the terrestrial upland ecosystems of the RNA through the movement of energy, nutrients, and plants and animals. Marine intertidal habitats along the southeast shore of Green Island and Little Green Island were investigated beginning in 1986 as part of RNA site documentation. Beach and intertidal habitats surrounding the RNA were highly productive and species-rich when first documented.

Effects of the *Exxon Valdez* Oil Spill

In late March of 1989 the waters, intertidal zone, and beaches around Green Island were oiled by the *Exxon Valdez* spill in Prince William Sound, the largest spill to date in North America. Many news reports and articles describing the effects of the *Exxon Valdez* oil spill include photographs or data taken from Green Island (Hodgson 1990).

An extensive program of damage assessments of the spill began late in the 1989 field season under provisions of the Comprehensive Environmental Response Compensation and Liability Act, including assessments of the Green Island area (*Exxon Valdez* Oil Spill Trustee Council 1993). After settlement of criminal action by Consent Decree in March 1991, results of damage assessments were released from confidentiality for litigation purposes. Results gradually have been published since that time (e.g., U.S. Coast Guard et al. 1993). The principal author of this report analyzed the effects of the spill on RNA values independent of litigation related funding, so these results can be released to the public.

The RNA was not as heavily oiled as the remainder of the shoreline of Green Island. The beaches of the RNA were not mapped as oiled in the first oil damage surveys, but later were generally rated as lightly oiled; short segments of beaches within the RNA actually were more severely affected by oil.

The *Exxon Valdez* oil spill devastated several elements of the ecosystem at Green Island, especially the formerly abundant sea otters around the island and plants and animals in the upper intertidal zone. Sea otters were more severely affected by the oil in Prince William Sound than other areas of the spill (DeGange and Lensink 1990), and Green Island was one of two high density sea otter population areas affected in the Sound

(DeGange et al. 1990). Oil triggered a major die-off of surf grass, rockweed and other algae, and upper intertidal barnacles (Juday and Foster 1990).

Based on experience in other spills, the ecosystem should achieve a substantially normal condition within five to 10 years (Nelson-Smith 1973). However, continuing concerns about the effects of the spill include the potential for re-oiling from pockets of oil buried in beach gravels (Juday and Foster 1991), persistence of oil breakdown products, and lingering ecosystem-level effects because of the large scale of the *Exxon Valdez* oil spill.

Conclusion

Despite the oil spill the RNA retains exceptional value as one of a small number of places in outer Prince William Sound with a record of pre-spill intertidal life, as an area dedicated to monitoring the long-term recovery from the oil spill, and as a site suitable for detailed studies of the linkage between terrestrial and marine ecosystems on small islands.

LOCATION

Green Island RNA is in Prince William Sound in southcentral Alaska in the Cordova Ranger District of the Chugach National Forest. The center of Green Island is at 60° 16' N., 147° 23' W. The RNA extends for seven miles (11.2 km) on a northeast to southwest axis on Green Island from the watershed crest to the elongated southeast shore. It includes all of Little Green Island, which is 1.2 miles (2.1 km) southwest of the southwest tip of Green Island, and The Needle, an isolated small rock 6.5 miles (10.5 km) south southwest of Little Green Island (fig. 2).

Portions of Green Island, Little Green Island, and The Needle that are above mean higher high tide line are within the Chugach National Forest. The state of Alaska manages areas below mean high tide line and seaward 3.0 miles (4.8 km) as state public trust lands. Mean higher high tide line cannot always be physically located easily. In practice the seaward margin of upland ownership is usually recognized by the limit of well-established vascular plant communities, which mostly consists of dune grass on Green Island. Southwestern Prince William Sound was uplifted by the 1964 Great Alaska Earthquake, placing formerly submerged lands well above tidal range and significantly increasing the land area of Green and Little Green Islands. When formerly intertidal surfaces are uplifted they accrete to the upland (National Forest in this case) owner. These additions to the Chugach National Forest are not consistently depicted accurately in available maps, reports, or inventories, and care should be taken in distinguishing among pre- and post-earthquake sources.

Boundaries

All bearings are given in true azimuth. Basis of elevations is mean sea level as depicted on the US Geologic Survey 1:63,360 scale topographic quadrangle maps for the Seward B-1 (1963), Seward B-2 (1964), and Seward A-2 (1963) quadrangles, Alaska. The boundary of the RNA (see fig. 2) is described as follows:

Beginning at a point on Green Island, said point being the West 1/4 corner of Section 9, T. 2 N., R. 12 E., SM; thence East approx. 0.5 miles to the center of Section 9, t. 2 N., R. 12 E., SM; thence North approx. 0.5 miles to the North 1/4 corner of Section 9, T. 2 N., R. 12 E., SM; thence East approx. 0.3 miles to a small drainage at the 100 foot contour interval and designated "A" on the referenced map in Appendix; thence Northeasterly along aforesaid drainage (drainage flows southwesterly) to its headwaters in a muskeg and along a northeasterly flowing drainage to mean high tide in Section 3, T. 2 N., R. 12 E., SM, and designated "B" on the referenced map in Appendix; thence South and Southeasterly along mean high tide through Sections 3, 10, 15, 16, 21, 20, 19, and 30, T. 2 N., R. 12 E., and Sections 25, 26 and 35, T. 2 N., R. 11 E., SM to the watershed divide (dividing the southeasterly flowing drainage from the northwesterly flowing drainage) in Section 35, T. 2 N., R.11 E., SM and designated "C" on the referenced map in Appendix; thence Northeasterly along the aforesaid watershed divide through Sections 35, 26, 25 and 24, T. 2 N., R. 11 E., and Sections 19, 18 and 17, T. 2 N., R. 12 E., SM to the section line common to Sections 16 and 17, T. 2 N., R. 12 E., SM, and designated "D" on the referenced map in Appendix; thence North approx. 0.55 miles to the west 1/4 corner Section 9, T. 2 N., R. 12 E., SM and the Point of Beginning.

The Research Natural Area Boundary also includes all of Little Green Island and The Needle above mean high tide.

Acreage and Elevations

Green Island RNA is 2,861 acres (1,158 ha) in size, including 46 acres (18.6 ha) on Little Green Island and 0.46 acre (0.19 ha) on The Needle. Elevations range from sea level to 520 feet (158 m).

Access (Figures 1, 2)

Access to Green Island is by boat or aircraft. Green Island is about 108 miles (174 km) southeast of Anchorage International Airport, 72 miles (116 km) southwest of Valdez harbor and airport, and 60 miles (97 km) west of Cordova (fig. 1). Boat charters are available in Whittier (accessible from Anchorage), Valdez, or Cordova. Floatplane charters are available in Anchorage and Cordova; helicopters can be chartered in Anchorage and Valdez. No roads exist on Green or Little Green Island.

Aircraft operations in Prince William Sound are regularly restricted by storms, heavy precipitation, high winds, and limited visibility because of fog and low clouds. During colder months super cooled water droplets in the atmosphere can cause dangerous wing icing conditions, and the short days of this high latitude location restrict daytime activities. Flights to Green Island are sometimes restricted by weather along the route, especially at Portage Pass between Anchorage and Whittier, even when conditions are operable at Green Island and the base of operations. Visitors arriving by aircraft cannot plan on adhering to a schedule and must be prepared to arrive or depart as circumstances dictate.

Boats provide the most reliable means of access to Green Island. Faster motor vessels can reach Green Island in about five hours from either Whittier of Valdez. Slower boats may require up to 12 hours, especially in adverse winds or sea state.

A narrow enclosed upper (northeast) arm of Gibbon Anchorage is an excellent small boat anchorage and float plane base. A public recreation cabin is at the upper end of the arm. Before the 1964 Great Alaska Earthquake the northeast arm was a channel between a small island and the main body of Green Island. Shoreline currents in the years following the earthquake uplift built a gravel spit between the two islands, enclosing the water (fig. 2). Shallow water in the arm limits the operation of deep-draft vessels, especially at extreme low tide stages.

AREA BY COVER TYPES

No comprehensive map of plant community types is available for Green Island RNA, but Figure 3 shows the location of closed canopy forests. The forests of the island do not exactly correspond to existing defined SAF forest cover types (Eyre 1980). Table 2 gives acreage figures for nearest equivalent SAF types and land cover features.

The closed canopy forest at Green Island most closely corresponds to SAF type 225 Western hemlock-Sitka spruce, except that it includes a minor component of mountain hemlock from sea level upward. Gravel beach terraces uplifted in the 1964 earthquake support early successional examples of SAF type 223 Sitka spruce, but only in locations such as Triangle Lake is this type more than about two or three tree crowns in width. Stable, excessively well drained sites are occupied by SAF type 224 Western hemlock, although this type is quite restricted in extent. Wave erosion of coastal bluffs produces most of the over steepened, excessively well drained topography on the island, but coastal erosion is so active on most bluffs that forests are not able to mature before a major slumping event strips all vegetation from the slope. SAF type 205 Mountain hemlock is defined as a high elevation forest type, but at Green Island it is the predominant forest cover at elevations near sea level on long bedrock ridges that parallel muskegs or blanket bogs. Above 400 feet (122 m) elevation a snowpack persists longer than elsewhere on the island and a more typical high elevation mountain hemlock type occurs.

Table 2. Extent of land cover features and estimated extent of forest types in Green Island Research Natural Area.

Cover Feature	Acres	Hectares	Percent
Total forest land	2,499	1,012	87
Muskeg	312	126	11
Ponds and lakes	51	20	2
Total	2,861	1,158	100
		Estimated Area	
Equivalent SAF Type	Estimated Portion of Total Forest	Acres	Hectares
225 Western hemlock-Sitka	30%	750	303

spruce			
223 Sitka spruce	1%	25	10
224 Western hemlock	9%	225	91
205 Mountain hemlock	60%	1499	607
Total	100%	2,499	1,011

Green Island, unlike larger islands in Prince William Sound, has few subalpine meadows or open rocky habitats. This is because the highest elevation is only 520 feet (158 m) and the bedrock is relatively soft, friable, and easily weathered. However, many muskeg types and limited areas of riparian habitat occur on the RNA. All of Little Green Island is covered with a productive western hemlock-Sitka spruce forest that is unusual for such a northerly location.

Permanent monitoring plots have been established on both Green and Little Green Island (fig. 2) to better document Prince William Sound forest types contained within the RNA. Both reference plots are within the western hemlock-Sitka spruce forest type, and represent relatively undisturbed highly productive examples of this type. Complete documentation of soils, understory vegetation, trees, stand structure, and age are available for the primary plot, Triangle Lake. Overstory structural data and soils information is available for the other plots. These data are available from the Alaska Ecological Reserves Coordinator at the University of Alaska Fairbanks and the Research Ecologist at the USDA Forest Service Forestry Sciences Laboratory in Juneau. These baseline data suggest Green Island contains outstanding examples of highly productive old-growth forest in the Prince William Sound Region, meeting or exceeding criteria for meeting RNA cell type needs.

PHYSICAL AND CLIMATIC CONDITIONS

Tectonics

Green Island is located near the subducting margin of the Pacific and North American geologic plates - the zone where the Pacific plate dives under the North American Plate. This zone is one of the most active of its kind in the world. Strain that gradually accumulates on this system (about two inches or five centimeters of relative motion per year) is released suddenly through earthquakes about every 750 to 1,200 years. The Great Alaska Earthquake in late March of 1964 was the largest ever recorded in North America (Plafker 1969). The tectonic adjustment associated with the 1964 earthquake moved coastal southcentral Alaska about 33 feet (10 m) seaward and uplifted Green Island about eight to 10 feet (2.5 to 3.0 m) (Plafker 1990). A distinctive ring of uplifted beaches and rock shelves surrounds Green and Little Green Islands. The uplifted shore can be distinguished by post-1964 grasses, shrubs, and small trees invading these newly exposed sites.

Climate

Green Island RNA has a cold, maritime climate with high precipitation. The nearest representative weather station was operated at Cape Hinchinbrook Lighthouse 24 miles (38 km) due west of the RNA on the outer coast of the North Pacific (fig. 1) from

1944 to 1974 (Table 3). Two other stations that currently collect climatic records from outer Prince William Sound are not suitable for analysis because of short records, gaps in the records, or unrepresentative locations. The 1944-1974 time period was marked by a strong cooling trend in Alaska temperatures (Juday 1984), and the climate of Green Island and the Prince William Sound region is warmer today than indicated in Table 3.

The Green Island area experiences a highly maritime climate with a mean annual temperature of 41.5°F (5.3°C) and mean annual precipitation of 97 inches (245 cm). The annual range of temperature is relatively limited (ca. 20°F), and the mean annual temperature is much warmer than practically anywhere else at an equivalent latitude in North America because of oceanic influence. Farr and Hard (1987) classified coastal Alaska weather stations into climatic groups, and placed Cape Hinchinbrook in a group characterized by higher maximum and minimum fall temperatures and longer frost free period than nearby but more inland stations. Cape Hinchinbrook experienced an average of fewer than three days warmer than 70°F (21°C) per year, but a total of only about 10 days colder than 0°F (-18°C) during the entire 30-year interval. Temperatures are somewhat cyclic, with as few as 69 and as many as 157 days with temperatures below freezing recorded per year. Frequent, strong, well-developed low pressure storm systems sweep into the RNA from the south and east (Brower et al. 1988). Precipitation is abundant and frequent, amounting to about 30% of all weather observations (Brower et al. 1988). Precipitation at Cape Hinchinbrook is evenly distributed throughout the year, with a slight minimum in June and a slight maximum in September or October.

Table 3. Climatic Records (1944-1974[a]) for Cape Hinchinbrook (AEIDC 1989), Chugach National Forest, Alaska at 190 feet (58 m) elevation.

	Mean Temperature		(years in record)	Mean Precipitation		(years in record)
	°F	°C		Inches	cm	
January	30.1	-1.1	(29)	6.48	16.4	(30)
February	32.0	0.0	(29)	6.20	15.7	(30)
March	32.4	0.2	(29)	5.54	14.1	(28)
April	37.5	3.1	(28)	5.65	14.4	(29)
May	43.4	6.3	(29)	6.44	16.4	(28)
June	50.3	10.2	(29)	4.54	11.5	(30)
July	54.5	12.4	(28)	7.25	18.4	(31)
August	54.9	12.7	(27)	9.38	23.8	(31)
September	50.3	10.2	(29)	12.82	32.6	(30)
October	42.3	5.7	(28)	12.12	30.8	(29)
November	36.2	2.3	(29)	7.89	20.0	(30)
December	31.9	-0.1	(27)	8.39	21.3	(29)
Mean Annual	41.5	5.3	(24)	96.59	245.3	(25)
Mean May-September	50.7	10.4		40.43	102.7	
Mean October-April	34.6	1.5		52.27	132.8	
Maximum	81	27.2		127.45	323.7	
Date or year	June & July 1963			1947		
Minimum	-15	-26.1		45.49	115.5	
Date or year	March 1963			1950		

aClimatic records were not continuous throughout the interval; data presented in this table are based on the available number of years in the climatic record indicated in parentheses (station was discontinued after August 1974).

Spring phenological events often begin in late March, although snow cover at sea level can persist well into May in heavy snowfall years. Green Island is in the rain shadow of the highest elevations of Montague Island, which receives the full force of storms off the North Pacific. Visitors standing on the shore of the RNA can often observe rainfall persisting throughout the day on Montague Island a few miles away while the weather remains partly cloudy or sunny in the RNA.

DESCRIPTION OF VALUES

Flora

Taxonomic nomenclature in Table 4 and 5 follows Little (1979) for trees, Viereck and Little (1972) for shrubs, and generally follows Hulten (1968) for herbaceous vascular plants, except as noted. Table 4 is a list of 143 plant species that are known to occur in the Green Island RNA and Table 5 is a list of 161 species that probably occur in the RNA. Table 5 is based on Hulten (1968) distribution maps, plant collections from adjacent map quadrangle areas, or on species collected regionally within the same habitats. Consequently, Table 5 species are considered to have a good likelihood of occurring in the RNA. Based on the combined total of 304 species within the RNA. This represents approximately 20% of the flora of Alaska, which is high for such a small area. Fourteen species collected in the RNA represent the first record for outer Prince William Sound and 5 vascular plants (Table 6) were collected beyond their previously known distribution limits in Alaska (Hulten 1968). From this preliminary survey we conclude that the Green Island area has a good representation of low elevation forest and wetland types in the outer Prince William Sound area, and a wide range in forest productivity that is probably also typical of the area.

Green Island and nearby sites in outer Prince William Sound are particularly suitable locations for the study of island biogeography, especially the influence of island size and isolation on species colonization and diversity. The effects of islands on plant species diversity can be recognized in some cases by the absence of plant species. Interpretations based on the absence of plants require thorough species inventories in the area of analysis. Unfortunately, the flora of the Prince William Sound region has not been collected as intensively as other parts of Alaska.

We surveyed a variety of habitats and landforms to document the character of Green and Little Green Islands and to investigate how plant species were distributed along environmental gradients. Forested areas were surveyed more thoroughly than wetlands. Six distinct habitats were identified during the survey:

1) beach and open shoreline areas dominated by graminoids;
2) freshwater and adjacent aquatic habitat along lakeshores;
3) alder shrublands above the beach zone;
4) conifer forest;
5) riparian or wet streamside areas; and
6) muskeg-fen wetlands.

It is notable that 2 species the Truncate quillwort, Isoetes truncata, and the choris bog orchid, Platanthera chorisiana, are on the January Forest Service Region 10 Sensitive Species list. These species have been collected near the RNA or noted within the distribution maps of Hulten (1968) and may occur in the RNA.

Table 6. Vascular plant species collected in Green Island Research Natural Area beyond previously known distribution limits.

Species	Herbarium Accession Number and Date
Cicuta mackenzieana Raup	Alaback 1023; 19 July, 1986.
Corallorrhiza trifida Chatelain	Alaback 1019; 21 July, 1986.
Polystichum braunii (Spenn.) Fee	Alaback 1018; 20 July, 1986.
Ranunculus orthorhynchus Hook.	Alaback 1022; 22 July, 1986.
Rumex crispus L.	Alaback 1016; 21 July, 1986.

Plant communities

Large forest monitoring plots were established on Green Island at Triangle Lake (0.5ha) and on Little Green Island (0.1875 ha) (fig. 2). All trees larger than 2 cm were mapped and measured for diameter. The dominant vegetation cover was mapped throughout the monitoring plots. Large and productive forest is restricted to well drained slopes. The south-facing slope above Triangle Lake supports a particularly well developed old-growth western hemlock-Sitka spruce forest. Figure 4 shows a cross section view of the forest on the Triangle Lake slope.

Dense climax western hemlock stand of the oval leaf blueberry, Vaccinium ovalifolium, understory type occupy steep headwalls at the top and bottom of the slope. A more open stand with a much higher dominance by Sitka spruce is found on a topographic bench in the middle of the slope between the two headwalls. The bench is largely made up of wet saturated ground based on the understory dominance of devil's club. This wet ground has a high incidence of trees blown over with intact root wads, apparently producing a high light environment in the forest understory that allows greater reproduction of Sitka spruce than elsewhere on the slope.

Understory plant cover was sampled in 74 plots of 1.0 m2 in the upper 0.25 ha of the Triangle Lake old-growth reference stand. Table 7 shows the composition, cover, and abundance of understory vegetation in the Triangle Lake old-growth reference stand, which is representative of most of the low elevation productive forest type on Green Island. In the shrub layer oval leaf blueberry and Devil's club, Oplopanax horridus, are abundant but at relatively low frequencies over the entire sampling area, consistent with their concentrated occurrence in different habitats, the well drained slopes and wet seepage portions of the stand respectively. Salmonberry, Rubus spectabilis, is associated with Devil's club, but is less abundant in general. In the herb layer purple sweet-cicely, Osmorhiza purpurea, lady fern, Athyrium filix-femina, and oak fern, Gymnocarpium dryopteris, are the most abundant species, but foamflower, a small species with relatively low cover but high frequency is possibly a better ecological type indicator. Moss cover, especially of Rhytidiadelphus loreus and the feather moss, Hylocomium splendens,is abundant and widespread in all but areas of the densest shrub cover. Both Sitka spruce and western hemlock seedlings display relatively high frequency, although spruce has about twice the coverage of hemlock.

Table 8 is a summary of the biomass and annual primary production data from understory sampling in the Triangle Lake reference stand. Skunk cabbage, Lysichiton americanum, spiny shield-fern, Dryopteris austriaca, and lady fern had the largest average size per individual. Oval leaf blueberry occurred at the highest density, nearly 25,000 stem per ha, and supported by a large margin the greatest total biomass on the plot. The feathermoss Hylocomium splendens was projected to support the greatest annual production on the plot and the second highest standing biomass.

Fauna

Mammals and Amphibians

The greater Prince William Sound ecosystem is one of the most outstanding marine mammal habitat areas in the national forest system. Small islands in the Sound are free of large predators and within a large expanse of productive marine habitat. Nine marine mammals and one aquatic mammal are known to inhabit Green Island RNA and the adjacent marine waters. Green Island serves as an attractive haul out site for several marine mammals.

Table 9 is a list of 24 mammals and two amphibians that are known to occur or that may occur in the RNA and immediately adjacent marine waters. The mammalian fauna of Green Island RNA includes few native terrestrial mammals and a relatively large number of marine mammals. Only 14 terrestrial mammals appear to occur on Green Island, and two of those were introduced on nearby Montague Island and are assumed to have spread to Green Island. The low number of terrestrial mammals is due to island isolation effects.

Sea otter--The occurrence of the sea otter, Lutra canadensis, is one of the principal elements of biodiversity justifying the establishment of Green Island RNA. The Green Island area was known as an important region for sea otter pup rearing before the *Exxon Valdez* oil spill (DeGange et al. 1990). In the early 20th century the sea otter was nearly extinct because of overharvest. The 1911 Fur Seal Treaty protected both sea otters and fur seals. Chanin (1985) estimated that the worldwide sea otter population was reduced to between 500 and 1,000 by this time. Southwestern Prince William Sound was one of nine areas worldwide where a remnant population of otters survived (Kenyon 1969, Johnson 1987). The drastic reduction of sea otter numbers represents a population bottleneck that probably severely reduced the total genetic diversity of the species.

Strictly speaking, sea otters are in Green Island RNA only when they are above mean higher high tide line. However, land use activity on shorelines such as Green Island has a decisive influence on the habitat suitability for sea otters of adjacent tidelands. Sea otters spend nearly all their lives in saltwater, but they come out of the water regularly (Kenyon 1969), often at known sites that are used repeatedly. Certain individuals come up on to the beach above the tide line more often than others. In the northern portion of their range and Alaska, sea otters may haul out in larger groups and haul out more often than in the southern part of their range (Riedman and Estes 1990). Haul-out behavior is known to occur throughout the year, but is more common in the winter. Sea otters sometimes come out of the water to avoid winter storms and they are known also to haul out for resting, often in groups.

Sea otters play a keystone role in subtidal ecosystems through their predation on shellfish (Estes and Palmisano 1974). Sea otters effectively control the numbers of shellfish that graze back kelps, the primary producers for the nearshore intertidal ecosystem. Green Island was the site of a definitive study that experimentally proved that sea otters restrict intertidal mussels to crevice refuges where otters are not able easily to pry them off their rocky attachment (VanBlaricom 1987). Without sea otters a less productive, shellfish-dominated, kelp-poor nearshore ecosystem develops (Duggins et al. 1989).

The *Exxon Valdez* oil spill caused an immediate and heavy mortality of sea otters (DeGange and Lensink 1990). At the time of the spill shallow waters near Green Island were recognized as important pup-rearing habitat (DeGange and Lensink 1990). Not only were many otters killed there, but pregnant and lactating females, the part of the population most important for reproduction, were disproportionately affected (DeGange and Lensink 1990).

Field notes of oil spill clean-up inspectors reported about 20 sea otters present in the summer of 1989 offshore from the RNA portion of Green Island. During site documentation of the RNA for this report, the first author saw fewer than 10 sea otters which appeared to be mostly young males (based on typical movement behavior of dispersing young males, lack of accompanying pups, sighting of individuals or small groups) that had begun to recolonize the area from nearby unoiled habitat. The amount of time that will be required for sea otter numbers to recover at Green Island is not known.

Steller sea lion--The Needle was one of five Steller sea lion, Eumetopias jubatus, rookeries and hauling grounds in the Prince William Sound-Kayak Island region in the early 1970's (Pitcher and Vania 1973), and the only one situated within the sheltered waters of the sound itself. The Needle is used year round by both sexes and all ages as a haul-out area; the only pupping that takes place is incidental (D. Calkins, Alaska Dept. of Fish and Game, pers. comm.). In southcentral Alaska Steller sea lions spend considerable periods of time on rocks and beaches well above mean higher high water but seldom more than about 62 feet (20 m) horizontally from the water's edge (Sandegren 1970). On smaller rocks and islands every available portion of the surface may be crowded with animals, and possession of territories on the limited spaces above the high tide line can be important for breeding success (Smith 1988).

Northern Montague Island and Green Island are the major concentration areas in Prince William Sound for spawning Pacific herring (Prince William Sound Environmentally Sensitive Areas Spring, no date), an important prey species for Steller sea lions. A major seasonal movement of Steller sea lions into the waters surrounding the entire RNA occurs in the spring in response to the return of Pacific herring from the open ocean.

Pitcher and Vania (1973) reported counts of Steller sea lions on The Needle ranging from 195 to 236 in periodic surveys that began in 1957. More recent counts are 668 in 1989; 926 in 1990; and 430 in 1991 (D. Calkins, Alaska Dept. of Fish and Game, pers. comm.).

The Steller sea lion is a federally listed Threatened species under the Endangered Species Act. Reasons for the population decline are not entirely clear. Some studies have shown that the population is failing to reproduce because of poor nutrition and lack of food (e.g., Merrick et al. 1987). What is certain is that as numbers decline there are fewer reproducing females although pups that are born remain in good condition. In addition, juveniles (post-weaning until 4 to 5 years of age) are not being recruited into the population (pers. comm. Kathy Frost). Steller sea lions in Alaska primarily eat fish, especially capelin, sand lance, rockfishes, sculpins, Pacific herring, and flatfishes (Fiscus and Baines 1966). Stocks of these fish are heavily harvested by commercial fisheries. Restrictions on fishing in the immediate vicinity of sea lion colonies have been imposed under the Endangered Species Act.

Harbor seal--The RNA is a significant harbor seal, Phoca vitulina, haul-out and pupping area. Harbor seals regularly haul out onto land for resting, pupping, and some mating, and most population surveys are based on sightings on shorelines, rocks, or floating icebergs, although these counts systematically miss numerous animals under water. In 1973 Pitcher and Vania (1973) counted 170 harbor seals in the waters around or hauled out on the beach at Little Green Island, and an additional two around The Needle. They did not find harbor seals on the RNA portion of the shore of Green Island, but sighted a group of more than 100 on the beach and in the water at Channel Rock, 1.1 miles (1.7 km) south of Triangle Lake (fig. 2). The Channel Rock group undoubtedly uses the nearshore environment of the Green Island portion of the RNA and may haul out near Triangle Point occasionally. In 1990 the first author of this report saw at least three female seals with pups on the rocks along the northernmost shore of the Green Island portion of the RNA. In 1988, the year before the *Exxon Valdez* oil spill, Pitcher (1989) reported a maximum count of 66 harbor seals around Green Island and 95 around Little Green Island.

The harbor seal is a species of management concern because of a significant population decline. Pitcher (1989) reported a population decline of about 41% (pooled mean estimate) in Prince William Sound in 1988 compared to 1984. The oil spill reduced the population further (US Attorney Alaska 1991).

The diet of harbor seals overlaps to some degree with sea lions, but in addition includes significant amounts of cephalopods (octopus and squid). Harbor seals move into the RNA in early spring (March) following schools of Pacific herring that spawn in kelp beds around the RNA. Harbor seals fall prey to orcas (killer whales) where the ranges of the two species overlap (Mate 1981).

Whales--Killer whales, Orcinus orca, are common in the waters around the RNA where fish and especially marine mammal prey are abundant. Orcas kill and consume Dall's porpoise, harbor porpoise, and harbor seal in Prince William Sound (Hall and Cornell 1985), and are known to kill minke whales (Mate 1981). The first author of this report observed an unsuccessful pursuit of a harbor seal by an orca in shallow water along the shore of the RNA near Triangle Lake (fig. 2), where the orca nearly beached itself. The availability of concentrations of seals, sea lions, and seabirds on the small islands of Prince William Sound offers a rich food source for orcas, and probably accounts for their abundance in the area.

Dall's porpoises, Phocoenoides dalli, and harbor porpoises, Phocoena phocoena, are common in the waters around the RNA and the first species often rides the bow wake of boats approaching the area. Minke whales are encountered regularly in waters around the RNA, and hump-backed whales are sighted often in the vicinity.

Montague Island Vole--The Montague Island vole, Microtus oeconomus ssp. elymocetes, a subspecies (Hall 1981) or possibly a distinct species of tundra vole, has been collected to date only on Montague Island, across Montague Strait from Green Island (fig. 2). Because of the shallow water between Green and Montague Islands it is possible that the vole inhabited both islands before they were separated by rising sea level about 11,800 to 10,000 years ago (Bloom 1983). Studies are underway to determine the degree of genetic difference between the tundra vole and the Montague Island vole. A survey should be conducted to establish whether the Montague Island vole is present on Green Island. The Montague Island vole is on the Alaska Region USFS Sensitive Species list (January 1994).

Birds

Table 10 is a list of 118 birds that are known to occur or that probably occur in Green Island RNA. Forty one species have been sighted in Green Island RNA or the immediately adjacent marine waters, and another 22 species are common in the region in habitats represented in the RNA and thus almost certainly present. The large number of bird species in the RNA is made up of a combination of shorebirds, marine birds, and terrestrial species which utilize diverse habitats including beaches and rocky shorelines, freshwater ponds, muskegs, and forest.

Prince William Sound, especially the outermost islands, is a major overwintering habitat for many mainland Alaska birds, and the northernmost in North America (Kessel and Gibson 1978). Large numbers of migrating birds also pass through the Sound. The following 4 bird species are of special note:

Yellow billed loon--The yellow-billed loon, *Gavia adamsii*, the largest member of the loon family, is primarily a Eurasian species with a relatively small population in North America (Terres 1980). The North American population winters in southcoastal

Alaska, especially Prince William Sound, and in southeast Alaska and northern British Columbia. Much of the wintering population appears to concentrate in southcoastal Alaska, including Prince William Sound. The species has been seen in waters around the RNA. The local southcoastal Alaska population of the yellow-billed loon experienced relatively high losses from the *Exxon Valdez* oil spill (Piatt et al. 1990).

Black-legged kittiwake--The Needle is one of 162 nesting colonies of black-legged kittiwakes, *Rissa tridactyla*, along the coast of southcentral Alaska; 263 nesting colonies occur statewide (Sowls et al. 1978). When inventoried in July of 1972, The Needle supported an estimated 760 black-legged kittiwakes. The kittiwake colony on The Needle experiences periodic complete reproductive failures. This is a characteristic of kittiwake colonies dependent on food webs in the Gulf of Alaska and North Pacific that experience dramatic ecosystem changes (Scott Hatch, US Fish and Wildlife Service, pers. comm.).

Marbled murrelet--The marbled murrelet, *Brachyramphus marmoratus*, is a robin-sized seabird that belongs to the alcid family. Under the Endangered Species Act, it has a C2 status in Alaska (listed Threatened in Oregon, Washington, and California). The C2 status implies the USFWS has information which may warrant listing, though more information on biological justification for vulnerability is needed.

The Prince William Sound population is resident (non-migratory), and was so abundant in a 1972 inventory that it was estimated to be the bird species with the greatest biomass in Prince William Sound (Isleib and Kessel 1973). Only a handful of marbled murrelet nests ever have been discovered, and the majority of these are on large upper canopy limbs of old-growth conifers (Quinlan and Hughes 1990). On the other hand marbled murrelet behavior consistent with nesting in alpine tundra or talus has been observed in Prince William Sound (Isleib and Kessel 1973) and ground-nesting by marbled murrelets is known elsewhere in Alaska (Simons 1980).

Marbled murrelets were abundant in saltwater around the RNA before the oil spill. They have been observed flying at dawn into the forest at Green Island, a characteristic nesting behavior, and may likely to be nesting within the RNA.

Black turnstone and surfbird--Norton et al. (1990) documented a spectacular concentration of migrating surfbirds, Aphriza virgata, and black turnstones, Arenaria melanocephala, in Prince William Sound. The birds were feeding on eggs (roe) deposited in the intertidal zone by spawning Pacific herring during their northward spring migration. At least 18,000 surfbirds and 10,000 black turnstones were observed in 1989, representing a significant portion of the species' total populations (Norton et al. 1990). The greatest concentration of birds was on northern Montague Island, just across from the RNA, but a few hundred were observed on Green Island as well (Norton et al. 1990). This area also has one the highest concentration of spring spawning herring in Prince William Sound (Prince William Sound Environmentally Sensitive Areas - Spring no date).

Insects

Western black-headed budworm--In 1989 and 1990 forests of the RNA experienced a major outbreak of the western black-headed budworm, Acleris gloverana (Walsingham), a defoliating moth of coastal Pacific forests. Both Sitka spruce and western hemlock are major hosts for the black-headed budworm. Budworm larvae consume only part of the host tree needle, which later dies (Furniss and Carolin 1977). Trees under attack at first appear brown or scorched, then drop their needles. Trees in later stages of attack appear skeletonized as only the new year's foliage is present on the tree. At the height of the black-headed budworm outbreak in the RNA in 1989 both young trees and old-growth displayed a completely brown canopy of dead needles. By 1990 and 1991 trees in the RNA had a thin canopy of single year's foliage, indicating that these trees were recovering.

Populations of the black-headed budworm are endemic but build up rapidly after one or two years of below average precipitation in July and August (Silver 1960). Prince William Sound experienced unusual intervals of clear, warm, dry weather in the early summer of 1988, 1989, and 1990 that appear to have triggered and sustained the black-headed budworm outbreak. The uninterrupted sequence of climatically favorable years appears to have contributed to the unusual severity of the black-headed budworm outbreak, which suggest a possible effect of global change in this system. Persistently cool and wet weather in the summer of 1991 appears to have significantly reduced the outbreak in Prince William Sound. Trees in the RNA that were already under stress were killed by the outbreak. Another year of heavy defoliation probably would have led to widespread tree mortality.

Geology

The RNA is part of the Prince William tectonostratigraphic terrane (Coney and Jones 1985), a structure that represents Late Cretaceous to Recent accretions of geologic fragments to North America. Green Island, Little Green Island, and The Needle are made up entirely of Paleocene turbidite or flysch (deep ocean sandstones and shales) deposits of the Orca Group (Tysdal and Case 1979). Typical Orca turbidite sequences include a conglomerate base, followed by a sandstone layer, and capped by a mudstone or shale. The beds are inclined at 76° to 80° (Photo 9) (Tysdal and Case 1979).

Green Island offers some of the best opportunities to observe, understand, and study the complete range of features associated with turbidites in the National Forest system. For example, Lethcoe (1990) used photographs from Green Island to illustrate middle fan deposits, conglomerates, ripple marks, convoluted flow, rip-up, groove casts, chevron marks, load casts, frondescent marks, and other features. Plant fossils, which are unusual in Prince William Sound, were discovered during RNA site documentation. The fossils are primarily leaf imprints and carbonaceous remains of wood and twigs.

Photo 2 shows that long narrow ridges of erosion resistant sandstone and conglomerate support well drained forest communities, which stand above poorly drained low sites that are softer shales or mudstone. Shallow caves are on the uplifted terrace (pre-earthquake shoreline) on the northern shore of the RNA. The caves were carved by wave action in softer sediments overlain by tilted erosion-resistant conglomerate and sandstone. Vertical turbidite beds accentuate the bench and headwall surfaces in the Triangle Lake forest plot (fig. 2). The bench may have been a wave-cut platform in softer rock with cobble beach fill from cliff-fall material.

Soils

Rieger et al. (1979) mapped the soils of the RNA as primarily Humic Cryorthods, with Terric Cryohemists, Terric Cryosaprists, and Terric Fragiaquods. In southcoastal Alaska humic layers accumulate, and if they are not excessively well drained or incorporated into lower mineral layers by mass wasting processes, they become strongly acidic, persistently saturated, and promote Sphagnum moss development.

Soil churning and mixing on over steepened slopes is common in the RNA. During RNA site documentation a buried, completely inverted soil profile was discovered over a void or cavity on an over steepened slope. Sites occupied by Sphagnum are nearly always stable landforms, and they develop histic horizons under wetland conditions, which become muskegs (Photo 7).

Soil data for the Triangle Lake forest plot are available from the Research Ecologist at the USDA Forest Service Forestry Sciences Laboratory in Juneau.

Lands

The entire Green Island RNA is in National Forest ownership. No leases or easements affect the area. The bed of submerged lands below mean higher high water is trust land managed by the state of Alaska. Figure 5 shows the characteristics of the state submerged lands along the shore of Green and Little Green Islands. The proclaimed boundary of the Chugach National Forest extends offshore. Jurisdiction over the marine water column and animals in it are the responsibility of several state and federal agencies depending on the resource or activity.

Cultural

There are no Native inholdings or allotments on Green Island, but there are 3 sites which have cultural and/or historic significance. None of these sites are located within the RNA boundaries, but are worth mentioning for the record. One site is a Native fish camp, one is a Native commercial fishing anchorage and hunting camp site, and one is an archeological site and old hunting lookout. This latter site was not allowed for individual Native land selection, but that decision is appealable. In general, disturbance to any archeological site requires notification of the USFS Cordova District Ranger, Cal Baker, in Cordova.

Little information is available on the ancient native inhabitants of Green Island. Some evidence of native occupancy may have been destroyed in the periodic earthquake-induced shoreline rises and alternating periods of slow submergence. The portion of Green Island outside the RNA is more likely to have archeological sites because of the excellent sheltered water at Gibbon Anchorage. Gibbon Anchorage is on the western side of Green Island opposite the RNA and supports localized recreational activity (refer to Recreation section of this Establishment Record). Oil spill cleanup operations resulted in the discovery and, in some cases, the disturbance of archeological sites.

Lethcoe and Lethcoe (1985) provide a brief history of the Green Island area. In the early years of the 20th century James Hyden of Latouche Island started a fox farm and built several buildings in the Gibbon Anchorage area of Green Island. In 1907 he sold the farm to William Gibbon who operated the farm for many years. By 1916 there were several cabins, a blacksmith shop, saltery, smokehouse, boathouse, and wharf. In the 1920's a Japanese syndicate had a role in the fox farm. No mail boat stop is listed for Green Island by the 1930's. After WW II the structures were used in a hunting guide operation. The Great Alaska earthquake in 1964 destroyed the wharf and structures. A cabin was constructed to support a long-term sea otter research project by the US Fish and Wildlife Service, and then turned over to the Forest Service to become part of the public recreation cabin system.

None of these sites is seen to present conflicts with use and protection within the Green Island RNA.

Other

Green Island is a significant scientific resource because of the numerous biological and geological studies mentioned previously. In addition, intensive, large-scale studies of a number of species and ecosystems damaged by the *Exxon Valdez* oil spill have amassed a huge data base that may be of value to continuing research, monitoring, and resource management.

IMPACTS AND POSSIBLE CONFLICTS

Mineral Resources

No historic mines or prospects occur on Green Island (Tysdal 1978). Modern mineral exploration and testing has revealed no mineral deposits (Tysdal 1978). Potentially economically important mineralized areas of copper, gold, and antimony in the Orca Group are associated with granitic intrusions, which are lacking in the RNA (Plafker and MacNeil 1966). The nature of the Orca Group as a thick accumulation of mineralogically unstable sandstone, mudstone, and conglomerate indicate poor potential for petroleum production or recovery, especially because potential source rock sandstones have low porosity and permeability (Winkler et al. 1976).

Grazing

No domestic livestock are on or near Green Island.

Timber

Green Island was allocated to non-timber production uses in the Chugach Forest Plan. There are currently no plans to harvest National Forest timber from this portion of Prince William Sound.

Cover Feature	Acres	Hectares	Percent of RNA
Commercial forest land	1,027	416	36
Non-commercial forest land	1,472	596	51

Watershed Values

Hydropower potential is very limited on Green Island because of a low elevation gradient, small total catchment area, narrow configuration of the island which produces short drainages, and the lack of high elevation snow-gathering area. Green Island is within the humid coastal zone of Alaska, but it occupies a minor rain shadow environment behind the continuous mountain crest of Montague Island.

Potable fresh water is very limited on Green Island. All of the lakes, ponds, and streams are suspect sources for drinking water because of potential contamination from birds and mammals. The Forest Service public recreation cabin at Gibbon Anchorage has a rain barrel cistern that collects water from the roof of the cabin. The cistern at the cabin is an important auxiliary source of freshwater for boaters and recreationists in this part of Prince William Sound.

Recreation Values

Green Island supports a variety of high-quality recreation resources. The scenery and wildlife viewing opportunities are exceptional. A diversity of marine mammals and birds can be seen from the island, including species of high public interest such as whales, seals, otters, eagles, and colonial nesting seabirds. The broad intertidal rock shelves around Green and Little Green Island display the high diversity of Prince William Sound intertidal life. Muskegs on the broad, level terraces of Green Island offer easy hiking terrain and excellent views of features such as the glaciers and tundra of Montague Island and scenic views of Prince William Sound. Old-growth forests with their large trees are features of high potential visitor interest.

A new public recreation cabin will be built at Gibbon Anchorage. The anchorage on the west side of the island, opposite the RNA, and the potential for human induced impacts within the RNA, especially given the island terrain, are minimal. The occasional person traveling on foot does not pose a disturbance problem.

Wildlife and Plant Values

Estimates of the pre- and post-spill populations or mortality of animals mentioned are taken from the summary of effects of the *Exxon Valdez* oil spill filed in federal court in April 1991 at the time of the Consent Decree (US Attorney Alaska 1991).

Steller sea lion--The Steller sea lion is listed as Threatened under the Endangered Species Act, and National Forest management must conform with species conservation measures.

Marbled murrelet--In June 1992 the Fish and Wildlife Service listed the marbled murrelet as Threatened in the lower 48 states. Its status in Alaska is C2 which implies the

USFWS has information which may warrant listing, though greater information on the biological justification for vulnerability is needed.

Sea otter--The Alaska population of the sea otter is not classified as Threatened or Endangered, but the southern sea otter is listed as Threatened in California and Washington. The total Alaska sea otter population was estimated at 100,000 to 150,000 (Calkins and Schneider 1985) in 1985, with about 10,000 in Prince William Sound. The *Exxon Valdez* oil spill reduced the Alaska population by an estimated 3,500 to 5,500, almost exclusively in Prince William Sound and the Kenai Peninsula coast. Relatively rapid recovery is expected, but in areas of severe local depletion, such as Green Island, National Forest management should be compatible with sea otter recovery.

Harbor seal--The harbor seal was a declining species before the oil spill, in which an estimated 200 seals were killed. In response to the decline, the National Marine Fisheries has contracted for a harbor seal conservation plan to assist in management and to consider whether to designate the species as depleted under the Marine Mammal Protection Act or federally list it under the Endangered Species Act. Maintaining undisturbed conditions around terrestrial haul-out sites should be a high priority for National Forest management in and adjacent to the RNA.

Yellow billed loon--This species is reported to have experienced high losses relative to the size of the local population as a result of the oil spill (Piatt et al. 1990). Its North American breeding habitat is centered on the expanding oil fields of the arctic coastal plain. Management of the Green Island RNA adjacent to saltwater habitat should be designed to minimize unnecessary disturbance to the population.

Montague Island vole--If surveys locate the Montague Island vole on Green Island, the RNA should be part of the habitat management plan for this potentially endemic species. It is a USFS Region 10 Sensitive Species.

Killer Whale--About 182 killer whales in distinct families or "pods" inhabited Prince William Sound before the oil spill. The spill is a major suspected cause in the disappearance of 22 of these animals. National Forest habitat that supports or directly influences the orca's prey base of marine mammals and sea birds should be considered sensitive and managed to minimize disturbance.

Plants--Two plant species, the Truncate quillwort, *Isoetes truncata*, and the choris bog orchid, *Platanthera chorisiana*, are on the Forest Service Region 10 Sensitive Species list (January 1994). These species have been noted within the distribution maps of Hulten (1968) and may occur in the RNA. The Alaska Natural Heritage Program shows that three rare plants may occur on Green Island: redwood violet (*viola sempervirens*), Thurber bentgrass (*Agrostis thurberiana*), and goose-grass sedge (*Carex lenticularis var. dolia*) which has Category 2 status under the ESA. No proposed Threatened or Endangered plant species have been located in Green Island RNA. The five vascular species reported as range extensions in this Establishment Record should be given special consideration for management purposes until better information about their abundance is available.

Special Management Area Values

No special management area designations apply to Green Island other than Research Natural Area. Plots in the area have been used in studies of the effects of the 1964 earthquake (National Academy of Science), the effects of the 1989 *Exxon Valdez* oil spill and clean up (Exxon and it's contractors, government natural resource damage and assessment teams), and the effects of bioremediation treatments after the spill (Department of Environmental Conservation and contractors). The location of forest (reference plots, fig. 2) and shoreline and intertidal monitoring plots (Juday and Foster 1990, 1991) used for evaluation of the RNA have been recorded for long-term relocation, study, and monitoring.

Transportation Plans

Access to Green Island is by boat or float plane. The island is not close to major air or water travel routes, although it was a heavily used staging area during cleanup and damage assessment operations after the *Exxon Valdez* oil spill. Gibbon Anchorage is strategically located as one of the only areas of sheltered water within a considerable area of marine surface and shoreline. The narrow channel in front of the Forest Service public recreation cabin is an outstanding stretch of water for float plane operations; it is sheltered, free of dangerous rocks, and has no surrounding topographic obstacles.

There are no plans for road construction on Green Island. The network of deer trails and open muskeg of low herbaceous and grass growth allow easy passage to most of Green Island. Most of the shoreline of the RNA provides good hiking, although a few portions of the beach are severely constricted during extreme high tide stages. Hiking is somewhat impeded on Little Green Island because of dense shrub growth that is not subject to deer browsing. However, Little Green Island is small and narrow and all locations can be reached with a short traverse from the beach.

MANAGEMENT PRESCRIPTION

Chugach National Forest LRMP Management Prescriptions for Analysis Area 17 - Timbered Sideslopes, Big Islands, Prince William Sound, which includes Green Island RNA are included as Appendix 1 of this Establishment Record.

Vegetation Management

Uplands

The terrestrial ecosystems of Green and Little Green Islands are isolated island ecosystems that are self-sustaining to a high degree. The 1988-1990 outbreak of western black-headed budworm caused some tree mortality at Green Island. However, the outbreak should subside naturally without control measures in the RNA. No upland terrestrial vegetation manipulation is necessary for the foreseeable future.

Beaches

Plastic waste, derelict fishing gear, and a random sample of trash introduced into the waters of the North Pacific makes its way onto the beaches of the RNA. The highly energetic shoreline environment can incorporate these wastes into the accumulating gravel beaches of Green Island. Items such as steel cables and logs or posts with metal spikes or attached sheet metal have been partially buried by gravel at Green Island, forming obstacles that are hazardous to visitors or wildlife walking along beaches. It would be highly desirable to periodically schedule the removal of debris from the beaches of the RNA.

Cooperative Management

Management of the RNA should be placed in the context of a larger ecological unit that includes the marine environment. Many animals that feed on or in the sea rest or breed in the RNA. Water and nutrients moving off the RNA are vital habitat features for certain marine organisms. The configuration of the shoreline influences local oceanographic conditions. The Forest Service should work cooperatively with the state of Alaska and other federal agencies to achieve management of submerged lands and ocean resources in a manner that is compatible with the purposes of the RNA. This could involve state classification or designation of surrounding submerged lands and other actions by the several authorities that have jurisdiction of marine waters and living resources in them.

ADMINISTRATION RECORDS AND PROTECTION

Copies of the establishment record are filed with the Ranger District, the PNW Station, and the Alaska Ecological Reserves Coordinator at the University of Alaska Fairbanks.

Administration and protection of the physical area is the responsibility of:

District Ranger
Cordova Ranger District
P.O. Box 280
Cordova, Alaska 99574
tel: (907) 424-7661
DG: Mailroom: R10F04D02A

Herbarium specimens have been deposited in the University of Alaska Herbarium (ALA) located in the Museum at the University of Alaska Fairbanks. The UA Herbarium is the major repository for Alaskan plant collections.

Approval and coordination of observational and nonmanipulative research is the responsibility of the Cordova District Ranger and the PNW Research Station Program Manager most directly concerned. If issues relating to the handling, capture, marking, or harassment of wildlife are significant, approval of the Alaska Department of Fish and

Game may be necessary. No special protection measures, other than protection of archeological resources as discovered, are required at Green Island RNA at present.

ARCHIVING

Maps accompanying this report were created as digital postscript documents (Adobe Illustrator for Macintosh ver 5.5 program) use as a map base the sources noted. The map files are archived with the archived with the Alaska Ecological Reserves Coordinator at the Agricultural and Forestry Experiment Station at the University of Alaska Fairbanks, the Alaska Region Ecology program, and the Forest Science Data Forest Science Data Bank, Corvallis, Oregon. An extensive documentary file of more than 300 color and black and white photographs, many at relocatable locations, was developed as part of RNA documentation. The photo file is archived with the Alaska Ecological Reserves Coordinator at the Agricultural and Forestry Experiment Station at the University of Alaska Fairbanks.

Terrestrial plant collections made on Green and Little Green Island are preserved in the Forest Service Herbarium in Juneau. Specimens of plants that represent range extension records are in the collections of the University of Alaska Herbarium in Fairbanks. Marine intertidal specimens collected in the area have been preserved at the University of Alaska Museum in Fairbanks. Stand maps and data from the permanent forest monitoring plots are archived in the files of the Alaska Ecological Reserves Coordinator at the Agricultural and Forestry Experiment Station at the University of Alaska Fairbanks and the PNW Research Station in Portland, Oregon. Understory vegetation plot data and light measurements are archived in the office of the Research Ecologist, USDA Forest Service, Juneau Forestry Sciences Laboratory and the PNW Research Station in Portland, Oregon.

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