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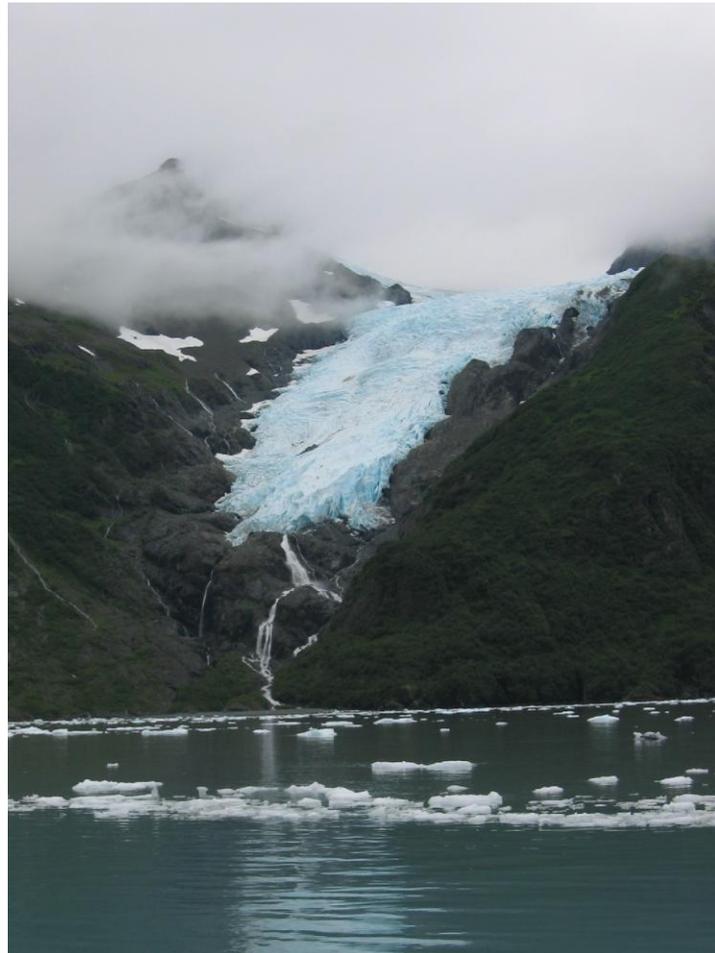
November 2005



Western Sound

Landscape Assessment

Glacier Ranger District, Chugach National Forest
USDA Forest Service, Region 10, Alaska



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EXECUTIVE SUMMARY

This Western Sound Landscape Assessment (WSLA) is an ecosystem analysis at the landscape scale; it is both an analysis and an information gathering process. The purpose is to develop a geographically explicit understanding of the important resources, processes, patterns and interactions occurring on the assessment area. The assessment focuses on the issues and key questions identified for this area. The area is described in terms of its physical, biological and social features.

This report is not a decision document; rather it is intended to serve as a mid-level document between the 2002 Chugach National Forest Revised Land and Resource Management Plan (Forest Plan) and the implementation of projects and management decisions. The Landscape Assessment is provided as a tool to managers, resource specialists and interested publics, to aid in the synthesis of available information and identification of topics of interest or concern.

The WSLA area encompasses 2,492,507 acres. A team of resource specialists from the Glacier Ranger District and Chugach National Forest Supervisor's Office prepared this assessment.

Following are the general stages used to conduct the analysis and corresponding chapters in this report

- Step 1 – Introduction (Chapter 1)
- Step 2 – Characterization of the Study Area (Chapter 2)
- Step 3 – Issues and Key Questions (Chapter 3)
- Step 4 – Issue Analysis (Chapter 4)
- Step 5 – Recommendations (Chapter 5)

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CHAPTER 1 – INTRODUCTION

PURPOSE

The purpose of the Western Sound Landscape Assessment (WSLA) is to develop a geographically explicit understanding of the important resources, processes, patterns and interactions occurring on the assessment area. The WSLA includes a description of the current condition, trends, and resources of lands and people in the area being studied. This landscape assessment does not directly result in any decisions. Therefore, it does not require National Environmental Policy Act (NEPA) review and is not subject to appeal. Rather, this assessment provides the informational context for proposing ways to achieve long-term goals of land management in western Prince William Sound (PWS). It results in a list of opportunities for possible projects intended to balance a variety of land and resource uses. Some of these proposed projects would still require further environmental analysis, public review and decision-making mandated by NEPA. Initiation and timing of projects would depend on many factors, including funding.

The assessment includes a characterization of the study area; identification of issues and key questions based on input by the Landscape Assessment team; description and discussion of identified issues and key questions; synthesis and interpretation of information; and a list of potential future projects and management opportunities. Existing data and information have been compiled and synthesized into an easily accessible format. This assessment identifies current data gaps and future data collection needs, and new data were not collected specifically for this assessment.

THE ASSESSMENT AREA

The WSLA study area includes the islands in western PWS, the glaciated portions of the Chugach Range that drain south into PWS, and the portions of the eastern Kenai Peninsula that drain into PWS. The boundary was defined using watershed associations identified in the Chugach National Forest Revised Land and Management Plan (Forest Plan) (USDA 2002). The analysis area lies on the Glacier Ranger District of the Chugach National Forest, east of Girdwood, Alaska (**Figure 1.1**). The area is bounded by the Chugach Range to the north, the Kenai Peninsula to the west, and Prince William Sound to the east. The eastern boundary of the WSLA study area is defined by the political boundary between the Glacier and Cordova Ranger Districts. Access to this area is primarily by aircraft or boat, although Whittier and Valdez are accessible by road.

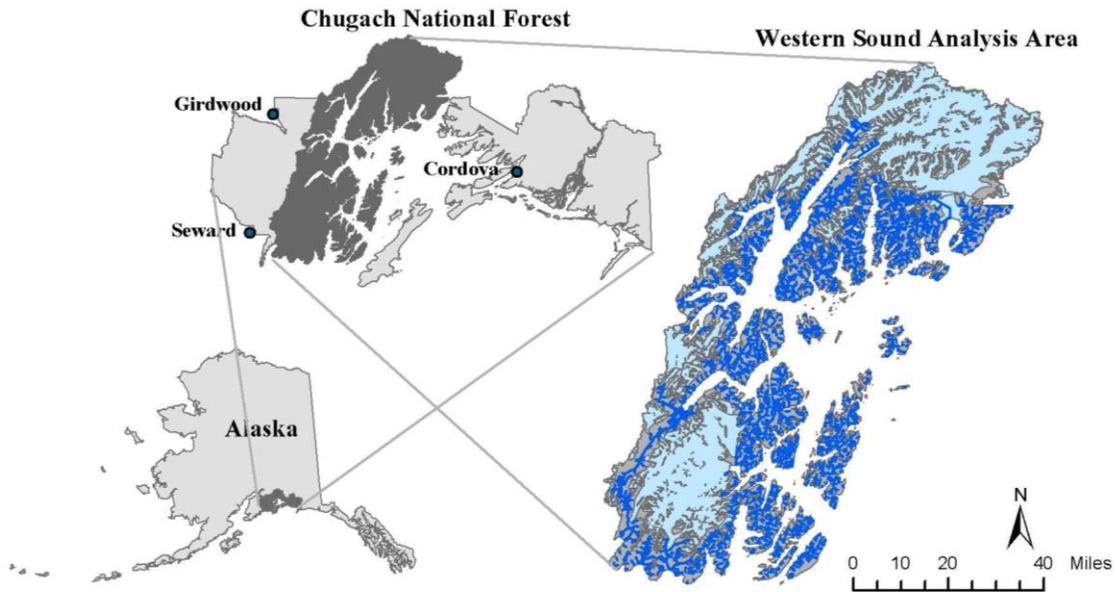


Figure 1.1: Location of the Western Sound analysis area.

The WSLA analysis area covers approximately 2,492,507 acres (3,895 square miles) of high relief coastal and mountainous terrain. This area is characterized by complex shorelines, islands with high relief, numerous fiords, and large glaciated areas in the Chugach and Kenai Mountains. Glaciers have carved spectacular valleys in this area, and glaciers including tidewater, piedmont and alpine glaciers are common throughout the study area.

Of this area, 2,217,980 acres (89% of WSLA area) are currently National Forest System lands. Generalized land status showing Forest and Non-Forest lands within the study area is shown in Figure 1.2. A series of more detailed maps with a complete listing of land ownership can be found in Appendix A. The intent of the WSLA is to assess landscape conditions on National Forest lands. Although the Forest Service cannot and does not intend to implement management decisions on the state and private land contained within Forest boundaries, these areas may occasionally be discussed in the WSLA where appropriate to provide a more holistic consideration of the landscape.

One important aspect of land ownership throughout PWS is the management of tidelands that are not submerged but are located below the mean high water line. Mean high water is defined in Glossaries for Surveyors, 2nd edition as: "The average elevation of all high waters recorded at a particular point or station over a considerable period of time, usually 19 years. For tidal waters, the cycle of change covers a period of 18.6 years, and mean high water is the average of all high waters for that period". In those coastal shorelines in PWS where the State claims ownership of submerged lands, the boundary line would be the mean high water tide line at time of Statehood (1958). This tide line was uplifted and subsided in many areas with the 1964 Good Friday earthquake. In the case of the reservations for the Chugach National Forest, the Forest Service claims that PWS is part of the land reserved (withdrawn) for National Forest and it did not pass to the State of Alaska at the time of Statehood. The State of Alaska and the Chugach National Forest both claim these tidelands, which are currently managed based on a 1992 Memorandum

of Understanding (MOU) between the two entities in which neither the Forest Service nor the State give up any land title claim, but agree to manage at mean high tide in 1992, adjusted to any subsequent natural movement of the line.

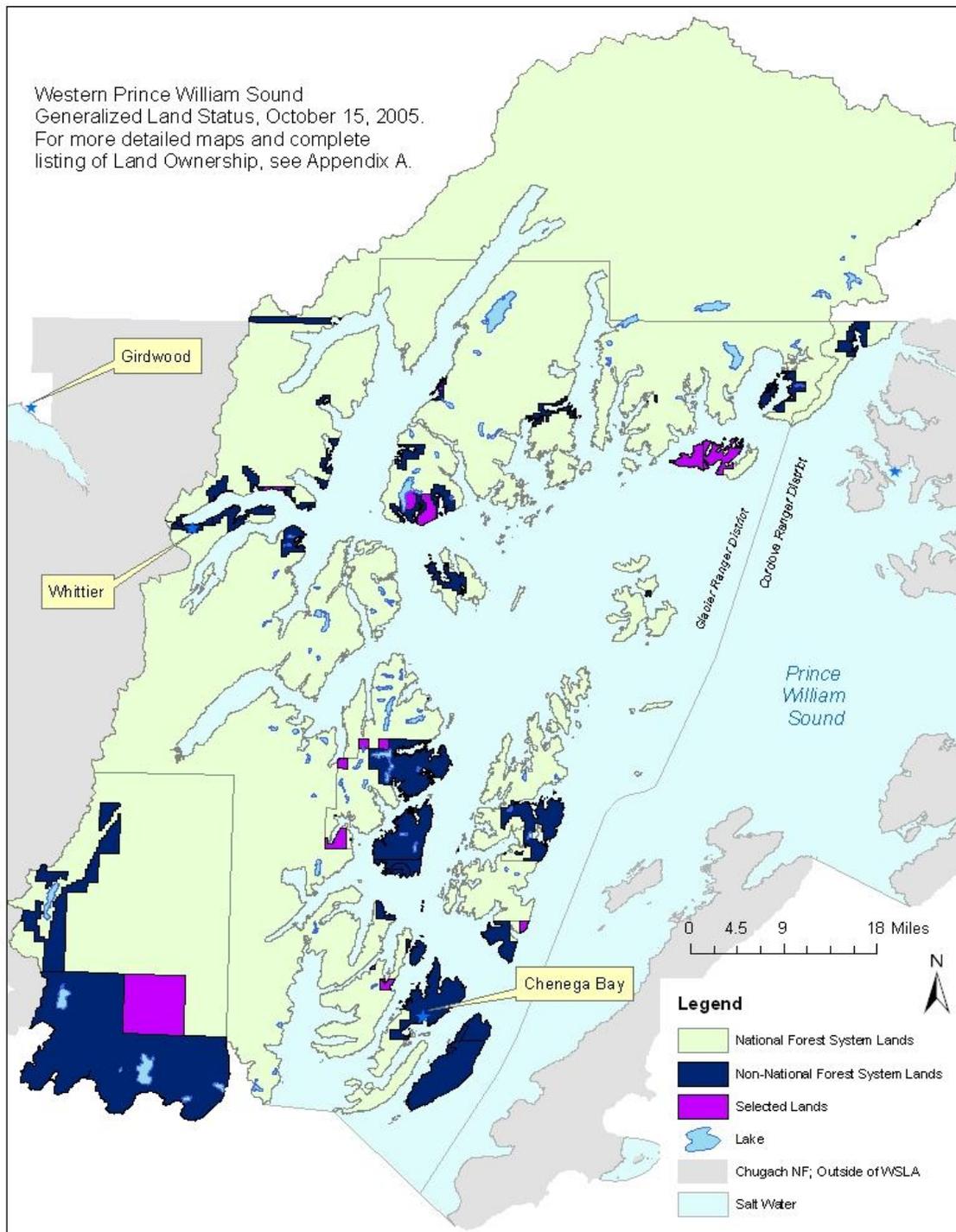


Figure 1.2. Generalized Land Status within the WSLA study area, showing National Forest System Lands, Non-Forest Lands and lands that have been selected by the State of Alaska or Alaska Native Corporations for potential future conveyance. More detailed information and a complete listing of land ownership can be found in Appendix A.

RELATIONSHIP TO THE FOREST PLAN

This Landscape Assessment document is based on direction provided in the Forest Plan, which was revised and the Record of Decision signed in May 2002. Full text and maps from the Forest Plan are available online at <http://www.geographynetwork.com/chugach/>. Also available on this website are most of the Chugach National Forest (CNF) corporate Geographic Information System (GIS) layers used by resource specialists in this report, including metadata and downloading information.

Forest-wide direction applicable to the WSLA is found in Chapter 3 of the Forest Plan. Specifically, Desired Conditions for the Prince William Sound Geographic area are described on pages 3-16 to 3-18, which state that, “The lands of the Chugach National Forest within Prince William Sound are managed primarily to maintain the wild character of this area and its unique wildlife. Human access will remain almost exclusively by boat or aircraft with the exception of the road accessed portals of Whittier and Valdez. Upon congressional designation, much of the area will have been established as Wilderness. Most of the remaining lands will maintain their natural characteristics while providing some accommodation to human visitors.”

Chapter 4 of the Forest Plan provides detailed descriptions of management prescriptions. The Forest Plan developed twenty-one different Management Area Prescriptions providing general direction on how to manage for the desired future conditions of both ecological and social systems. These management prescriptions outline the types of activities and facilities that are allowed or not allowed, consistent with the management intent for the identified area.

The majority of the WSLA area falls within the 2,116,000 acre Nellie Juan–College Fiord Wilderness Study Area (**Figure 1.3**) and as such has been identified for management under the Wilderness Study Area (WSA) management prescription, until such time as the United States Congress acts on wilderness recommendations. “The WSA is managed to maintain presently existing wilderness character and potential for inclusion into the National Wilderness Preservation System. Forest Service regional manual direction controls the management direction for the Wilderness Study Area until Congress considers the Wilderness Study. The Revised Forest Plan Map displays recommended prescriptions for the Wilderness Study Area after Congress considers the Wilderness Study.” (Forest Plan, 4-12). Desired future conditions for social systems are also identified in the Forest Plan (4-12): “The WSA will provide outstanding opportunities for solitude, quiet and isolation when traveling cross-country. Scenery will be natural in appearance...People should expect to use primitive skills in an environment that offers a moderate to high level of challenge and risk.”

In the Forest Plan, management prescriptions are identified that will apply after Congress has acted on designation of Wilderness. These prescriptions are included below. Of the possible twenty-one different management prescriptions on the Forest, nine are present in the study area (**Table 1.1**). Management prescriptions applicable to the WSLA area are shown in **Figure 1.3**.

Table 1.1. Forest Plan Management Prescriptions in the WLSA study area.		
Prescription	Acres	% of FS lands in Prescription
Recommended Wilderness Management Area	1402874	63%
Wild River in Recommended Wilderness	3494	< 0.5%
Proposed RNA in Recommended Wilderness	6330	< 0.5%
Proposed RNA	512	< 0.5%
Backcountry	776005	35%
EVOS Fee	21579	1%
Fish, Wildlife and Recreation	7186	< 0.5%
Backcountry Groups Management Area	n/a**	n/a
Total National Forest System land within WLSA boundary	2217980	100%
<p><i>**Backcountry Groups Management Area (Prescription 313) is a designation given to two locations within the WLSA area; one area on Growler Bay of Glacier Island, and one on the northeastern end of Esther Passage. This prescription is intended for small, site-specific developments and not for use over large areas. No development of these sites has occurred or is planned at this time.</i></p>		

It is important to note that the above Management Prescriptions are recommended to take effect after the United States Congress has made a decision regarding the 2,116,000 acre Nellie Juan–College Fiord Wilderness Study Area (WSA), which currently encompasses most of western PWS. According to the Forest Plan (Chapter 4, page 12): “The WSA is managed to maintain presently existing wilderness character and potential for inclusion into the National Wilderness Preservation System. Forest Service regional manual direction controls the management direction for the Wilderness Study Area until Congress considers the Wilderness Study. The Revised Forest Plan Map displays recommended prescriptions for the Wilderness Study Area after Congress considers the Wilderness Study.”

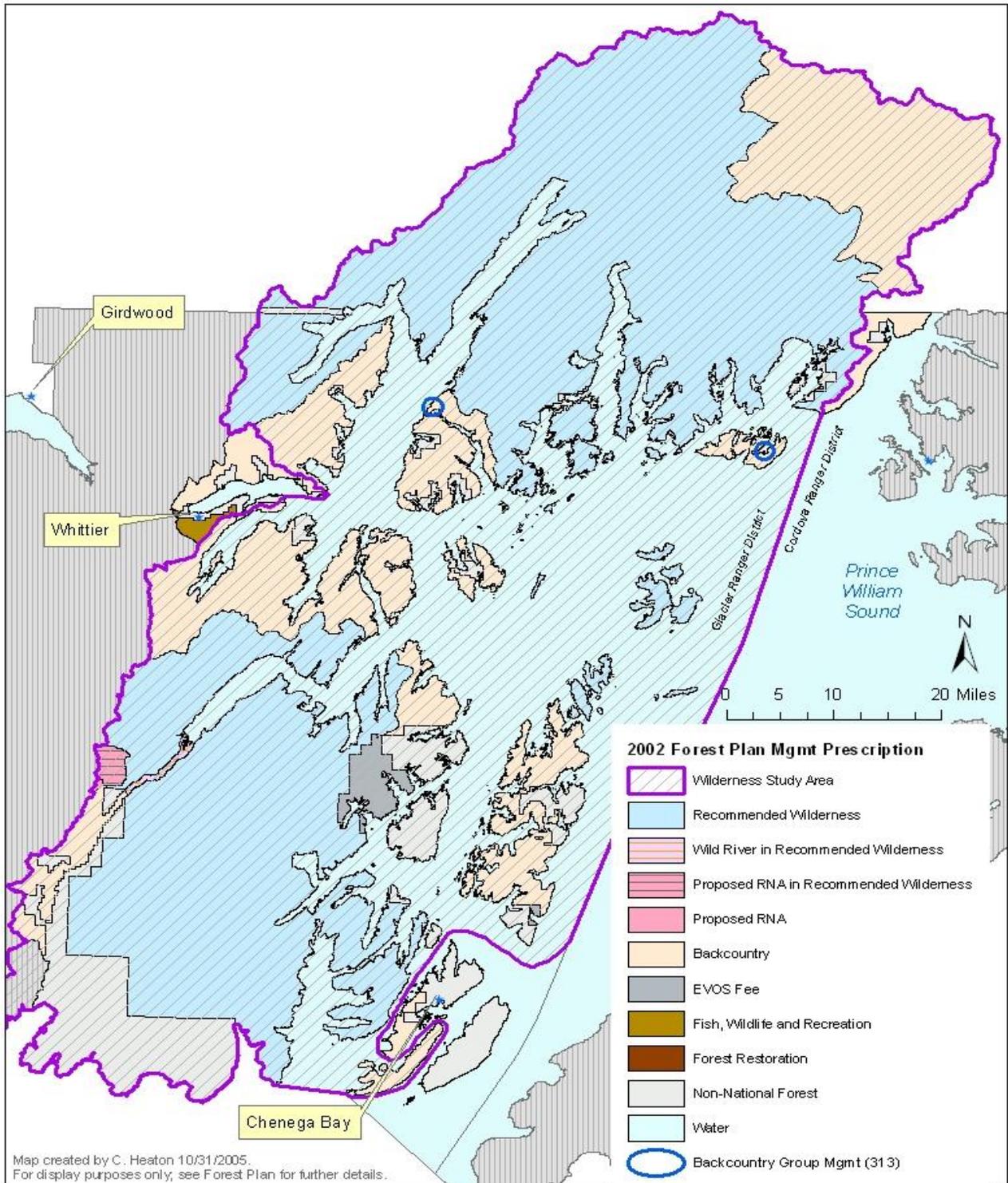


Figure 1.3. Management Area Prescriptions as described in the Chugach National Forest Revised Land and Resource Management Plan, 2002. For map of entire Chugach NF and further details on prescriptions, see Chapter 4 of the Forest Plan.

CHAPTER 2: ANALYSIS AREA CHARACTERIZATION

PHYSICAL CHARACTERISTICS

CLIMATE

Western PWS experiences a maritime climate with mild temperatures and heavy precipitation. Average maximum July temperatures are generally about 62 degrees, and minimum January temperatures range from 18 degrees F at Valdez to 26 degrees F at Port San Juan (Table 2.1). Low pressure storms generally circulate counterclockwise in the Gulf of Alaska, and weather and winds in western PWS area come from the southeast. Precipitation increases dramatically with elevation and increases toward the west, with mean annual precipitation ranging from 66 inches at Valdez to 198 inches at Whittier (Table 2.1 and Figure 2.1). The heaviest rainfall generally occurs in the late summer and fall, and the lowest precipitation occurs in the spring and summer. Snow falls at all elevations between mid-October and mid-May. Low elevation areas in western PWS receive from 100 to 250 inches of snow annually and snowfall increase dramatically with elevation (Table 2.1). About 10% of total annual precipitation falls as snow along the coast. This increases to over 50% in the higher elevations of the Chugach and Kenai Mountains, where numerous glaciers and ice fields exist.

Table 2.1: Climate summary for weather stations located in and near the Western Sound analysis area. Weather station data are from the Western Regional Climate Center, 2005.

		Whittier	Cannery Creek	Valdez WSO	Port San Juan
Location	Elevation (ft)	60	10	20	0
	Latitude	60°46'	61°01'	61°08'	60°03'
	Longitude	148°41'	147°31'	146°21'	148°04'
	# of years of data	43	25	38	24
Temp.	Average Daily Temp (F)	40.1	38.5	38.6	41.0
	Average Max July Temp (F)	62.5	62.3	62.6	61.9
	Average Min Jan Temp (F)	22.9	19.8	18.0	26.2
Precip.	Avg Annual Precip (in)	197.6	123.4	66.0	130.3
	Avg Annual Snowfall (in)	250.2	141.6	295.5	105.0
	Avg Jan snowpack depth (in)	34	32	30	12
	Avg March snowpack depth (in)	50	51	43	14

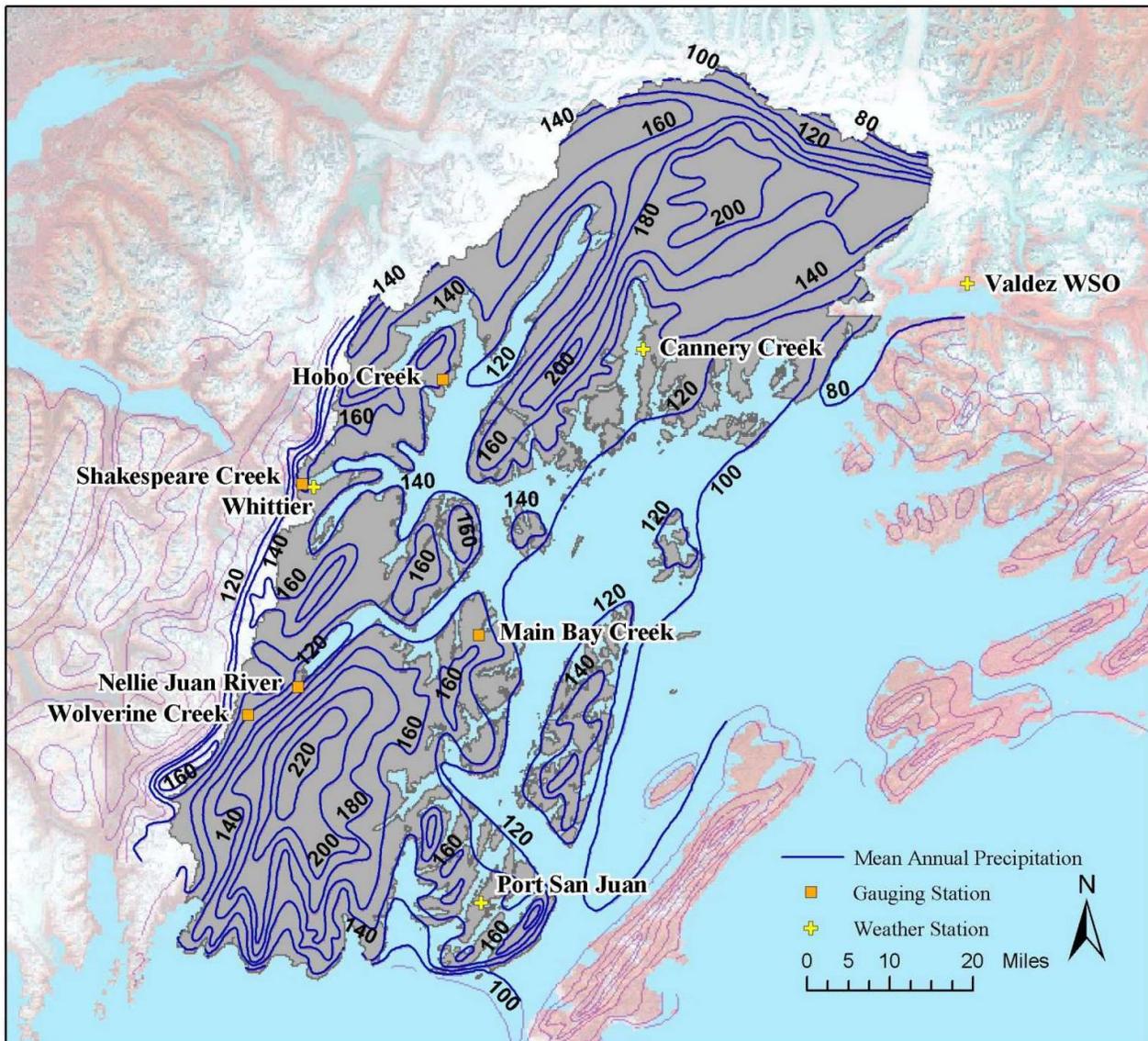


Figure 2.1: Weather stations and mean annual precipitation, in inches, for the WSLA area. Precipitation data from USDA Forest Service.

WATERSHED MORPHOMETRY

The WSLA area lies within the Big Islands, Chugach Mountains, and Kenai Fiords 4th level watersheds. All watersheds within the analysis area generally flow south and east into PWS. Ocean currents in PWS generally flow in a counterclockwise direction. Because of the complex shoreline and the fiords that extend far inland, most of the watersheds in the analysis area are small, draining the steep topography to the coast. The largest watersheds include the Nellie Juan River and the Columbia Glacier.

Elevations in the analysis area range from sea level to 13,176 feet at Mount Marcus Baker in the Chugach Range north of College Fiord. Elevations in the Kenai Mountains reach over 6,000 feet. Elevations in the islands in western PWS reach over 3,000 feet.

Lakes cover about 29,800 acres, or 1.3% of the watershed. The most prominent lakes include Nellie Juan Lake, Esther Lake, Coghill Lake, Kadin Lake, and Terentiev Lake.

ECOLOGICAL CLASSIFICATION

Davidson (1999) delineated the ecological sections and subsections for the Chugach National Forest (USDA Forest Service 1999). There are portions of four ecological subsections found within the WSLA area. The subsections represented are: Chugach Icefields (57%); Prince William Sound Mainland (26%); Prince William Sound Islands (13%); and Kenai Fjordlands (4%) (**Figure 2.2**).

Chugach Icefields: ice fields, glaciers and rugged, rocky mountains that surround PWS. Most precipitation, which ranges from 140 to 220 inches, falls as snow to produce an annual snow pack ranging from 80 to 320 inches in depth.

Prince William Sound Mainland: lower non-glacial, steep, rugged mountains and hills on the mainland adjacent to the ocean. This area has a maritime climate where precipitation is enhanced by the trapping effect at the end of the fjords and the orographic effects as moist air rises in elevation to get over the mountains.

Precipitation ranges from 80 inches on the shoreline to 200 inches at upper elevations in the mountains. The temperature of this area is sufficiently cooler so that snow packs remain present for a month longer than the islands in PWS. Needleleaf forests characterize the undisturbed portion of the sideslopes and tall shrubs characterize the open areas, avalanche slopes, and other disturbed sideslopes. Many of the gentler slopes are covered with fens and are characterized by grassy herbaceous vegetation.

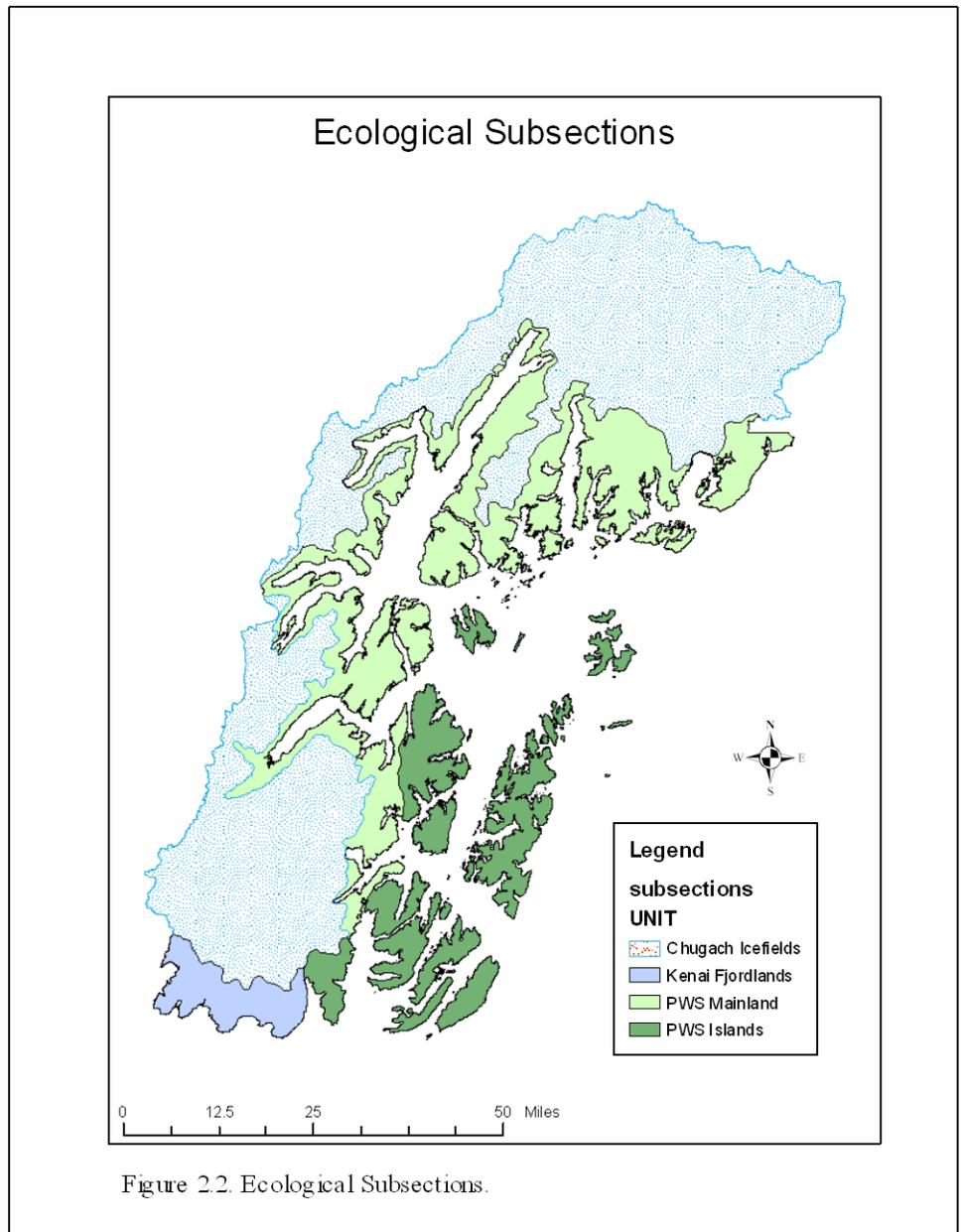


Figure 2.2. Ecological Subsections.

Prince William Sound Islands: steep, rugged, mountainous islands in PWS. This area has a maritime climate, which ranges from 80 inches at the lower elevations to over 300 inches at higher elevations on southern Montague Island (just outside the WSLA area boundary). Most precipitation occurs as rain. Needleleaf forests characterize the undisturbed portions of the sideslopes and tall shrubs or exposed soils characterize the open areas, avalanche slopes, and other disturbed sites. Many of the gentler slopes are covered with fens and are characterized by grassy herbaceous vegetation.

Kenai Fjordlands: outwash and rolling hills in valley bottoms and adjacent glaciated sideslopes and uplands. The annual precipitation at sea level is about twice that of the other subsections on the Kenai Peninsula. Precipitation ranges from 40 inches in the inland valleys to 150 inches in the coastal alpine. A large portion of the precipitation falls as snow. The characteristic vegetation in the alpine and some of the mountain sideslopes is dominated by dwarf scrublands and herbaceous vegetation types. The remainder of the sideslopes and the valley bottoms are covered with a needleleaf forest.

GEOLOGY

The bedrock geology of the study area consists primarily of undivided sedimentary rocks of the Valdez Group along the western portion of the study area and the Orca Group on the eastern portion. Siltstone, shale, greywacke, and slate are common throughout the area, with a few areas of volcanic rock, particularly on Glacier and Knight Islands (Nelson, Dumoulin, and Miller, 1985).

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.

1964 Good Friday Earthquake

The epicenter of the magnitude 9.2 earthquake of March 27, 1964 was located within the analysis area, east of College Fiord. Warping of the crust during this tectonic event resulted in uplift in the eastern portion of PWS and subsidence in the western portion. A maximum uplift of over 30 feet occurred on Montague Island. Knight Island experienced 4 to 6 feet of uplift, and the area around Whittier experienced 6 to 8 feet of subsidence. This caused numerous geomorphic changes along the shoreline.

GLACIERS

Glaciers cover 985,500 acres, or about 44% of the analysis area. Much of the mainland portions of the analysis area are currently covered by large glaciers or ice sheets. Past glaciation sculpted much of the topography of PWS, and large glaciers carved deep fiords throughout the area. Tidewater glaciers exist at the ends of most of these fiords. Glacier scouring is evident throughout the WSLA area in the form of U-shaped valleys with cirques at their head, valley walls that rise progressively steeper and morainal deposits (Sheehy 1997). The largest glaciers in western PWS include the Columbia Glacier, Harvard Glacier, and Yale Glacier in the Chugach Range, and the Sargent Icefield and its associated glaciers in the Kenai Mountains.

SOILS

The soils of the WSLA area are the product of a continually changing landscape that breaks apart, transports, and reworks the parent material upon which they are forming. Some of these changes are brought about by the erosive effect of glaciers, the transport and deposition of sediments by water and gravity, the accumulation of wind-blown materials, wave and tidal action, and tectonic uplift. The resulting mineral and organic materials strongly influence the type of soils that develop.

Land Type Associations

Soils in the study area can be described in terms of where they lie on the landscape because of the strong correlation between landscape position and soil formation. The Landtype Association (LTA) is part of the National Hierarchical Framework that is 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). The LTA units and a general description of soils typically found on them are given (**Figure 2.3**) to provide an overview of soil composition for the study area. Soils information is a compilation of work based on soil surveys done throughout the Chugach National Forest (Davidson, 1989; Davis et. al., 1980; Sheehy, 1975; Sigmund, 1991).

Glaciers (49%): active glaciers, ice fields and rock inclusions. Soil development is minimal because of the lack of exposed mineral substrate. The LTA is found throughout the northern and eastern extent of the study area.

Mountain Summits (19%): rocky terrain with intermittent ice and snow. The soil that does occur tends to be stony, weakly developed and shallow. Subtle changes in the soil profile and depth will occur as you move from concave to convex positions on the landscape. The management limitations are typically due to the high elevation, steep slopes, shallow soils, and the occurrence of avalanches and rock fall. The vegetation is mostly low growing forbs, grasses, and lichens where there is sufficient soil. Willows and other woody plants grow in localized wet areas.

Mountain Sideslopes (15%): characterized by disturbance in the form of mass wasting and slope erosion. The soils in these units 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 B) should be performed before ground disturbance to evaluate the risks. The extent of soil development is typically determined by where along the sideslope it occurs. The soils get deeper and more developed as you move from the higher, steeper, convex positions to the lower, gentler, concave positions down slope. 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 conifer forests. The management limitations are generally related to soil erosion, which can be accelerated by ground-disturbing activities. The upper sideslopes are commonly vegetated with low growing subalpine plants, which grade into mixed communities of grasses, shrubs, and trees on the lower slopes. The location of trees is strongly dependent on disturbance by avalanches.

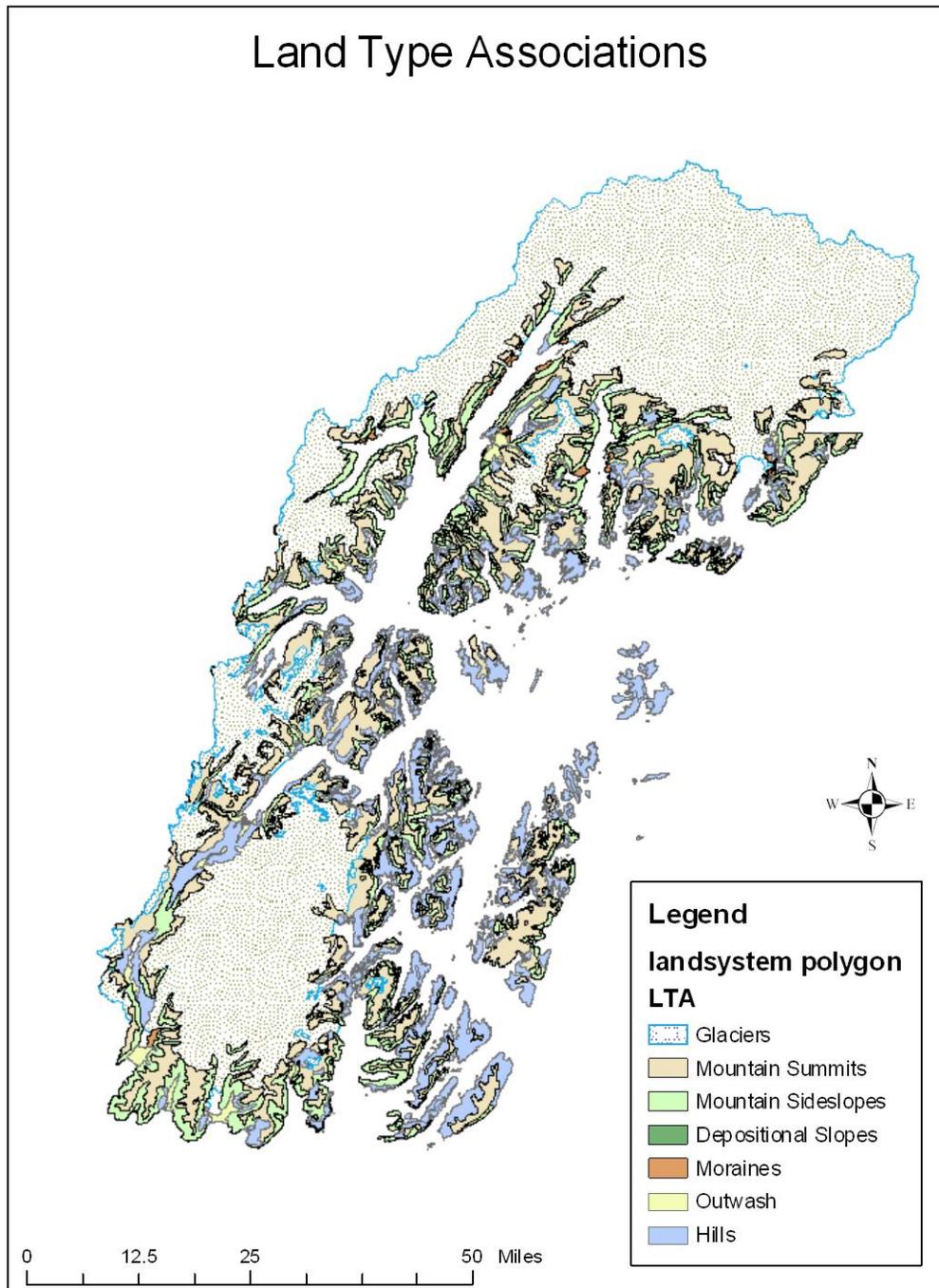


Figure 2.3. Landtype Associations in WSLA.

Hills (14%): dominated by soils that are formed on 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. Those in toe slope positions and basins that receive and collect water will tend to develop organic soils and

may support wetland vegetation. The vegetation will usually consist of forested communities on the slopes and hilltops where the soils are well drained.

Outwash (1%): active floodplains and glacial outwash sediments that were laid down under high water energy. 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. Wetlands and other hydric soils are common on these units. The vegetation on the poorly drained sites will be indicative of wetlands where the surface is level, and poorly productive forests on gentle slopes. Coarse textured soils will produce highly productive forests.

Depositional Slopes (<1%): typically composed of soils that are forming at the base of long sideslopes where sediments from higher slopes are accumulating and can also include stream terraces that are no longer affected by floods or stream bank erosion. The soils in this unit are usually, deep, coarse textured, and well drained, except where there is accumulation of subsurface runoff. Limitations are usually associated with drainage problems and avalanches. Vegetation is strongly dependent on disturbances by avalanches.

Moraines (<1%): glacial depositional features such as esters, kettles, kames and moraines. In general, the soils tend to be poorly to well drained and are a mix of unsorted gravel, cobbles, and stones in a moderate to fine textured matrix. Trees are normally found on the sideslopes and tops of moraines. Wetter vegetation is commonly found in the lower basins in between the moraines.

EROSION PROCESSES

Erosion processes can be evaluated in terms of landslides, surface erosion, and streambank erosion. Landslides are not common in the study area but there are critical slope stability factors that have to be evaluated when management activity is considered (Swanston, 1997). Sites are evaluated based on their slope, topographic position, and any subsurface restrictions. These criteria are individually rated and the total score for a particular site can be used as an indication of its stability. Surface erosion is not common in the WSLA area. It can occur on areas recently exposed from continual frost shattering and sloughing of material at higher elevations. Areas where vegetation is trampled may also be susceptible to increased rates of surface erosion. Particularly susceptible are wetland and alpine areas, which have a long recovery period.

STREAMS

Stream Types

A total of about 2,183 miles of mapped streams lie in the WSLA area (**Figure 2.4**). Channel types have been assigned to these streams based on the Tongass National Forest Channel Type User Guide (USDA Forest Service, Alaska Region, 1992). However, field verification of channel types has been limited in this area. High Gradient Contained channels are by far the most common in western PWS as a result of the high relief and mostly small drainage areas. Glacial Outwash channels are present throughout the mainland portions of the analysis area draining the numerous glaciers and ice fields, and

Moderate Gradient Contained and Moderate Gradient Mixed Control channels are typical in the areas with moderate relief.

Streams in the analysis area are generally very short. The Nellie Juan River is the longest river in the analysis area. Most of the larger drainage basins are occupied by glaciers and fiords, and substantial subglacial streams exist but are not mapped. Multiple glacial outburst systems exist on the Columbia Glacier, where side valley drainages are dammed by glacial ice (Post and Mayo, 1971).

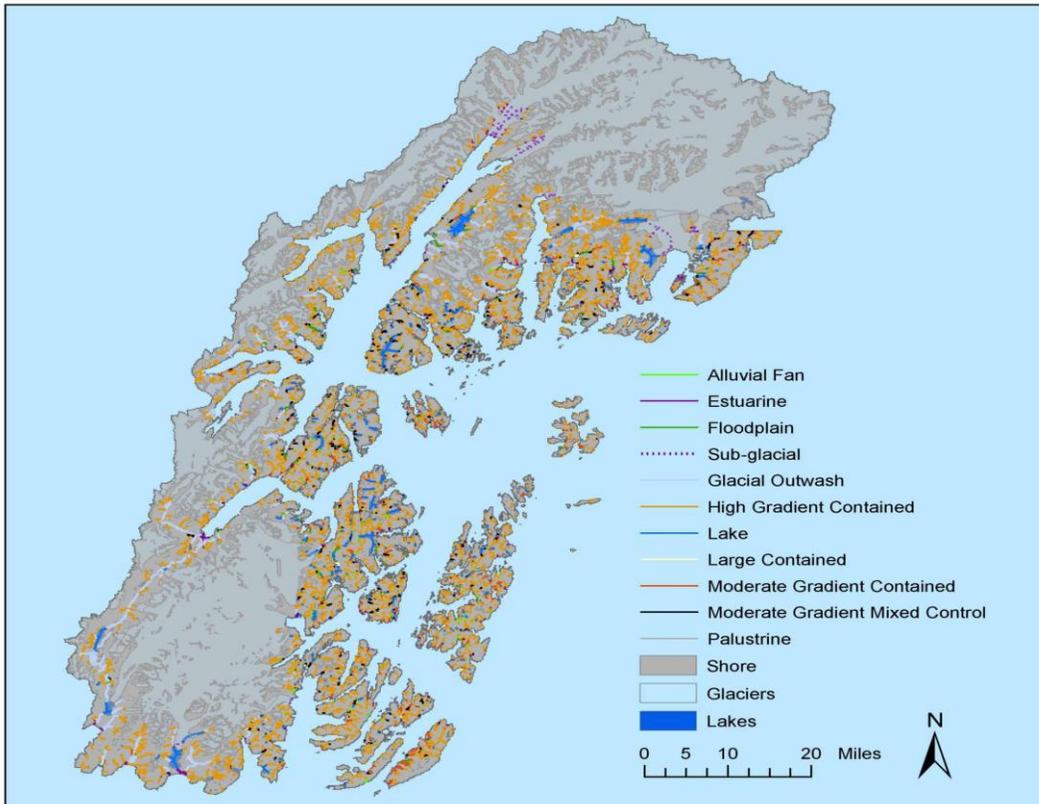


Figure 2.4: Channel Type process groups for streams in the WSLA analysis

Stream Flows

Because of the marine influence, heavy precipitation, and mild temperatures, streamflows in most of the small, low elevation drainages in western PWS are predominantly controlled by rainfall runoff. Snowmelt runoff generally occurs in April, May, and June, resulting in moderately high flows. However, peak flow events during fall rainstorms are generally larger than peak flows from snowmelt runoff (**Figure 2.5**). Large flood events can occur during any time of the year, but are most likely to occur during heavy rainstorms in the fall.

Streams draining the mainland can have a slight to great degree of glacial influence, depending on the percentage of the watershed that is glaciated. Glacially dominated streams experience peak flows in July or August, and flows are generally very low in the winter (**Figure 2.5**). Peak flow events can also occur as a result of late summer and fall rainstorms, and extreme events can be the result of heavy rainfall occurring simultaneously with high glacial runoff.

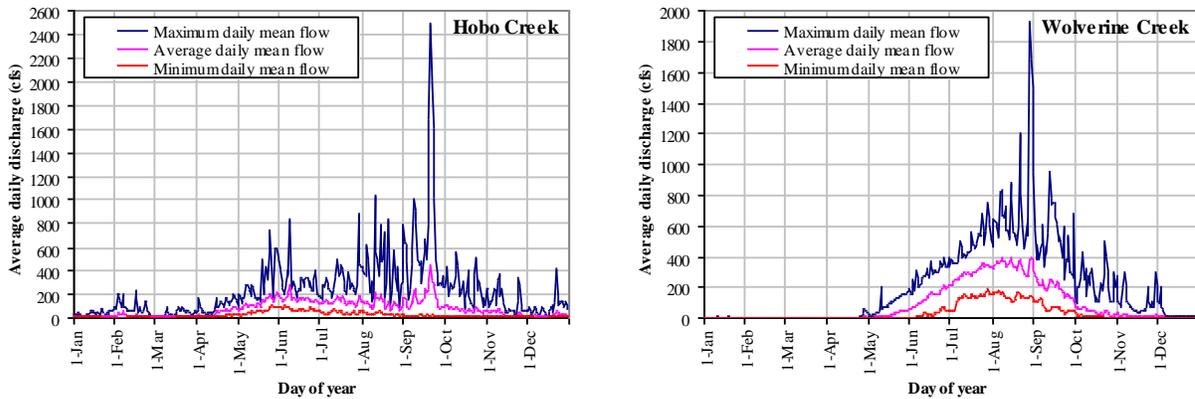


Figure 2.5: Average daily streamflows for Hobo Creek (non-glacial) and Wolverine Creek (glacial). Data from US Geological Survey (2005).

WETLANDS

Wetlands cover about 9% of the analysis area, located predominantly in the low elevation areas along the coast and on the islands with low relief. Palustrine wetlands, or wetlands associated with swamps, bogs, ponds, and floodplains, comprise about 80% of the wetlands in the area. Small amounts of estuarine, lacustrine, marine, and riverine wetlands also exist. Wetlands in western PWS are particularly susceptible to human impacts because human activities occur predominantly in low relief areas and along the coastline.

WATER QUALITY

In general, water quality in most of the WSLA area is very good, with nearly pristine conditions as a result of the backcountry character and limited development within the area. The small, non-glacial streams generally have very low sediment loads, but can increase greatly during large flood events. Sediment loads in glacial watersheds vary with the amount of glacial influence.

Human impacts on water quality are predominantly limited to the coastal areas, where most activities occur. Water quality may be impaired from residential and industrial pollutants in the area surrounding Whittier, as well as hatcheries and other industrial sites throughout western PWS. Oil residues from the 1989 Exxon Valdez Oil Spill remain in many of the beaches of western PWS. Tailings piles from the abandoned Granite Creek Mine are known to contain mercury and other heavy metals. Heavy metals likely exist in streams flowing through other abandoned mines in the area, and from naturally occurring mineral deposits.

BIOLOGICAL CHARACTERISTICS

Fish

Community Composition

Anadromous fish species documented in the assessment area include sockeye salmon (*Oncorhynchus nerka*), coho salmon (*O. kisutch*), chum salmon (*O. keta*), pink salmon (*O. gorbuscha*), chinook salmon (*O. tshawytscha*), Dolly Varden char (*Salvelinus malma*), and coastal cutthroat trout (*O. clarki clarki*) (Johnson et al. 2004). Resident fish species (non-anadromous) include coastal cutthroat trout, Dolly Varden char, threespine stickleback (*Gasterosteus aculeatus*), and sculpin (*Cottus* spp). An introduced population of rainbow trout (*O. mykiss*) is known to exist in a single lake on Culross Island.

Aquatic Habitat Characterization

Aquatic habitat in the analysis area ranges from highly productive estuarine channels located near the mouths of the larger streams to less productive high gradient upper valley channels found in the smaller tributaries and streams. Additionally, numerous lakes and ponds provide important spawning, rearing, and overwintering habitat for anadromous and resident fishes.

The numerous clear water streams and lakes in the WSLA area tend to provide the most productive aquatic habitat. Mid-slope, moderate gradient stream channels transitioning to low gradient flood plain and glacial outwash channels provide the most productive spawning habitat. However, steep terrain in the area tends to create migration barriers that restrict access to additional habitat. Many glacially turbid streams also occur in the area but their importance to fish populations and production is thought to be limited to primarily migration corridors to the more productive clear-water tributaries and lakes.

Lakes and ponds are critical for many of the anadromous and resident fish stocks in the WSLA area. Watersheds having accessible lakes tend to have greater fisheries diversity and production. As with the streams, both highly turbid and clear-water lakes are found throughout the area. Production potential in glacially turbid lakes can be low due to the inability of primary producers (phytoplankton, periphyton, and macrophytes) to absorb sunlight through the turbid waters. This, in turn, leads to a less productive forage base (zooplankton and aquatic invertebrates) for rearing juvenile and adult fish. However; glacially influenced Coghill Lake is highly productive and contributes the greatest number of naturally produced sockeye salmon to commercial fishing in western PWS even though its water clarity rarely exceeds six feet.

Riparian vegetation along the streams and lakes varies from alpine tundra at the headwaters of streams to lowland muskeg bogs closer to the marine environment. However, dense hemlock-spruce forests with an understory of alder, devil's club, salmonberry, and blueberry dominate most riparian zones in the analysis area. These hemlock-spruce forests are an important source of large wood recruitment into the streams and contribute complex habitat features beneficial to all life stages of resident and anadromous fish. The deciduous understory can provide additional overhanging stream cover during the summer months and is an important source of stream nutrients in the fall.

Fish Distribution¹

Pink salmon, followed by chum salmon, are the most widely distributed anadromous fish species in the area (Johnson et al. 2004). Because these two species commonly spawn in the lower reaches of streams and intertidal areas (Heard 1991), they are well adapted to the stream characteristics commonly found throughout western PWS; short and steep with most available spawning habitat close to the marine environment. Additionally, because their fry migrate to estuaries and bays shortly after emerging from the gravels, a lack of adequate freshwater rearing habitat is not as limiting to survival as it might be for other anadromous species.

Dolly Varden char are also widely distributed throughout western PWS (Currens et al. 2003). However; existing databases do not adequately reflect this because Dolly Varden char are more difficult to see in streams or lakes and are not usually target species for surveys. Therefore, they are often unnoticed and unreported to these databases.

Sockeye salmon are an important commercial and subsistence species in western PWS and are present in greatest numbers in watersheds associated with larger lakes. Lakes are typically important to stocks of sockeye salmon as juveniles can spend one to three years rearing in lakes before migrating to the marine environment (Burgner 1991). At least one lake (Davis Lake) has an introduced population of kokanee (landlocked sockeye salmon) (USFS, unpublished data). Anadromous fish do not have access into Davis Lake because of large in-stream barriers (falls) and this population appears to be the result of excess hatchery sockeye fry that were placed in the lake in the late 1980s (D. Reggiani, Prince William Sound Aquaculture, Cordova, personal communication). Marsha Lake, on the eastern side of Knight Island, has also received excess hatchery sockeye fry on at least two different occasions and it is suspected of having a kokanee population as well.

Because of similar life histories, coho salmon are likely to be found in the same watersheds as sockeye salmon in the assessment area. However, coho salmon tend to be more prevalent than sockeye salmon in non lake-fed streams. This species is not as important to the commercial fishery, but their aggressive nature makes them a popular target for sportfishing.

Threatened, Endangered, Sensitive, Invasive and Management Indicator Species

No federally listed threatened, endangered, or Region 10 sensitive freshwater fish species occur in the analysis area. A population of rainbow trout has been introduced to an unnamed lake on Culross Island. Whereas this species is native to many parts of Alaska, it is not known to occur naturally in western PWS. Atlantic salmon, not native to the west coast of the United States, have been identified in several streams in southeast Alaska. It is feared that this fish species may continue to expand further north in Alaskan waters, including PWS, if commercial fish farming continues in British Columbia.

Coho salmon and Dolly Varden char are Management Indicator Species (MIS) for the Chugach National Forest and both can be found throughout the analysis area. Coastal cutthroat trout are listed as a Species of Special Interest in the Forest Plan (USDA 2002a). Western PWS is thought to be the northern- and western-most range of this species and sporadic populations have been identified and documented in various streams and lakes in the WSLA area (Howse 1975; Gillikin 2000; Currens et al. 2003).

¹ Fish distribution information is based on existing data, which may have some limitations.

WILDLIFE

Western PWS is characterized by rugged coastal mountains, glaciers, sheltered waters, and forested islands which offer relatively pristine maritime habitats. Its collection of productive inter-tidal lands, estuaries, and mature coastal forests support a diverse assemblage of terrestrial and marine wildlife species. PWS provides essential habitat for thousands of seabirds, waterfowl, shorebirds and marine mammals, as well as habitat for upland birds and mammals. The wealth of abundant wildlife has drawn people to the area for thousands of years. As human activities in western PWS have changed, so has the distribution and abundance of wildlife populations.

In recent history, the *Exxon Valdez* oil spill (EVOS) in 1989 has been the most notable human-caused impact to the PWS ecosystem. Thirteen years after the spill, six injured species are considered to have recovered from the effects of the spill, while five are believed to still be recovering. Populations of eight species have shown little or no improvement and are listed as “not recovering,” while an additional four are in an unknown recovery status (*Exxon Valdez* Oil Spill Trustee Council 2002). Recent analyses of waterbird (seabird, waterfowl, and shorebird) survey data summarized by the USFWS in a report to the EVOS Trustee Council may change recovery status for a few species currently described as recovering (Sullivan et al 2004).

Recent concerns regarding an apparent increase in human activity may increase hardship for injured species recovering from the spill (Murphy et al. 2004). Similar concerns have been expressed for other species in this region (USDA Forest Service 2002b). The Whittier road, new in 2000, provides easy access to the western Sound for 73% of Alaska's population and serves an increasing number of visitors to Alaska. As a result, Whittier tourism patterns in the Sound have changed as cruise ships and glacier tour operators have altered their routes and added trips into this region. This improved access to a formerly remote location of the state may have significant consequences for wildlife populations in the Sound.

Wildlife Management Activities

The Chugach National Forest manages the majority of lands above mean high-tide line including beaches, rocky islets, coastal forests, estuaries, lakes and streams. According to direction within the Forest Plan: “The land areas and islands in Prince William Sound will continue to sustain much of the wildlife typical of Alaska.” Thus, management emphasis is on minimal disturbance to native wildlife populations. The majority of western PWS is currently a *Wilderness Study Area*, and under this prescription only very minor modifications would be made to wildlife habitat. Furthermore, management activities to encourage viewing of wildlife or enhancement of wildlife habitat are not permitted. If Congress accepts and acts upon Wilderness designation recommendations in the Forest Plan, approximately 35% of the WSLA area would be in a *backcountry* prescription which also severely limits potential habitat modification. Management activities to support wildlife viewing are allowed but must blend with the area's natural features.

Though the Chugach National Forest generally is not directly involved in the direct management of marine mammals and seabirds, the Forest Plan does define a number of restrictions with regard to human and management activities relative to concentrations of

these species. These restrictions for individual species and species groups are discussed later in this document.

Sport and Subsistence harvest

There is a significant amount of sport hunting in western PWS focused on two species: black bear and Sitka black-tailed deer. There is also a limited harvest of mountain goat, waterfowl, and river otter. ADF&G manages the sport harvest of large game species and furbearers in western PWS as unit 6D. Harvest regulations are available at: <http://www.wildlife.alaska.gov/regulations/pdfs/gmu6.pdf> . Harvest records for bear, deer, goats, and river otter are available through the Area Office in Cordova. Current sport harvest patterns for each species are discussed in a later section.

There has been a recent increase in commercial guided and non-guided hunting operations in PWS. The Glacier Ranger District (GRD) administered nine permits with hunting activity in western PWS in 2005, versus only five such permits in 2004. In addition there are an unknown number of transportation and water taxi operators serving hunters in PWS. During 2005, ADF&G Area Biologist Dave Crowley requested that three applications from operators applying for Special Use Permits for commercial black bear and mountain goat hunting operations not be granted by GRD, stating concern about increased level of harvest for these two species in western PWS.

Subsistence harvest is an important part of the rural Alaskan lifestyle. It is widely recognized in Alaskan land and wildlife management that subsistence harvest provides irreplaceable cultural, spiritual, personal, and sustenance value. Alaska National Interest Lands Conservation Act (ANILCA) requires the Forest Service to consider the effect of any management activities on subsistence (USDA Forest Service 2002a). People in the native community of Chenega Bay partake in a variety of subsistence harvest activities in western PWS. Fish and marine mammals comprise the majority of subsistence resources taken but there is also significant use of terrestrial species including Sitka black-tailed deer, black bear, mountain goats, waterfowl, seabirds, river otters and mink (Stratton et al. 1986, Fall et. al. 1999). A tightly limited subsistence harvest for moose within King's Bay exists exclusively for the residents of Chenega. The Division of Subsistence within ADF&G maintains records of systematic household surveys for communities, including Chenega Bay, reporting subsistence harvest within the Community Profile Database (Scott et al; 2001) which is available online at: <http://www.subsistence.adfg.state.ak.us/geninfo/publctns/cpdb.cfm>.

There is growing concern within the community of Chenega Bay that increased competition from sport hunting and commercial harvest from individuals from outside of Alaska may impact their ability to maintain a subsistence lifestyle (J. Fall, Division of Subsistence, personal communication with A. Poe).

Wildlife Viewing

Nationwide, wildlife viewing has become the number one reported reason for visiting National Forests (USFS National Visitor Use Monitoring), and with its high quality for potential wildlife viewing experience, the Chugach National Forest is no exception to this trend. PWS attracts increasing numbers of Alaska residents as well as visitors to our state who are interested in viewing the remarkable wildlife in this region. The unique species and encounters made possible by the relatively pristine environment of western PWS have intensified interest from both private recreationists and commercial operators

catering to clients from across the globe (Colt et al. 2002). The vast majority of commercial operators in western PWS sell their services with emphasis on wildlife viewing opportunities.

Though often viewed as benign, activities associated with wildlife viewing have been shown to have negative consequences for species related to reproduction, feeding, care for young, and mating systems. Impacts range from direct immediate harm to eventual cumulative impacts as species are exposed to constant disruptive activity (Liddle 1997). Species dependent on near-shore marine waters and intertidal habitats are of special concern in western PWS (Murphy et al. 2004).

Wildlife Research

As a result of the Exxon Valdez oil spill (EVOS) a tremendous amount of research, monitoring, and analysis of wildlife populations has been conducted by a variety of federal and state agencies, universities, and private organizations. Understandably, the majority of this research has primarily focused on species dependent on marine and intertidal habitats. Distributions and important areas for marine mammals, seabirds, waterfowl, eagles, and shorebirds have been fairly well characterized (NOAA 2001). EVOS research within PWS has also produced a community of scientific experts with detailed knowledge regarding the wildlife species and ecosystems of western PWS. As a result a number of systematic wildlife monitoring efforts have been established in western PWS. Complete details of studies funded by the EVOS Trustee council can be accessed at: <http://www.evostc.state.ak.us/publications.html>. The western Sound's reputation as a natural biological laboratory, coupled with concern for its pristine resources, continues to fuel an active research effort. Studies investigating continuing effects of oil pollution are joined by those investigating ecological and management questions about the area's wildlife species.

Areas of Biological Significance

The National Oceanic and Atmospheric Association (NOAA) conducted an assessment of environmental sensitivity to future oil spill events within PWS. The resulting Environmental Sensitivity Index is generally considered the most comprehensive collection of information regarding spatial extent of biological resources within PWS. The vast majority of wildlife resources described by this document and its associated GIS layers are those associated with nearshore and intertidal areas. It includes concentration areas for marine mammals, seabirds, waterfowl, shorebirds, and bald eagles. Concentration areas for marine mammals are represented as polygon features for both whales and sea otters. Marine mammals depicted as point features include pinnipeds (seals and sea lions), whales, and sea otters. These points include 38 major haulout sites for harbor seals and five for Steller sea lions. Bird concentration area polygon features are included for: resident and migratory waterfowl; shorebirds; and colonial waterbird nesting sites (for seabirds and shorebirds). Coverages for western PWS include information for 182 seabird colony and 853 bald eagle nest sites (NOAA 2001). A complete atlas of maps, GIS coverages, and metadata is available for this assessment by request at: <http://archive.orr.noaa.gov/esi/pdfs/PWS.pdf>

Another important analysis to identify important biological areas in PWS was completed by the National Wildlife Federation (NWF) in collaboration with the National Audubon Society and several researchers from the USFWS, ADF&G, and the University of

Alaska. NWF held a workshop attended by 29 biological experts for PWS. The results of this workshop include the identification of seven coastal areas recommended for conservation within western PWS (NWF 2002). Locations were selected and prioritized based primarily on marine and intertidal fish and wildlife assemblages. These areas are listed here in priority suggested by workshop participants:

- 1) Prince of Wales, Erlington and Latouche Passages
- 2) Naked , Peak, Storey, Smith, and Little Smith Islands
- 3) Knight Island Passage including: Nassau Fjord, Icy, Jackpot, and Whale Bays
- 4) Harriman Fiord and Barry Arm
- 5) Columbia Bay, Heather Island, and Chenega Bay
- 6) Unakwik Inlet including: Wells, Cedar, Granite, and Fairmount Bays as well as Fairmount and Little Fairmount Islands
- 7) Eshamy Bay and Lagoon

Complete descriptions of the biological resources supported by each area as well as location maps are available in the proceedings from the Biological Hotspots Workshop Report at: <http://www.nwf.org/princewilliamsound/>

Species of Concern

The EIS completed for the Forest Plan contains a list of species which should be considered under any proposed management action (Table 2.2). Threatened and Endangered species are those currently protected under the Endangered Species Act. Sensitive species are those designated by the Regional Forester on Alaska's National Forests as species with potential viability concerns. These three types of species are grouped in the category (TES) in Table 2.2. Management indicator species (MIS) were selected during the Forest Planning process because their habitat requirements serve to indicate the outcome of possible management options implemented for many species with similar habitat requirements. Species of special interest (SSI) were selected because they have habitat requirements that are narrow enough that they may not be fully covered under a coarse filter approach, or because interest in them by the public or by land managers is best treated by highlighting them separately from other species (USDA Forest Service 2002b).

Table 2.2. The Management Indicator species (MIS), Threatened, endangered, or sensitive species (TES), and Species of Special Interest (SSI) are defined in the Chugach National Forest Revised Land and Resource Management Plan (USDA Forest Service 2002b).

Species	Scientific Names	MIS	TES	SSI
Brown Bear*	<i>Ursus arctos</i>	X		
Black Oystercatcher	<i>Haematopus bachmani</i>	X		
Moose*	<i>Alces alces</i>	X		
Mountain Goat	<i>Oreamnos americanus</i>	X		
Marbled Murrelet	<i>Brachyramphus marmoratus</i>			X
River Otter	<i>Lutra canadensis</i>			X
Gray Wolf	<i>Canis lupus pambasileus</i>			X
Lynx	<i>Lynx canadensis</i>			X
Sitka Black-tailed Deer	<i>Odocoileus hemionus sitkensis</i>			X
Townsend's Warbler	<i>Dendroica townsendi</i>			X

Wolverine	<i>Gulo gulo</i>			X
Bald Eagle	<i>Haliaeetus leucocephalus</i>			X
Humpback Whale (Endangered)	<i>Megapteris novaeangliae</i>		X	
Steller Sea Lion (Endangered)	<i>Eumetopias jubatus</i>		X	
Steller's Eider (Threatened)	<i>Somateria fischeri</i>		X	
* Populations of this species are only known from King's Bay which is connected by the Nellie Juan River corridor to populations from the interior Kenai Peninsula.				

Threatened, Endangered, and Sensitive Species (TES)

Humpback Whale

The humpback whale is the most abundant of the eight endangered species of whales that occur in southcentral Alaskan waters. Humpback whales are regularly sighted in PWS (NMFS 1991). Peak numbers of humpback whales are usually found in nearshore waters during late August and September, but substantial numbers usually remain until early winter. Concentration areas have been identified within western PWS (NOAA 2001). The Forest Plan specifies that all management activities will comply with requirements of the Endangered Species Act, Marine Mammal Protection Act of 1972 and their implementing regulations as well as other applicable federal and state laws and Forest Service Policy. Specific regulations for approach distances relevant to wildlife viewing activities are available at: <http://www.fakr.noaa.gov/protectedresources/mmv/guide.htm>

Steller Sea Lion

Populations of this species have declined in southcentral Alaska, but are fairly stable in southeastern Alaska (NMFS 1992). Steller sea lion habitat includes marine and terrestrial areas that are used for a variety of purposes. Sea lions use haulouts on suitable beaches or rock outcrops. Adults also congregate at rookeries for pupping and breeding. Rookeries generally are located on relatively remote islands, often in exposed areas where access by humans and mammalian predators is difficult. Locations for five critical haulout sites in western PWS have been identified, including: S. Glacier Island; NE. Perry Island; N. Eleanor Island; Pleiades Islands; and SW Elrington Island (NOAA 2001). In addition to the requirements stated above for Humpback whales, the Forest Plan also recommends the separation of all human activities 750 feet from any hauled out sea lion to avoid disturbance.



Figure 2.6. Sea Lion Haulout on Glacier Island

Steller's Eider

The Steller's Eider breeding distribution is restricted to the North Slope and western Alaska. It winters in near-shore marine waters in western and southcentral Alaska.

Nothing specific is known regarding winter concentration areas within western PWS for this species.

Management Indicator Species (MIS)

Black Oystercatcher

The Black Oystercatcher is one of the most abundant species of shorebirds in the Prince William Sound-Gulf of Alaska region (DeGange and Sanger 1986). Oystercatchers are dependent on marine shorelines for their life requirements and are most abundant along low-sloping gravel or rocky shorelines (Andres 1998). The entire world population is estimated at about 11,000 individuals. More than 50% of that population occurs in Alaska and about 1,500-2,000 individuals reside in south coastal Alaska (Andres and Falxa 1995). Population trends for Black Oystercatchers throughout their range are unknown; however within PWS the populations are described as “recovered” from the effects of the Exxon Valdez oil spill in 1989 (EVOS Trustee Council 2002). Systematic, boat-based surveys have been conducted over the past 15 years to monitor waterbird populations in PWS. Data from these surveys has been used to investigate population trends within Black Oystercatchers. Recent analysis showed no trend toward recovery for this species (Sullivan 2004).

Continual disturbance from human activities is the greatest threat to breeding Black Oystercatchers. Disturbance often prevents pairs from nesting or causes them to abandon their nest sites (Andres 1998). Management of human induced disturbances may be increasingly important as human activity in western PWS increases. Protection of areas with exceptionally high nesting densities in PWS will be important to maintain current population levels (Poe and Murphy 1999). Biologists from the USFWS and USFS have completed five years of oystercatcher shoreline surveys and have identified 105 nesting territories on shorelines and islets within western PWS (Andres and Poe 2001, Poe 2003, Brown and Poe 2003). Forest Plan direction recommends that concentrated human activity be kept at a distance of >330 feet from Black Oystercatcher nesting territories from April through July (USDA Forest Service 2002a).

Brown Bear

This species has an extremely limited distribution within western PWS. Populations from the interior Kenai Peninsula apparently disperse to the head of King’s Bay, where individuals are seen with some regularity. The Kenai Peninsula brown bear has been the subject of study for approximately 20 years, culminating in a Conservation Assessment of the Kenai Peninsula Brown Bear (Interagency Brown Bear Study Team 2001) and various journal articles in press (e.g., Suring et al. 2002). The significance of individuals observed in King’s Bay to the overall population of the Kenai is not clear.

Forest Plan direction requires managers to monitor population trends of brown bears and habitat relationships over time in collaboration with the Interagency Brown Bear Study Team. Specific direction was developed for management of brown bears and their habitats on the Kenai including: (1) maintenance of forest cover within 750 feet of important feeding areas and (2) locating long-term concentrated human activities away from important seasonal brown bear concentrations (USDA Forest Service 2002a).

Moose

Similar to brown bears this species has an extremely limited distribution within western PWS. As with the bears it is thought that populations from the interior Kenai Peninsula disperse into this area. Moose are native to the Kenai Peninsula (Nowlin 1996). The population on the Kenai Peninsula is approximately 7,000 – 9,000 moose, with about 1,000 of these on the Chugach National Forest (USDA Forest Service 2002b). Moose populations on the Forest currently appear to be stable (USDA Forest Service 1999c). The population within King’s Bay was estimated to be less than 20 animals during the late 1990s based on an aerial survey conducted by ADF&G and USFS (USFS unpublished data). A very limited subsistence hunt exists for the residents of Chenega Bay and Tatitlek.

Forest Plan direction requires managers to monitor population trends of moose and changes in habitat relationships, and to assess how Forest activities change the availability, amount, and quality of habitat. No specific Standards and Guidelines have been developed for management of moose (USDA Forest Service 2002a).

Mountain Goat

Mountain goats are endemic to mountains on the mainland in western PWS and to Bainbridge, Culross and Knight Islands (Beaglehole 1966). In the past, goat populations have fluctuated throughout PWS as a result of harvest pressure, severe winters and predation (Griese 1988a, Reynolds 1981). In response to declining populations and low recruitment, ADF&G reduced harvest levels in PWS (Nowlin 1996). As a result of reduced harvest and mild winters the population had rebounded to approximately 4000 goats as of 1999. Since 1998 goat populations in western PWS have declined slightly and continued to do so through 2004 (Crowley 2004).

Harvest of goats in PWS is managed as a restricted draw permit hunt and many areas of PWS have been subject to emergency closures in recent years. The majority of the WSLA area is currently closed to goat hunting (**Figure 2.7**). Recent results from 2004 show that most successful hunters were nonresidents and that hunter success averaged 50%, which was within the normal range during the last 5 years. In general September and October were the most productive months. Boats and airplanes were the primary means of access to goat populations in western PWS (ADF&G 2004).

ADF&G monitors goat populations within western PWS in cooperation with biologists from the USFS based out of Cordova. They use a combination of methods involving close monitoring of hunter success and systematic flight surveys of goat populations in western PWS which have been conducted at regular intervals for over 10 years. Data regarding goat populations within western PWS, as well as the current the status of goat populations, are available from ADF&G’s annual management reports at:

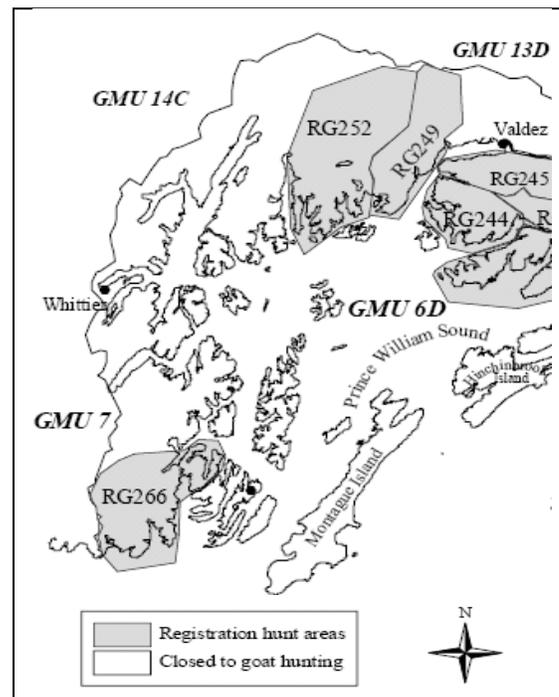


Figure 2.7. ADF&G Game Management unit 6D for registration hunts permitted in 1998-2003 (adapted from Figure 1, p. 90, ADF&G 2004).

http://www.wildlife.alaska.gov/pubs/techpubs/mgt_rpts/04goamt.pdf. A comparatively smaller amount mountain goats are also harvested by subsistence users in western PWS.

In addition to sensitivity to harvest pressure, mountain goat populations have been shown to have sensitivity to a variety of recreation activities (Oliff *et al.* 1999, Claar *et al.* 1999). Of specific concerns in many regions are this species' potential to be disturbed by low-level aircraft overflights (Goldstein *et al.* 2005, Foster and Rahe 1984, Cote 1996.). The Forest Plan specifies two guidelines regarding management activities related to goats: (1) locate concentrated human activity at least one mile from important wintering and kidding habitat; and (2) Forest Service permitted aircraft shall maintain at least a 1500 feet separation distance from goats and shall not land within ½ mile from observed goats (USDA Forest Service 2002a). At this time, specific important habitat for goats has not been identified in western PWS.

Species of Special Interest (SSI)

Gray Wolf, Lynx and Wolverine

Nothing specific to gray wolf, lynx, or wolverine populations are known from western PWS. It is generally believed that sustained populations of wolves do not exist in PWS, though occasionally individual sightings are reported. Wolverines are distributed throughout western PWS but nothing specific is known with regard to their populations. Harvest of this species is allowed within unit 6D according to ADF&G regulations but numbers taken are very low to zero (D. Crowley, ADF&G pers. com.). Lynx are known to exist in western PWS but sightings are very rare. Subsistence records from Chenega indicate a minimal historical harvest (a few individuals) of lynx and wolverine (Stratton *et al.* 1986).

Marbled Murrelet

Recent surveys suggest that Marbled Murrelets are numerous and widespread throughout the coastal waters of Alaska, with estimates of 100,000 occurring in PWS (Kuletz 1997). Population trends within the Chugach National Forest are generally downward for the long-term, with a 67 percent decline since surveys were done in 1972 and 1973, but have been stable since 1990 (Kuletz 1997). The murrelet population was injured by the *Exxon Valdez* oil spill. The population in the oil spill area was considered to be recovering (EVOS Trustee Council 2002) but a recent report to the EVOS Trustee Council summarizing 15 years of waterbird survey data in PWS states that there was “no trend toward recovery” for this species (Sullivan *et al.* 2004).

River Otter

River otters are common residents of coastal Alaska and occur throughout the Copper River Delta, PWS, and along the Kenai Peninsula. The river otters in PWS were considered a resource damaged by EVOS but were listed as recovered in 1999 (EVOS Trustee Council 2002). There is a concern that management for developed recreation within PWS may affect river otter populations (USDA Forest Service 2002b). Based on this stated concern the CNF partnered with the University of Wyoming, ADF&G, and Kenai Fjords National Park to establish baseline information on the distribution, relative abundance, and minimum-number-alive of river otters in PWS (Ben-David *et al.* 2004).

Sitka Black-tailed Deer

This species was introduced to Hinchinbrook and Hawkins Islands in 1916 as a game species and spread throughout PWS. It is believed that their densities in western PWS are relatively lower compared to populations in eastern PWS (Crowley 2003). Sitka black-tailed deer have been hunted in PWS since 1935 and are harvested in greater numbers than any other game species in PWS. The majority of harvest has historically occurred in the eastern PWS and barrier islands with only limited numbers taken from the islands and mainland shoreline of western PWS. ADF&G presently manages this population to sustain an annual harvest of at least 1500 individuals; 2641 were harvested in 2002. Harvest effort is split evenly between PWS residents and non locals and an average of 1.5 deer are taken per hunter. Hunters primarily use boats and airplanes to for access (Crowley 2003) and harvest occurs primarily in the fall (September – November).

Townsend's Warbler

Nothing comprehensive is known regarding Townsend's warbler populations or habitats within western PWS. Breeding individuals have been detected on survey routes within the analysis area (USDA Forest Service unpubl. data).

Bald Eagle

North America's Bald Eagle population reaches its highest density in southeast Alaska. Nesting habitat is primarily old-growth trees along the coast and within riparian areas. Summer populations in PWS have been estimated at 5,000 individuals, including 1,800 to 2,000 pairs (ADF&G 1975, Bowman et al. 1993). Nest locations in western PWS were collected during aerial and boat based surveys supporting EVOS monitoring efforts in the 1990s. The biological database assembled by NOAA (2001) describes 853 individual nests. Recent surveys have not been conducted to evaluate actual occupancy of these previously identified sites. Recent analysis of population surveys conducted over the past 15 years has documented an increasing trend in bald eagle population within PWS (Sullivan et al 2004).

Grubb and King (1991) found that pedestrians (hiker, anglers, and hunters) were the most disruptive type of human activities to Bald Eagles. The active Bald Eagle nesting season is generally from March 1 to August 31 (USDA Forest Service 2002b). It is not clear what level of shoreline activity during this time period may impact the success of nesting Bald Eagles in western PWS. The Forest Plan requires adherence to Bald Eagle nest protection standards established in an interagency MOU between USFWS and Alaska Region USFS. Specifically those standards call for a 330 foot retention zone from potentially disruptive land management activities between March and August.

Other Species of Concern

Populations of these species are discussed in relation to western PWS as a result of national, state, regional or Forest monitoring direction or are a locally important species.

Landbirds

This group represents primarily passerine or songbird species dependent on terrestrial habitats during all life phases. Many members of this group include long distance, or neo-tropical migrants whose populations are a national conservation priority. Currently there is nothing comprehensive known regarding landbird populations in western PWS. In cooperation with Boreal Partners in Flight, the GRD has conducted limited landbird inventory work in Passage Canal, Harriman Fiord, Port Nellie Juan, and Port Bainbridge

under the Alaska Off-road Breeding Bird Survey and has established a single permanent landbird monitoring plot under the Alaska Landbird Monitoring System in Bettles Bay. Survey objectives, methods and resulting data from these surveys are available on the Boreal Partners in Flight: <http://www.absc.usgs.gov/research/bpif/monitor2.html>

Waterfowl

The protected waters of western PWS offer excellent habitat for a variety of marine birds including many species of waterfowl (Isleib and Kessel 1973). The waters of PWS are of primary importance for sea ducks during winter when migratory species congregate in its protected waters. The National Wildlife Federation summarized data collected by ADF&G and USFWS and stated that sea ducks in PWS include “harlequin, goldeneye, surf scoter, black scoter, white-winged scoter, oldsquaw and bufflehead total over 80,000 birds in winter, but only 13,000 in summer.” (NWF 2002).

The EVOS Trustee Council recognizes a single species, the Harlequin Duck, to have been harmed by the oil spill and this species is still described as “not recovered” (EVOS Trustee Council 2002). Data from surveys conducted by ADF&G during the 1990s was used to delineate specific winter concentration areas in western PWS (NOAA 2001). Systematic, boat-based surveys have been conducted over the past 15 years to monitor waterbird populations in PWS. Data from these surveys has been used to investigate trends within waterfowl species. Recent analyses show “goldeneyes” to exhibit trends consistent with continuing oil spill effects, and Harlequin Ducks, Scoters, Buffleheads and Mergansers exhibiting no trend toward recovery (Sullivan et al 2004).

There is an unknown level of waterfowl harvest in western PWS with activity focused during September and October. Some sea duck hunting occurs near Whittier and further harvest is known to occur in the Coghill flats in east College Fiord (D. Crowley, ADF&G pers. com. Tom Rothe, ADF&G pers. com.). There is also some amount of subsistence harvest from Chenega residents (Statton et al. 1986). There is little likelihood of human-caused direct waterfowl habitat alteration within the analysis area. Potential exists for disturbance to molting ducks in late summer in areas where large rafts of individuals congregate within areas popular for kayaking, recreational boating, and commercial tour operations. Specific concern for disturbance to Harlequin Ducks in molting areas between July and August is stated by the Forest Plan. Furthermore, direction in the Forest Plan recommends a minimum distance of 330’ from human activities on the ground and waterfowl intertidal concentration or nesting areas between May and June and September and November (USDA Forest Service 2002a).

Seabirds

The rocky islets, estuaries, beaches and cliffs of western PWS host huge populations of seabirds of many species. The National Wildlife Federation summarized data collected by USFWS and stated that: “In descending order of abundance, they are murrelet (82,000), black-legged kittiwake (48,000), glaucous-winged gull (25,000), fork-tailed storm petrel (16,000), mew gull (14,000), tufted puffin (5,000), arctic tern (4,900), murre (3,300), and pigeon guillemot (3,000). In winter some of the seabird populations in the Sound increase dramatically (the murre population goes from 3,300 to over 46,000), while others decrease by as much as half (murrelet) and still others leave altogether (kittiwake).” (NWF 2002).

More species of seabirds were injured by the EVOS than any other taxonomic group. The Trustee Council currently recognizes seven species including: the Common Murre, three species of cormorants, Pigeon Guillemots as well as Marbled and Kittlitz's Murrelets (EVOS Trustee Council 2002). Systematic, boat-based surveys have been conducted over the past 15 years to monitor waterbird populations in PWS. Data from these surveys has been used to investigate trends within seabird species. Recent analyses suggest Black-legged Kittiwakes, Mew Gulls, Glaucous-winged Gulls, "terns," Pigeon Guillemots, "murrelets" and "murre," exhibited trends indicative of no recovery since the oil spill (Sullivan 2004). NOAA (2001) identified 182 seabird colonies within western PWS. The USFWS has also irregularly conducted counts of targeted colonies within western PWS (S. Stephenson, USFWS pers. com).

A number of studies have documented disturbance impacts to seabird colonies as a result of human activity (Rodgers and Smith 1995, Thompson et al. 1998, Hirons and Thomas 1993). The Forest Plan states: "Human activities may be restricted from known seabird colonies consistent with the Migratory Bird Treaty Act during the sensitive seasons (Mid-April through October). Specific requirements will be determined in cooperation with the U.S. Fish and Wildlife Service during project analysis."

Kittlitz's Murrelet

The Kittlitz's Murrelet is a diving seabird of relatively low abundance found only in Alaska and eastern Siberia. PWS hosts 15-20% of the known Alaska population (USFWS 2003). In PWS, marine bird surveys indicated an 84% decline in Kittlitz's Murrelets from approximately 6400 birds in 1989 to 1000 birds in 2000 (Kuletz et al. 2003). This species is generally associated with tidewater glaciers and at one time was distributed throughout PWS, but its distribution in the Sound is now primarily limited to the few areas of active tidewater glaciers within the WSLA study area. These remaining population centers are in: College Fiord, Harriman Fiord and Barry Arm, Blackstone Bay, Port Bainbridge, and Columbia Bay (Kuletz et al 2003).

Recent data indicate that several glaciers in the northwest region of PWS are now stagnating or retreating, likely due to global warming (Arendt et al. 2002), which in turn might result in further declines in the Kittlitz's Murrelet population. In addition this species is confronted with oil spills, incidental take in gillnets, and possibly disturbance from increased boat traffic near tidewater glaciers (Day et al. 1999, 2003, USFWS 2003).

Harbor Seal

Harbor seals are widely distributed throughout western PWS but tend to concentrate in areas around haulout sites. Harbor seals were historically declining throughout the Gulf of Alaska, including PWS, and were negatively impacted by the Exxon Valdez oil spill. In oiled areas, harbor seal populations declined by 43 percent. The species is described as "not recovered" according to the most recent assessment of the EVOS Trustee Council (EVOS 2002). The locations of 38 haulout sites in western PWS were digitized by Murphy et al. (2004) using data supplied by ADF&G, Living Resources Inc., and NOAA. These locations as well as polygons representative of concentration areas are included in GIS layers created by NOAA (2001).

Harbor seals, like other marine mammals, have documented sensitivity to human disturbance (Renouf et al. 1981, Richardson et al. 1995). Harbor seals are protected under the Marine Mammal Protection Act and as such have similar regulations to sea lions

regarding human approach. A guideline within the Forest Plan recommends the management of human activity within 750 feet of haulout sites and pupping areas between mid-May and October (USDA Forest Service 2002a).

Black Bears

Black bears are common throughout PWS with the exception of Montague, Hinchinbrook, and several smaller islands. The highest density of black bears is in the western half of PWS. Modafferi (1978) roughly estimated densities of 0.5 bears/km² in western PWS. Black bear management and conservation is of concern to wildlife managers because of historically high harvests due in part to convenient and improving access into PWS from population centers through Whittier.

Hunting pressure continued to increase through the 1990s and peaked in 2001 when 435 bears were taken and has remained below 400 bears in subsequent years. Most bears were taken in May during the past 5 years (Crowley 2005). Over the last 10 years, black bear hunters have spread throughout PWS because of increasing numbers of transporters, more efficient engines, and inexpensive GPS units. Most black bears are taken by non-local Alaska residents (Crowley 2005). In response to these concerns, the Alaska Board of Game, beginning in 2003, prohibited the shooting of bears from boats in Unit 6d in order to reduce wounding loss. In 2005, the Board reduced the spring season by 20 days (closing on June 10 rather than June 30 as in previous years) to further reduce harvest levels.

Commercial operations under Special Use Permit in western PWS which are dependent on wildlife viewing opportunities have expressed concern about what they see as a decreasing number of bears using shorelines in western PWS. Concerns have also been expressed regarding user conflicts between bear hunters and other recreationists. The practice of bear baiting during the harvest season has generated concerns for public safety in areas used by other groups. In response to these concerns ADF&G has eliminated bear baiting from Blackstone Bay as well as Harriman Fiord and Barry Arm beginning in the 2006 regulatory year. Bear baiting is also not allowed to occur within 1 mile of any developed site within PWS including USFS cabins, USFS and State hardened campsites and permanent research camps.

VEGETATION

The mountainous and rugged terrain of the WSLA area is predominantly covered with ice, snow, and rocks. Huge ice fields, snowfields and glaciers form a nearly continuous matrix over these mountains and some glaciers run all the way to tidewater. Vegetation is generally limited to the coastal fringe, major riparian areas, and other low elevation areas. Shoreline habitats transition rapidly from beach habitat to a temperate rainforest intermingled with muskeg vegetation. Forests are dominated by Sitka spruce, mountain hemlock, and western hemlock. Yellow cedar occurs in the northeast part of the WSLA area. Alder and salmonberry dominate avalanche chutes. In forested areas, common understory species include blueberry, salmonberry, devil's club, rusty menziesia, copper bush, yellow skunk cabbage, wood fern, deer fern, lady fern, oak fern, bunchberry, fiveleaf bramble, and foam flower. Common species of shrublands and herblands include: salmonberry, crowberry, bog blueberry, bog cranberry, deer cabbage, luetkea,

cotton grass, few-flowered sedge, many-flowered sedge, sphagnum mosses, tufted hairgrass, beach rye, and seaside sandplant.

Distribution and structure of plant communities have developed in response to climate, landform, natural processes such as avalanche, insects and wildfire, and past and existing land uses. Because much of the landscape area is relatively undisturbed by human activities, the distribution of plant communities has not been heavily influenced by human uses. Glaciation, avalanches, landslides, flooding, and other natural processes appear to be the major disturbance processes affecting the current patterns and distribution of the various cover types.

Vegetation Composition

Information on existing vegetation in western PWS is limited. The most up-to-date and complete GIS layer is the Landcover Classification (Markon et al 1996). This coverage is a satellite image based classification (**Figure 2.8**). Each 30-meter pixel was assigned to one of 25 classes, which basically follow the first three levels of the five-level hierarchy of Viereck et al. 1992. The major limitation with this coverage is the lack of field verification of the cover types. Fifteen of the 25 classes are found in western PWS (**Table 2.3**).

Landcover Class	Percent
Forest-Needleaf-Closed	12%
Forest-Needleaf-Open	1%
Forest-Needleaf-Woodland	4%
Forest-Broadleaf-Closed	1%
Total Forest	18%
Scrub-Dwarf_Tree-Open	1%
Scrub-Tall_shrub-Closed	6%
Scrub-Low_shrub-Closed	5%
Scrub-Low_shrub-Open	2%
Total Shrub	14%
Herb-Graminoid/Forb-Dry/Mesic	4%
Herb-Graminoid/Forb-Wet	1%
Total Herbaceous	5%
Water-Salt-Turbid	2%
Total Water	2%
Barren-Unconsolidated or Bedrock	6%
Other-Ice/Snow/Clouds	50%
Other-Shadow	4%
Other-Sparsely Vegetated	1%
Total Non-Vegetated	61%

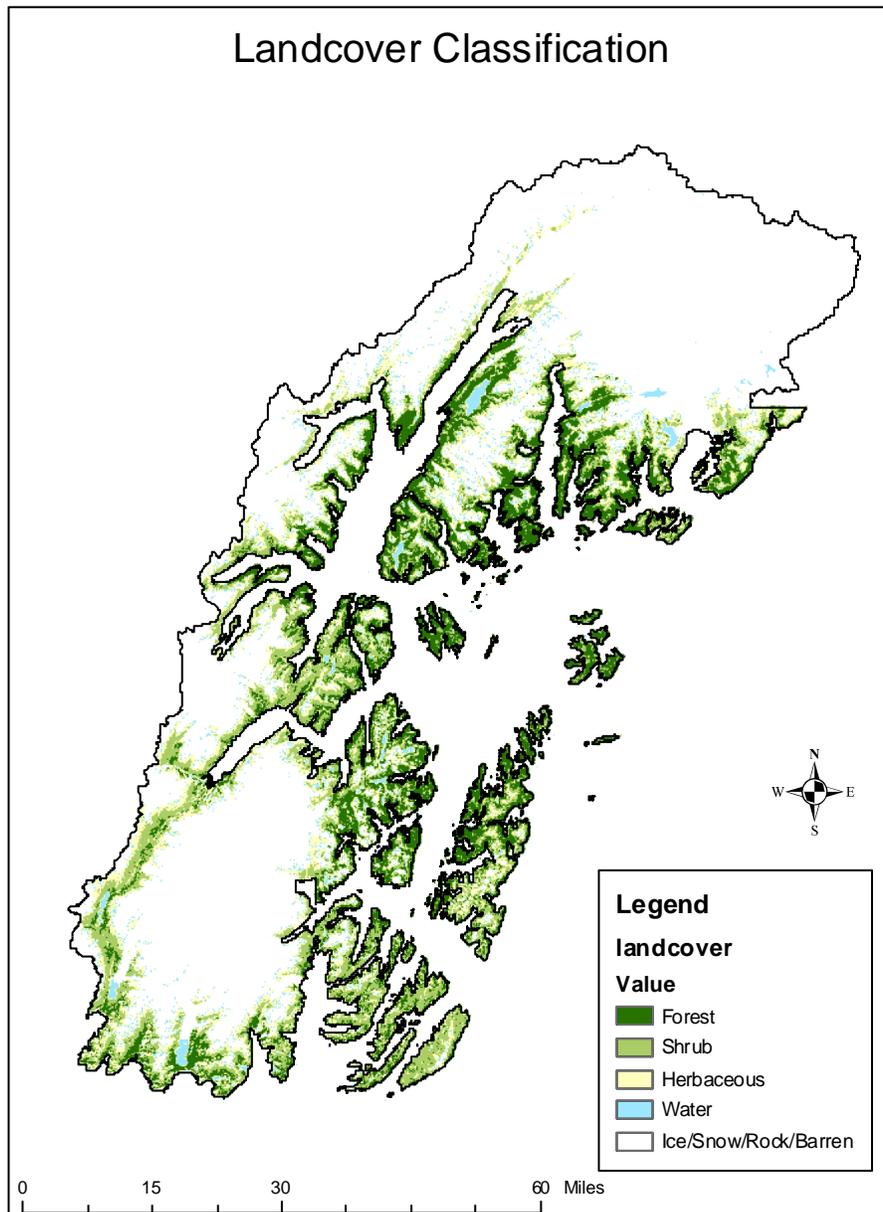


Figure 2.8. Landcover Classification.

Non-Native Plants

The introduction and spread of invasive plant species is a growing concern in Alaska. Baseline abundance and distribution information on invasive plants is needed to assess the magnitude of the problem, determine potential locations for control treatments, and monitor changes in plant populations. Existing surveys on the Chugach National Forest (DeVelice et al. 1999; DeVelice 2003; Duffy 2003) found that most areas of invasive plant occurrence on the Forest are presently in areas of intensive human-caused disturbance such as road edges, visitor facilities, trailheads, and trails. Invasive plants are

presently rare within natural communities on the Forest. Owing to the relative rarity of invasive plants in the area, land managers of the Chugach National Forest are in a unique position to prevent invasive plant problems before they occur. Prevention is generally much cheaper than control and identifying outbreaks early and responding to them quickly can reduce costs.

In general, the likelihood of non-native plants occurring in the WSLA area should be very low due to the remoteness of the area, difficult means of access, and wilderness study area status. However, non-native plants are present in the area, which is a concern. Existing surveys for non-native plants in PWS are limited to along trails, recreation cabins, as well as 26 beach sites that were closely examined from 2003-2005 for plant species composition. These surveys reveal that presence of non-native plant species occurs in areas with high human use. For example, all the recreation cabins had extensive populations of *Poa annua* (annual bluegrass). *Plantago major* (plantain) was found at Shrode Lake cabin. Annual bluegrass was also found at a dispersed campsite at Willard Island in Blackstone Bay. Both the annual bluegrass and plantain are on the State of Alaska list of restricted noxious weeds. In addition, a site in Pigot Bay has a small population of Icelandic poppy (*Papaver nudicaule*) which was inadvertently planted as part of a revegetation project along a spawning channel. With an increase in human use, the potential for further introduction and spread of non-native plants would likely increase.

Rare Plants

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 western PWS.

Nineteen vascular plants are designated as sensitive in the Alaska Region. Of these, the following 11 species are known or suspected to occur on the GRD of the Chugach National Forest:

Eschscholtz's little nightmare (<i>Aphragmus eschscholtzianus</i>)	known
Norberg arnica (<i>Arnica lessingii</i> ssp. <i>norbergii</i>)	known
goose-grass sedge (<i>Carex lenticularis</i> var. <i>dolia</i>)	known
tundra whitlow-grass (<i>Draba kananaskis</i>)	known
truncate quillwort (<i>Isoetes truncata</i>)	suspected
Calder lovage (<i>Ligusticum calderi</i>)	suspected
pale poppy (<i>Papaver alboroseum</i>)	known
smooth alkali grass (<i>Puccinellia glabra</i>)	known
Kamchatka alkali grass (<i>Puccinellia kamtschatica</i>)	suspected
Unalaska mist-maid (<i>Romanzoffia unalascensis</i>)	suspected
circumpolar starwort (<i>Stellaria ruscifolia</i> ssp. <i>aleutica</i>)	suspected

Plants Known

There are five known sensitive plant locations in the WSLA area as follows.

- *Carex lenticularis* var. *dolia* in Thumb Bay on Knight Island and in Whale Bay
- *Arnica lessingii* ssp. *norbergii* on Evans Island and in Unakwik Inlet

- An unconfirmed sighting of *Poa laxiflora* on Evans Island (note, this species is not known or suspected to occur on the GRD; however, there is an unconfirmed sighting in the database).

During 2005, a *Puccinellia* sp. was found on Perry Island, but this specimen has not been positively identified yet. Since only a very small portion of the WSLA area has been surveyed for sensitive plants, the five known locations do not reflect a complete assessment of sensitive plant locations.

Plants Suspected

Due to the large area and diverse habitats, all of the 11 sensitive species have potential to occur in the WSLA area. See list below for general habitat descriptions.

- *Aphragmus eschscholtzianus*: heath, alpine and subalpine habitats
- *Arnica lessingii* ssp *norbergii*: tall shrubland, open forests, meadows, alpine and subalpine habitats
- *Carex lenticularis* var. *dolia*: lake margins, marshy areas, alpine and subalpine habitats
- *Draba kananaskis*: alpine and subalpine habitats
- *Isoetes truncate*: shallow freshwater
- *Ligusticum calderi*: forest edges, wet meadows, alpine and subalpine habitats
- *Papaver alboroseum*: well drained open areas, dry meadows, alpine and subalpine habitats
- *Puccinellia glabra*: maritime beaches, upper beach meadows
- *Puccinellia kamtschatica*: maritime beaches, upper beach meadows
- *Romanzoffia unalaschcensis*: streamsides, riverbanks, forest edges, and rock outcrops
- *Stellaria ruscifolia* ssp *aleutica*: lake margins, marshy areas, alpine and subalpine habitats

Areas of Potential Concern

The potential number of sensitive plants to occur in a given area has been estimated using a bioenvironmental model that summarizes climatic, vegetation, and landform features to represent potential habitat. This model was developed during the Forest Plan revision process. Based on this model (**Figure 2.9**), the areas of most concern occur along the coastal fringe, where there is potential for the greatest number of sensitive plant species. The coastal fringe is also where most human use occurs, which could potentially impact sensitive species and their habitats. In general lower elevation coastal areas would likely need more intensive sensitive plant biological evaluation work than at higher elevations.

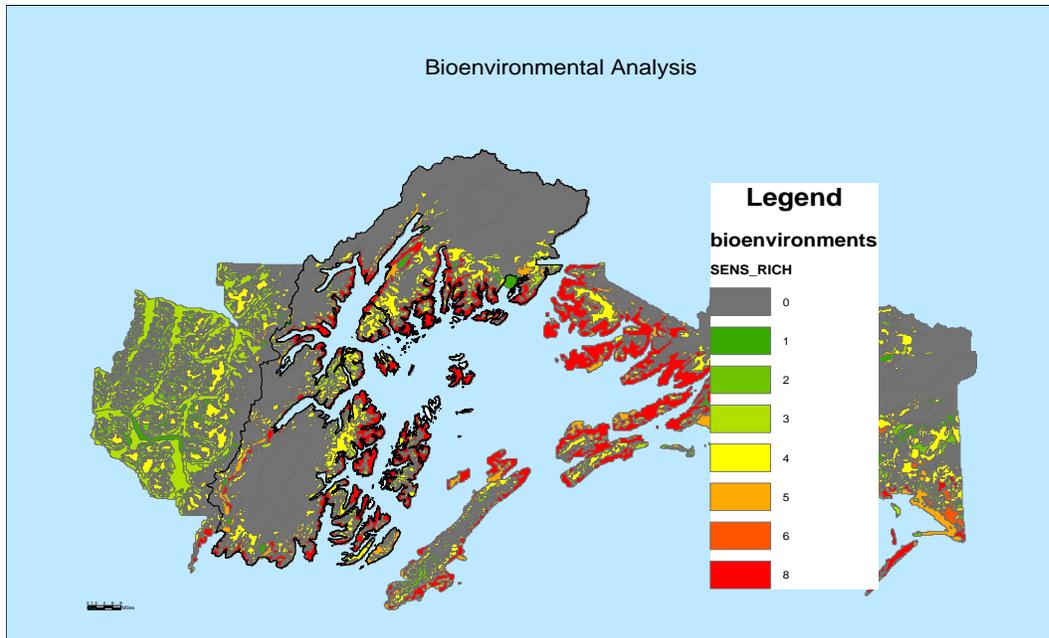


Figure 2.9. Potential number of Alaska Region sensitive plant species. Red is highest with 8 species, and gray is lowest with 0 species.

SOCIAL CHARACTERISTICS

PWS COMMUNITIES

The shores and islands of PWS are sparsely populated, and generally have not been highly impacted by human settlement, commerce or recreational use (with the notable exception of the Exxon Valdez oil spill of 1989). Common uses of the waters and lands of PWS include commercial and recreational fishing, fish hatcheries, oyster farms, transport of goods and people, subsistence and recreational hunting, tourism and recreation. In the western portion of PWS, there are two permanent human settlements: Whittier and Chenega Bay.

Whittier is a town of about 172 residents, located at the head of Passage Canal, about 75 miles southeast of Anchorage (Alaska DCCE 2005). Whittier's proximity to the major population center of Anchorage and the popular recreation areas of the Kenai Peninsula make the town the major gateway to western PWS used by the majority of Alaskans and out-of-state visitors. The Anton Anderson Memorial Tunnel opened to private vehicle traffic in summer of 2000, connecting Whittier with Portage Valley and the Seward Highway. This created easy access to western PWS for residents of Anchorage and the Matanuska-Susitna valley, which make up the majority of the state's population. Prior to the tunnel opening, access to Whittier was only by boat, train, or plane.

Chenega Bay is an Alutiiq community of approximately 81 residents (Alaska DCCE 2005). The village is located on Evans Island at Crab Bay, 42 miles southeast of Whittier in PWS. The community was originally located on the southern end of Chenega Island, but over half of the residents were killed and the town was destroyed in tsunamis following the 1964 Good Friday earthquake. The community was re-established at its

current location in 1984. Commercial fishing and subsistence are important to the economy of Chenega Bay (Alaska DCCE 2005).

RECREATION

The GRD does not currently have any timber sales or grazing leases. Most of the activity that occurs on the District is recreation, including independent public recreation and commercial recreation in the form of outfitter-guide companies with special use authorizations to operate on National Forest System (NFS) lands.

The large size, rugged terrain and remote nature of NFS lands in western PWS create some challenges for understanding and managing recreation. However, the concentrated access points at coastal towns such as Whittier, Cordova and Valdez give researchers the opportunity to contact the majority of PWS recreation users through surveys at these points. Climatic conditions also create a strong seasonal variation in use, with most recreation use occurring from May through September (Murphy et al 2004).

The majority of use in western PWS is facilitated through air traffic and water transportation. While transportation via water is often undertaken by personal watercraft, an increasing number of recreationists are utilizing charter services to access locations in western PWS. The largest increase in backcountry visitor nights has been in the use of guide services (Colt et. al 2002). Whether accessing western PWS independently or with the assistance of professional guides, visitors are engaging in a variety of activities including, but not limited to: fishing, hunting, sea kayaking, hiking, camping, wildlife viewing and scenic viewing. Reviewing use data from 1987-1998, Colt et al (2002) found that the most popular recreation activity was viewing of scenery, wildlife, and fish.

Several studies of recreation in Alaska and PWS give some insight to recreation characteristics of the area (Murphy et al 2004, Colt et al 2002, Bowker 2001, Brooks et al 2001, Twardock and Monz 2000). Common themes in these studies are the importance of recreation and tourism to the economy of Alaska, a high level of participation in outdoor recreation by Alaska residents, and an overall increase in the number of recreation users of the Chugach National Forest including PWS. The annual growth rate of overall recreation user days from 1987-1998 has been estimated to be from 5%-6.1% (Colt et al 2002), almost doubling the number of users recreating in the area between 1987 and 1998, with the most dramatic increase in use occurring with chartered independent travelers. The annual growth rate of sea kayaking during the same period has been estimated at 7.5% (Twardock and Monz 2000) with the most dramatic increases in the late 1990s.

Data from the late 1990s were used in a study of the spatial distribution of human use in western PWS prior to the opening of the Whittier tunnel (Murphy et al 2004).

Researchers used data obtained from 1) a survey of recreational boaters using western PWS, 2) records from the Whittier Harbor Master's office, 3) interviews with and records of charter boat operators, and 4) information from the State of Alaska on commercial fishing use. Aerial surveys of western PWS were flown in summer of 1998 to verify data. Human use was divided into five categories of water craft: kayaks, charter boats, cruise ships and Alaska State ferries, commercial fishing, and other recreational motor boats.

In general, recreational studies of western PWS have found that areas closer to Whittier experience higher levels of use than areas in more remote areas of PWS. This pattern has

been consistent over time, as exhibited by use data collected both in 1987 and 1998 (Colt et al 2002). During each of these years, there was a decrease in the number of recreation user days with increasing distance from Whittier (Colt et. al 2002, Twardock and Monz 2000). Several factors probably contribute to this trend, including the additional cost associated with air and water taxi services, the inability of many private boats to travel long distances with limited fuel supplies, and the challenges associated with paddling watercraft long distances over immense stretches of open water. Additional factors such as the presence of tidewater glaciers, existence of adequate campsites, ability to view wildlife and opportunities for fishing will often dictate use patterns (Murphy et al 2004).

Factoring in the information provided above, some of the areas most heavily used by Chugach National Forest visitors include Blackstone Bay, Harriman Fiord, Port Nellie Juan, College Fiord, S. Esther Island, and Culross Passage/Perry Island. Use data from 1987 to 1998 exhibits that of these areas, Blackstone Bay and Harriman Fiord have usually exhibited the most visitor use, with this exhibited most dramatically from 1991 to 1998 (Colt, et. al 2002). Other areas such as Unakwik Inlet, Eaglek Bay, Naked Island, and Knight Island receive a certain degree of recreation use, but in much lower numbers than the locations listed above.

All of the previously mentioned studies of recreation in PWS occurred prior to the opening of the Whittier tunnel. It is generally believed that the opening of the tunnel has changed the recreation use levels and possibly patterns of use in PWS. In summer of 2005, survey data were collected for a research project being conducted by the Pacific Northwest Research Station (principal investigator is Dr. Brian Garber-Yonts). This study will be discussed in more detail under Issue 1, Chapter 4 of this document.

Desired Condition

To facilitate the prospects for solitude and enhance opportunities for a high level of challenge within the Wilderness Study Area management prescription (the majority of the WLSA area), the Forest Plan has established parameters regarding the number of encounters and total group size that are acceptable in the area. Within the WSLA area, Forest Plan guidelines do not allow a group to encounter more than 15 parties/day on trails and 6 parties/day on shorelines or off trails/off shorelines. The maximum party size allowed throughout the majority of the WSLA area is 15. All of these parameters are in place to encourage a high to moderate degree of risk and challenge (Revised Forest Plan, 3-38).

In 2001, a Recreation Capacity Analysis was initiated in the WSLA area. This analysis determines the shoreline-based carrying capacity for recreational uses in western PWS. This study defines the optimum number of groups that can be in the project area on any day during the primary use season while still preserving the social, physical and environmental settings specified in the Forest Plan. One product of this analysis was the designation of 18 Capacity Analysis Areas, which were delineated based on Forest Plan direction, public input, average distance and known routes of kayak trips, and other factors. These Capacity Analysis Areas (**Figure 2.10**) are currently used as administrative units for special use authorizations, and serve as a reference for District staff and the public. Further discussion of the usefulness and limitations of this study can be found in Chapters 4 and 5 of this document. The Capacity Analysis is currently being updated with new information that has been gathered by the GRD's backcountry rangers. The

most recent review and update of the Capacity Analysis is anticipated to be complete in early winter of 2006. In some cases, the original recommended capacities were made with a very low level of confidence due to the lack of inventory data for some analysis areas. The Capacity recommendations for these areas will be reviewed and updated as the capacity analysis area data sheets are updated.

Existing Facilities

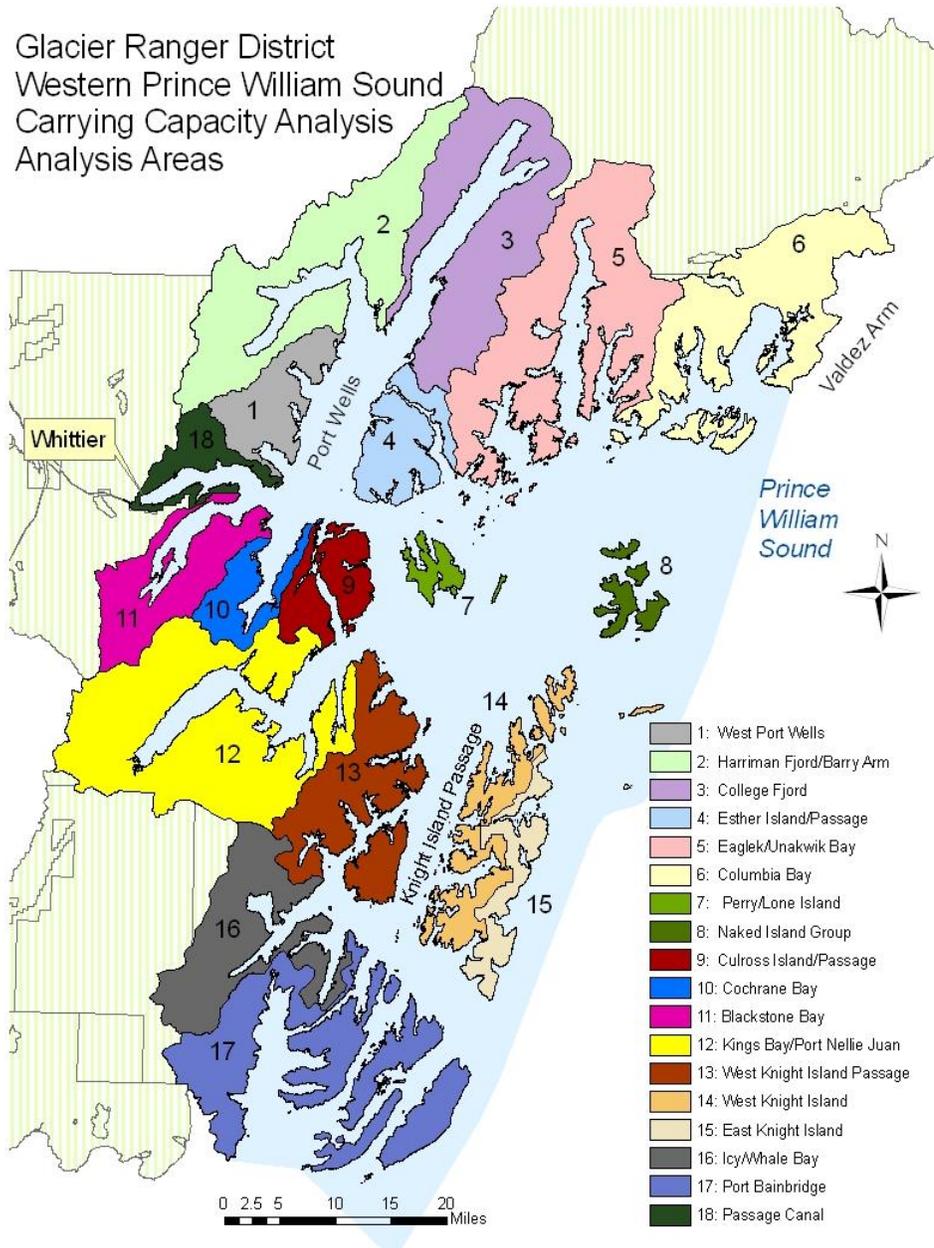


Figure 2.10: Capacity Analysis Areas identified in the working document “Glacier Ranger District Western Prince William Sound Carrying Capacity Analysis” written in 2001 by Doug Blanc and Dave Sanders

Due to the remote nature of western PWS, the WSLA area has very few Forest Service recreation facilities available for use (the State of Alaska Department of Natural Resources and various Native Corporations have minimal facilities scattered throughout the PWS as well). The two main types of constructed facilities available for recreation use on NFS lands are Forest Service public use cabins and Forest Service system trails.

Cabins

Six Forest Service public use cabins are available for rent in western PWS: Coghill Lake, South Culross Passage, Harrison Lagoon, Paulson Bay, Pigot Bay, and Shrode Lake. These cabins are available for rental through an on-line reservation system run by a private contractor.

Trails

A number of Forest Service system trails are also located throughout the WSLA area, many of which have been developed due to their proximity to Forest Service public use cabins or historical features of PWS:

Table 2.4. Forest Service system trails located in the WLSA study area.		
Trail Name	Class Level	Distance (miles)
3 Finger Shrode Lake Trail	2	1.67
3 Finger Shrode Portage Trail	1	.5
Cascade Trail	1	.3
Columbia Bay Easement Trail	1	.5
Deep Water – Contact Glacier Trail	1	.63
Coghill Lake Trail	2	2.81
Eshamy Lagoon Easement Trail	1	.3
Esther Island North Portage Trail	1	.2
Granite Mine Access Trail	1	.52
Gunboat Lakes Portage Trail	1	.5
Heather Bay Easement Trail	1	1.6
Jackpot Bay Easement Trail	1	.9
Lansing Mine Access Trail	1	.7
Otter Creek Portage Trail	1	.8
Otter Creek Portage #2 Trail	1	.2
Otter Lake Access Trail	1	.1
Red Lake Portage	1	.2
Portage Pass Trail	2	2.05
Sawmill Bay Easement Trail	1	.3
Sockeye Lake Access Trail	1	.2
Shrode Lake Trail	2	.86

Hardened Campsites

In the past few years, the Forest Service has begun to harden campsites in western PWS, with initial work taking place at a small number of sites in Blackstone Bay. The hardening work, undertaken both to protect area resources and to provide amenable camping for visitors, has been done utilizing primarily natural materials (**Figure 2.11**).



Figure 2.11. Example of campsite hardening project using local materials such as driftwood and beach gravel. Hardening of heavily used sites can prevent further resource damage to fragile upland areas in PWS.

SPECIAL USES/LANDS

One component of human use of western PWS is use that is managed through the issuance of special use authorizations. A special use authorization is a legal document (such as a permit, lease, or easement) that allows occupancy, use, rights, or privileges on NFS land. The authorization is granted for a specific use of the land for a specific period of time. This includes all uses except disposal of timber, minerals, and grazing of livestock. More information regarding Special Use Authorizations is available on-line at <http://www.fs.fed.us/r10/chugach/lands/index.html>.

Special use authorizations can only be issued for NFS lands. As mentioned in Chapter 1 of this document, in PWS this means the Forest Service can authorize use only on those lands above the mean high water line. Existing NEPA documents are on file addressing several common types of use including sea kayaking, camping, day hiking, hunting, and charter boat tours. These documents were last given a formal review by District staff in 2000. An Environmental Assessment and Decision Notice for issuing special use authorizations for Temporary Setnet Camps in Eshamy Fishing District is also on file, and were last given a formal review in 2001.

At the time of writing, there are 68 currently issued special use authorizations with permitted use in western PWS on the GRD². Seven of these permits are administered by neighboring Seward or Cordova Ranger Districts. These special use authorizations include eleven different types of use, as defined by national policy (FSH 2709.11 Chapter

² For the purposes of this assessment, all special use authorization data were current as of October 15, 2005.

10, Exhibit 03), ranging from commercial outfitter-guide uses to resource monitoring sites, fish hatcheries, and research camps. The number of each type of special use permit is shown in **Table 2.5**. Of these, 38 (56% of permits) are held by Outfitter-Guide companies with use throughout the Sound, including some companies which also have use authorized in eastern PWS on the Cordova Ranger District. The next most common permit type is ANILCA Set-Net Camp, of which there are currently 14 active authorizations (21% of permits). These camps are seasonal, temporary fishing camps all located in Main Bay.

Table 2.5. Special Use Permits with use in western Prince William Sound, Glacier Ranger District as of 10/15/2005.			
Use Code	Use Type	# of permits	General Locations in western PWS
153	Outfitter and Guide	38	Throughout western PWS
216	Fish Hatchery	2	Cannery Creek, Main Bay
422	Research	4	Squire Island, Naked Island, Dangerous Passage, Columbia Glacier, College Fjord
511	Construction Camp and Residence;	1	Coghill River (fish weir and camp)
512	ANILCA Set Net camp	14	Main Bay
513	ANILCA Set Net cabin	2	Eshamy Bay area
514	ANILCA temporary camp	1	Herring Bay (EVOS field camp)
521	Warehouse and Storage	2	Evans Island and Cannery Creek (oil spill response storage), Main Bay (warehouse for fishing support).
724	Navigation Aid, Lighthouse	1	Pigot Point, Naked Island (Communications Sites)
806	Private Mobile Radio	1	Naked Island (part of Comm. Site)
810	Cellular	1	Naked Island (part of Comm. Site)
814	Resource Monitoring Site	3	Perry Island, Glacier Island, Naked Island, Seal Island, Big Smith Island
	All Uses	70	Throughout western PWS

Because the majority of active permits in western PWS fall under the category of Outfitter-Guide activities (54% of permits are this type), and due to the importance of commercial and private recreation use of the study area, we will focus mainly on this category of special use authorization. Outfitter-guide permit holders are authorized a specified number of service days (formerly called client days), defined as one client using any part of the National Forest during one day. These days are further divided into Priority days and Temporary days. Priority and Temporary designations are mainly for administrative purposes and will become more meaningful as capacity levels are reached in certain areas, when permit holders with Priority days will be given first consideration in the allocation of service days. For this report, all service days have been combined rather than separated into Priority and Temporary days.

Since 2002, service days authorized under special use authorizations (permits) issued to outfitter-guide companies have been allocated according to the 18 Recreation Capacity Analysis Areas identified in 2001 (Blanc and Sanders 2002). Permits issued prior to the existence of these Capacity Analysis Areas are being updated as they expire and are renewed. Currently, 18% of the total outfitter-guide service days in western PWS are not allocated to a specific Capacity Analysis Area. We estimate that by 2007, all outfitter-guide permits will be administered according to the Capacity Analysis Areas. One possible exception to this may be permits authorizing big game hunting; we will discuss this situation in more detail later in this section.

A summary of the current number of authorized commercial recreation service days allocated to outfitter-guide permit holders within each Capacity Analysis Area is given in **Table 2.5**. Existing authorized use is compared to the suggested maximum level of use described in the Western Prince William Sound Recreation Capacity Analysis (Blanc and Sanders 2002), which offers guidelines based primarily on the quality of non-motorized (in this case, sea-kayaking) recreational experience. The percent of recommended maximum commercial service days allocated to each Capacity Area in 2005 is shown in **Figure 2.12**. Note that only days allocated to the current study area are included here; several permit holders have additional days not listed here that are allocated to areas in the eastern Sound on Cordova Ranger District. Other permit holders have additional days for use in other areas on the GRD (i.e. Kenai Peninsula and Turnagain Arm areas), which are also not included in the totals in **Table 2.5**.

Due to climatic conditions of PWS, there is a strong seasonality to recreation use both by the general public and outfitter-guide companies. In general, most recreational use of the Sound occurs from May through September. On the GRD, the core season for recreation activity is considered to be from June 15 – August 15. The majority of outfitter-guide companies with special use authorizations in western PWS focus on sea kayaking and camping, and are therefore limited to summer months; however, some companies also offer boat-based or fly-in winter activities such as skiing or snowshoeing.

Table 2.5: Summary of commercial user days currently allocated to outfitter-guide companies, compared to the maximum commercial user day capacity described in the Western Prince William Sound Recreation Capacity Analysis (Blanc and Sanders 2002).

Analysis Area Name and Number	Total 2005 Allocation	Recommended Maximum Service Days	% of Maximum Service Days Allocated in 2005
Blackstone Bay (AA11)	1363	3720	37%
Cochrane Bay (AA10)	352	1860	19%
College Fjord (AA3)	273	1860	15%
Columbia Bay (AA6)	1167	3720	31%
Culross Island Group (AA9)	807	3100	26%
Eaglek/Unakwik Bays (AA5)	778	3720	21%
East Knight Island (AA15)	319	1860	17%
Esther Island/Passage (AA4)	406	1860	22%
Harriman Fjord/Barry Arm (AA2)	1514	3100	49%
Icy/Whale Bay (AA16)	909	3720	24%
Kings Bay/Port Nellie Juan (AA12)	1023	3720	28%
Naked Island Group (AA8)	282	3720	8%
Passage Canal (AA18)**	80	n/a	n/a**
Perry/Lone Island (AA7)	451	1860	24%
Port Bainbridge (AA17)	322	3720	9%
West Knight Island (AA14)	529	2604	20%
West Knight Island Passage (AA13)	694	1860	37%
West Port Wells (AA1)	336	3100	11%
All of western PWS (none)***	2545	n/a	n/a***
TOTAL WSLA study area	14150	49104	29%
***Several older permits have not been allocated according to the Capacity Analysis Areas. These permits are being re-issued according to these Areas as they expire and are renewed. It is anticipated that all outfitter-guide permits will be under this system by 2007.			

Western Prince William Sound
 Outfitter-Guide Service Days
 2005 Allocation by Capacity Analysis Area

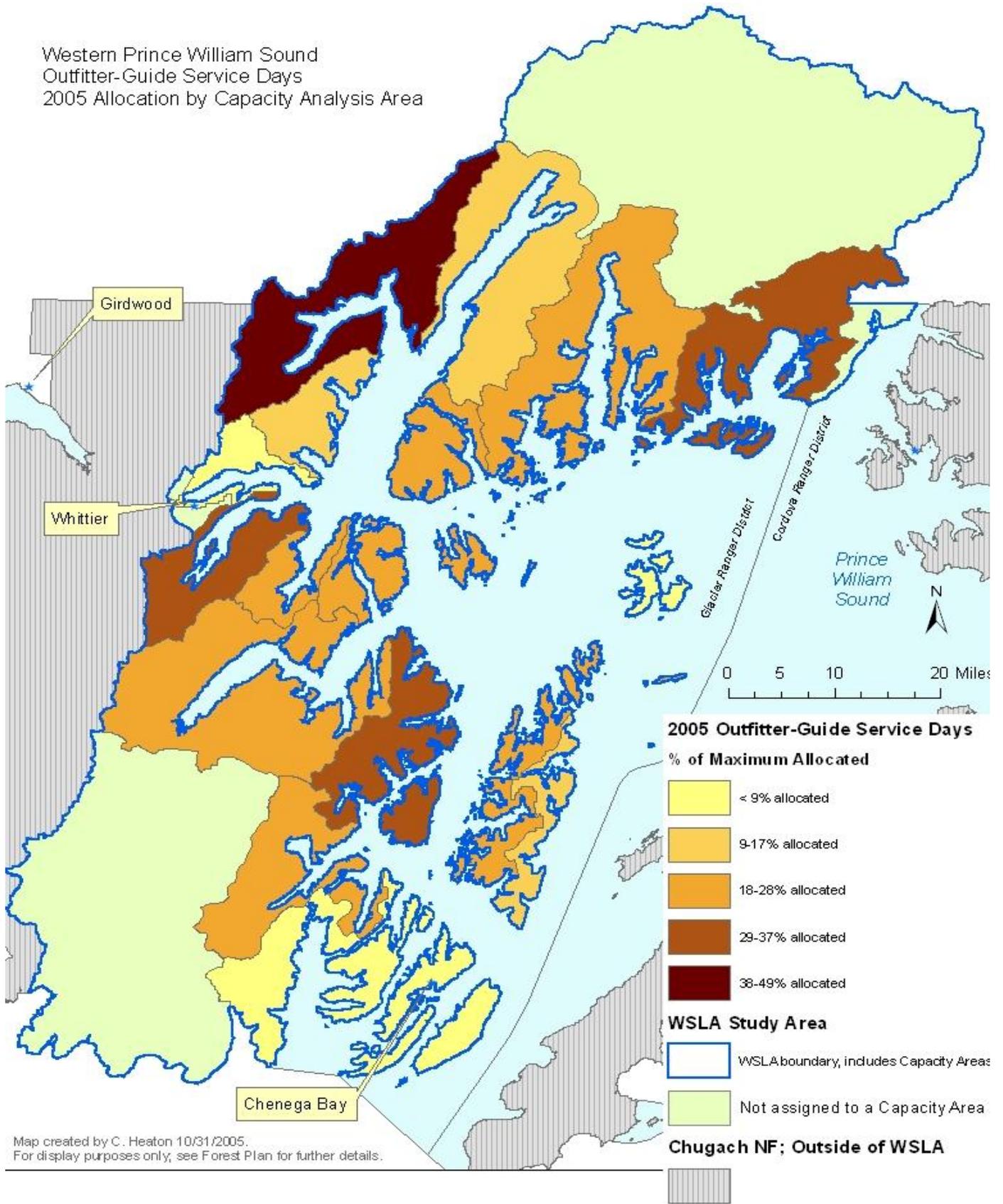


Figure 2.12. Percent of maximum recommended allocation of commercial service days in Capacity Analysis Areas in 2005. Harriman Fjord / Barry Arm (AA2) currently exhibits the highest percentage of total use allocation at 49%, while Port Bainbridge (AA17) and the Naked Island Group (AA8) have < 9 % of recommended commercial service days currently allocated

Outfitter-guide companies operating on the GRD can be divided into three general categories: sea-kayaking (which includes associated on-shore activities such as camping and hiking), charter boat tours (generally including on-shore day-use activities) and sport hunting (Table 2.6).

Table 2.6. Commercial outfitter-guide service days allocate within each Capacity Analysis Area in 2005, separated by type of use.						
Analysis Area Name and Number	Kayak Service Days	Charter Service Days	Hunting Service Days	Mixed Use Service Days	Capacity Area Service Days	% of WSLA Service Days
Blackstone Bay (AA11)	1273	51	9	30	1363	10
Cochrane Bay (AA10)	300	0	10	42	352	2
College Fjord (AA3)	221	0	10	42	273	2
Columbia Bay (AA6)	998	169	0	0	1167	8
Culross Island Group (AA9)	695	40	30	42	807	6
Eaglek/Unakwik Bays (AA5)	589	144	33	12	778	5
East Knight Island (AA15)	277	0	0	42	319	2
Esther Island/Passage (AA4)	271	100	23	12	406	3
Harriman Fjord/Barry Arm (AA2)	1461	10	13	30	1514	11
Icy/Whale Bay (AA16)	818	30	19	42	909	6
Kings Bay/Port Nellie Juan (AA12)	792	150	39	42	1023	7
Naked Island Group (AA8)	126	72	72	12	282	2
Passage Canal (AA18)**	80	0	0	0	0	0
Perry/Lone Island (AA7)	359	40	10	42	451	3
Port Bainbridge (AA17)	274	6	30	12	322	2
West Knight Island (AA14)	352	155	10	12	529	4
West Knight Island Passage (AA13)	602	30	20	42	694	5
West Port Wells (AA1)	296	40	0	0	336	2
All of western PWS (none)***	803	1001	579	162	2545	18
TOTAL WSLA study area	10587	2038	907	618	14150	100

Of the 14,150 service days allocated to outfitter-guide companies in the study area, 76% are authorized primarily for sea kayaking, 14% are given to charter boat tours, 6% are authorized for guided or non-guided hunting, and the remaining 4% are authorized for mixed uses that cannot easily be placed into one of the other three categories. Fishing may be included in charter boat activities or as a component of other permits; freshwater fishing in streams or lakes is the only type that will generally occur on NFS lands. Fishing and hunting are regulated by ADF&G, and all special use permit holders are expected to abide by ADF&G rules and regulations.

As mentioned previously, assigning hunting use to specific Capacity Analysis Areas is problematic. There is currently not a consistent, clear method for assigning use to hunting permits according to these Forest Service areas. Hunting guides are licensed by the State of Alaska for guiding in specific Guide Use Areas, which are large areas that do not correspond to Forest boundaries. The WSLA area includes portions of three of these Guide Use Areas. Due to the nature of the hunting activity, hunting parties tend to move more frequently and have less established itineraries than other types of commercial uses; the hunters must go where the animals are, and this cannot be accurately forecast. The number of guided and non-guided hunting permits administered by the GRD in western PWS nearly doubled in 2005 (from 5 permits to 9 permits). While these permits make up only 6% of the total commercial service days in the study area, such an increase indicates that the frequency of this type of permitted use may continue to rise.

Actual use is reported each year by all outfitter-guide permit holders, as required under the terms of their special use authorizations. Each permit holder reports the trip or hunt date, location of use, number of people on NFS lands, and activity. These data are entered into a relational database, started by the backcountry ranger program in 2002 and updated in spring of 2005 by special uses staff. It now contains complete final use data from companies permitted in western PWS for 2002, 2003 and 2004. Final use data indicate a much higher level of use in 2002 than in the two subsequent years; however, this is not believed to indicate any trend toward decreasing use. Anecdotal evidence suggests that the high use rates in 2002 were due to a number of political and economic factors (including an increase in domestic tourism following 2001 terrorist attacks, and a National Geographic Magazine feature article on kayaking Prince William Sound), and that use is overall on an upward trend. As more final use data are added each winter, trends over time should become evident. A comparison of allocated service days with actual use reported by outfitter-guide permit holders is located in Chapter 4 of this document.

The spatial distribution of outfitter-guide use on the GRD (including the WSLA area) has been poorly understood. The need for a spatial database of special use authorizations has been identified by District resource specialists since 2000. In 2005, work was begun on a GIS database of all issued permits, which will be completed in 2006. When complete, any location on the District may be queried to obtain a list of special use authorizations in that location. Outfitter-guide permits have been given the first priority to be entered into the database; however, all special use authorizations will eventually be entered. All current permits with use in Prince William Sound, and all outfitter-guide permits expiring in 2005 have been entered to date. Completion of this GIS database will greatly increase efficiency of special uses analysis, including public and internal scoping of new permit requests. These data will also aid in the analysis of cumulative impacts of special use

authorizations, as they may be overlaid with additional information such as wildlife habitat, recreation sites, trails, vegetation, inventoried campsites, and any other layer compatible with the GIS format.

HERITAGE

More than 1,500 cultural sites have been recorded and assigned site numbers on the Chugach National Forest and over 400 individual cultural resources have been assigned site numbers within the WSLA area. Many of the recorded sites require field verification through archaeological survey to meet the current standards as outlined in the Region 10 Programmatic Agreement. In addition to currently inventoried sites, background literature for the WSLA area suggests that numerous cultural sites of both historic and prehistoric nature are present but have not yet been field verified. References for unrecorded sites include historic maps, oral histories, historic special use permits and those sites reported by recreation users and outfitter guides. The sites included in this landscape analysis are those known at the present time. Research and future field investigations will most likely reveal additional cultural resources. In addition, many sites may become eligible for the National Register as they reach the 50 year mark and require formal evaluation.

Prehistoric Period

The WSLA area was occupied prehistorically by the Suqpiaq, who speak the Aluutiq language. Their occupation of this area has been documented archaeologically to at least 4,000 years ago. The prehistoric Suqpiaq were primarily a maritime-oriented people, with some activities occurring inland.

There are eight identified sub-groups of the Suqpiaq (Chugach) people (Johnson: 1984), these include:

- 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.

Prehistoric archaeological sites in PWS date from within the past 4000 years and encompass three cultural phases. The Uqciuvit phase is identified with dates ranging from 4000-2500 B.P., the Palugvik phase with dates ranging from 2500-900 B.P., and the Chugach phase with dates ranging from 900-200 B.P. (Yarborough 2000). The protohistoric period dates between A.D. 1741, when Vitus Bering made landfall on Kayak Island, and A.D. 1778, when Captain James Cook made direct contact with Native inhabitants of PWS.

Historic Period

The historic period began in the analysis area in A.D. 1778. The following period of time, through A.D. 1867, is characterized as the Russian Period.

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

The Suqpiq (Chugach) of PWS 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 PWS (de Laguna 1990). Eyak Natives in 1933 described Eyak territory as having at one time extended from Cordova Bay, inside PWS, 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). The Russians enforced peace between the Eyak and the Suqpiq, after which the Eyak expanded their territory as far north as Port Gravina (Birket-Smith and de Laguna 1938). Non-native use of the WSLA 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.

Cultural sites associated with the Suqpiq have been identified and recorded on NFS lands within the analysis area. The Alaska Native Claims Settlement Act (ANCSA) 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. Chugach Alaska Corporation has selected Cultural and Historical Sites (paragraph 14(h)(1) of ANCSA) selections within the analysis area, these have received a determination of either Pending and/or Eligible for conveyance by the Bureau of Indian Affairs (CAC 2005). Although still in selection status, it is expected that these selections will eventually be conveyed. This selection status should be taken into consideration by the Forest Service for all projects.

As early as 1914, the Alaska Engineering Commission explored the route between Whittier and Portage for a potential rail line to connect PWS with the Alaska Railroad at Turnagain Arm, (Bush 1943, Crittenden 2002) (**Figure 2.13**).



Figure 2.13. Camp above Portage Glacier, between Turnagain Arm and Prince William Sound. Triangulation party of R.P. Strough. USC&GS Season's Report Strough 1914.

The Alaska Railroad made a preliminary survey in 1939, the project was authorized and funded in 1941, and a contract was let in June for construction of two tunnels and 14 miles of new line along a route that was essentially the same as that explored in 1914 (Bush 1943). Construction of what was ultimately a 12.4 mile long branch of the Alaska Railroad called the “Whittier Cutoff” was completed in 1942, running between the main line at Portage Station and the town of Whittier on Passage Canal in PWS. The larger of the two tunnels, called the “Whittier” tunnel, was, at the time, the fourth largest in the world at 13,090 feet long. This tunnel is now on the National Register of Historic Places, and has recently been renamed the Anton Anderson tunnel. The shorter tunnel, named the “Moraine” tunnel was about 4,910 feet long. This line was intended to “safeguard the flow of military supplies and personnel” during World War II. It also provided a second deep-water port, in addition to Seward, where connections could be made with ocean-going ships, and the increased tonnage of freight associated with the war could be more easily accommodated (Clifford 1999). What is now known as the Upper Engineer’s Camp served as the army construction camp on the west side of the tunnels, near Portage Lake. The personnel stationed there were almost entirely Alaska natives.

The analysis area includes cultural resources of historic significance related to western culture. These cultural resources include evidence of exploration, mining, timber harvesting, fox farming, commercial fishing, hunting and trapping.

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 2002).

CHAPTER 3 – ISSUES AND KEY QUESTIONS

This chapter includes a list of issues and key questions the Western Sound Landscape Assessment is intended to address. These issues and questions were developed by an Interdisciplinary Team (IDT) of Chugach National Forest, Glacier Ranger District resource specialists and guided the analysis.

Issue 1: *As recreation increases, there may be recreation user conflicts as well as impacts to the recreational experience from permitted (lands and special uses) or non-permitted activities.*

Key Questions

- What are the existing levels of recreation and permitted activities, and what are the trends?
- Which areas are at capacity according to the current capacity study?
- How is the recreation experience being impacted, what are the impacts, and how significant are these impacts?
- In what areas do we need more information or not yet know the impacts?
- What are the potential options to reduce impacts, and what measures are currently working or not working?
- What safety concerns currently exist and are expected as a result of increased recreation? How significant are these concerns?

Issue 2: *As recreation, non-recreation, and lands activities increase or change, they have the potential to impact other resource values such as wildlife, fisheries, hydrology, soils, minerals, vegetation, heritage, wilderness, and scenery integrity objectives.*

Key Questions

- What resources are being impacted, what are the impacts, and how significant are these impacts?
- In what areas do we need more information or not yet know the impacts?
- What are potential options to reduce impacts, such as management, partnerships, agreements, and educational/interpretive materials?
- What management measures are currently working or not working?

Issue 3: *As human use approaches capacity in some areas, management options are needed to maintain capacity objectives, which ensure compatibility with wildlife, fisheries, hydrology, soils, minerals, vegetation, heritage, wilderness, and scenery integrity objectives.*

Key Questions

- Which areas are highly sensitive to increased use?
- In what areas is there a need to close/restrict use, and how would this be accomplished?
- In what areas could hardened campsites, cabins, trails or other infrastructure be built?
- What partnerships or agreements are needed to maintain capacity objectives?

- What educational and interpretive materials are needed to maintain capacity objectives?
- How do we work with our permittees, non-permitted recreation users, and adjacent landowners to maintain capacity objectives?

Issue 4: *The assessment area supports many wildlife and fish species that contribute significantly to the economic, recreational, and subsistence needs of both local residents and visitors. Also, demand for opportunities to hunt, fish, and watch wildlife in Prince William Sound appears to be increasing. To preserve these biological resources, the Alaska National Interest Lands Conservation Act (ANILCA) states that fisheries research, management, enhancement, and rehabilitation activities are allowable within wilderness study areas to maintain fish production at optimum sustained yield levels. Additionally, the Forest Plan directs that lands within Prince William Sound be managed primarily to maintain the wild character of the area and sustain its unique fish and wildlife. However, basic information on many species is insufficient or lacking, making it difficult to know if these species are being sustained and whether or not enhancement activities are necessary.*

Key Questions

- For what species or populations do we need more information?
- What opportunities exist for monitoring of appropriate management indicator species in western Prince William Sound?
- Can we obtain adequate information on the distribution and relative abundance of these species to meet this goal?
- What opportunities exist for partnerships or agreements to obtain this information?
- What fish and wildlife enhancement opportunities exist?

Issue 5: *Production of natural resources has historically occurred in the area. Mineral resources are known to exist and their production may conflict with other uses and resources.*

Key Questions

- What Forest Service lands are underlain by private mineral estate?
- What lands are open to mineral entry, mineral leasing, and mineral material sales?
- What mineral deposits and occurrences are known and what is the potential for mineral development?
- What opportunities exist for other resource production?
- Are there conflicts between resource production and other resource values?
- What effect have mining operations, logging, and the related camps had on the cultural landscape of the Sound? Some of these mines, millsites, and logging camps may now be considered historic and afforded protection.

Issue 6: *Past and potential future activities and existing trends that are out of our control (fast ferry, development on non-National Forest land, the Exxon Valdez oil spill, introduction of invasive species, geologic hazards, and climate change) may create conflicts or opportunities for recreation and other resources.*

Key Questions

- What are the past, present, and potential future events, activities, and existing trends that may affect resource values and human use?
- How do these events, activities, and trends affect resource values and human use, what are the impacts, and how significant are these impacts?
- If there are impacts/opportunities how do we manage and plan to ensure they are compatible with Forest Service management objectives?

CHAPTER 4 - ISSUE ANALYSIS

In this chapter, each issue is analyzed using available information. Key questions are used as guides to address the issues.

Issue 1: *As recreation increases, there may be recreation user conflicts as well as impacts to the recreational experience from permitted (lands and special uses) or non-permitted activities.*

Key Questions

- What are the existing levels of recreation and permitted activities, and what are the trends?
- Which areas are at capacity according to the current capacity study?
- How is the recreation experience being impacted, what are the impacts, and how significant are these impacts?
- In what areas do we need more information or not yet know the impacts?
- What are the potential options to reduce impacts, and what measures are currently working or not working?
- What safety concerns currently exist and are expected as a result of increased recreation? How significant are these concerns?

EXISTING LEVELS OF RECREATION AND PERMITTED ACTIVITIES

The first step in considering the impacts of recreation is to understand the current use levels and patterns occurring in PWS. Recreational use is not evenly distributed in PWS. Certain areas are more desirable for a variety of reasons including: distance from access communities, presence of glaciers and post-glacial landscapes, availability of landing beaches, protected anchorages, sport fish streams, cabins and wild game concentrations (Murphy et al 2004).

Independent use is not well understood for western PWS. General trends are evidenced by studies conducted by Alaska Pacific University, other research projects and by anecdotal evidence collected by the District's backcountry rangers and by public comment gathered from PWS recreation workshops, PWS business operators at the backcountry information center in Whittier, and from field contacts.

The most recent, comprehensive spatial analysis of human use in the western PWS was conducted in 1998, prior to the opening of Whittier to private vehicle access (Murphy et al 2004). This study and several others are described in Chapter 2. The *PWS Human Use Study* is currently underway, spearheaded by Dr. Brian Garber-Yonts of the Pacific Northwest Research Station. This study will analyze current levels and patterns of use following the opening of the tunnel to Whittier. As part of this study, surveys were conducted by Forest Service staff in Whittier, Cordova and Valdez during summer of 2005. These data are being analyzed to determine the current recreational use of PWS, but were unavailable at the time of writing. These data will be compared to data collected prior to the tunnel opening (Murphy et al 2004) to analyze how use levels and patterns may have changed.

We do not have additional recent, systematically collected data regarding the recreation experience of users of PWS, nor any clear idea of where impacts to or from recreation are occurring nor to what degree. Some anecdotal information has been collected by backcountry rangers and staff at the yurt that has been set up in Whittier during the summers of 2001-2005 to distribute backcountry information. This information was not systematically collected, and is in the form of a visitor contact record. These records do have applicable data such as group size, destination, length of visit, etc., that may possibly be useful in association with data from commercial users associated with special use permits. Data on human use have also been collected as part of Black Oystercatcher research conducted by District wildlife staff. A pilot project to have Forest Service interpretive rangers track human use during their scheduled trips into PWS was begun in 2005, but there are several limitations to this approach and it is not known whether this will be pursued as an option for tracking recreation use numbers. We hope that the ongoing *PWS Human Use Study* will provide a valuable starting point for increasing our knowledge of independent public recreation activities in PWS.

Commercial operators with special use authorizations are currently the only group of recreationists whose use levels are regularly monitored and can be actively managed by the Forest Service. A better understanding of the levels and patterns of public recreation use will allow permit administrators and recreation planners to develop strategies for minimizing any conflicts between special use authorization holders and the general public. At this time there have not been any regular, recurring conflicts between these user groups reported to District staff. Occasional reports of conflict have been received, but in general we have not received any indication of high levels of conflict or impact to the recreational experience of the public. The most common user conflict may be that between consumptive uses (i.e. hunting) and non-consumptive uses (i.e. hiking, kayaking). See the discussion on black bear hunting in the next section for more detailed discussion of reported recreational user conflicts between bear hunters and other groups.

Trends in permitted outfitter-guide use of western PWS are shown in **Figure 4.1**. These use data are reported by outfitter-guide permit holders at the end of each operating season. Due to the timing of this report, 2005 final use data are not included in this summary. Additional years of data prior to 2002 have not been entered at this time and do not exist in electronic form, but may be gleaned from paper permit files as staff time allows. Special uses data from 1987-1998, were compiled and analyzed by Colt et al (2002); unfortunately, these data cannot be directly compared with more recent numbers due to differences in the calculation of user days.

Outfitter-Guide Special Use Permits Allocated Service Days and Actual Use in western PWS

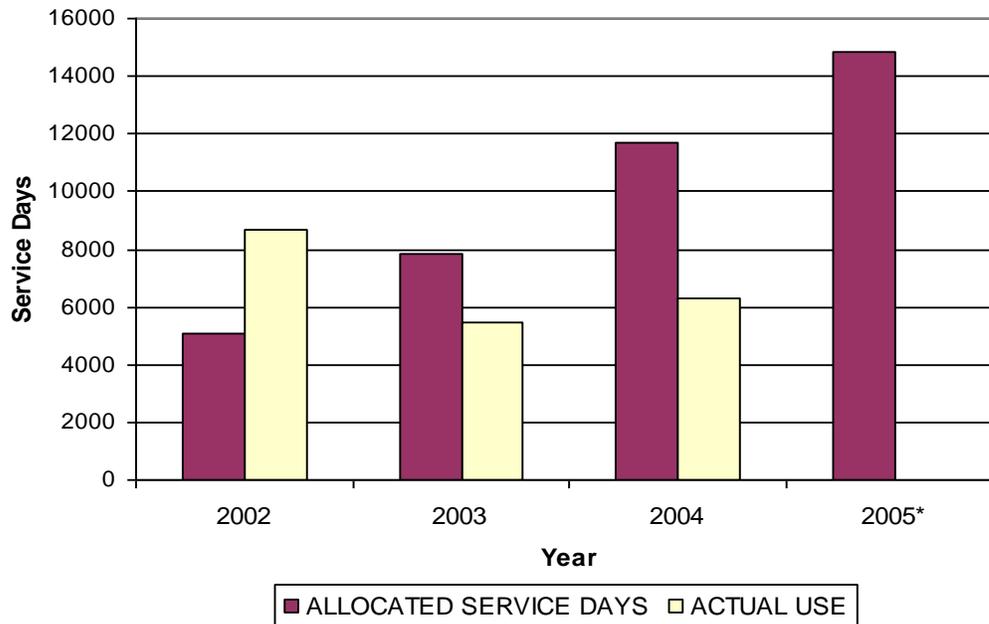


Figure 4.1. Service days allocated to outfitter-guide special use permit holders in western Prince William Sound from 2002-2005. Actual use by outfitter-guides is shown for 2002-2004; due to the timing of this report, 2005 data were not yet available for inclusion.

Black Bear Hunting Recreation

An important and poorly understood group of recreationists in western PWS, and one where the potential for conflict with other recreational users may be substantial, is black bear hunters. The majority of hunter activity occurs during the spring (May and June) when male bears are foraging in areas immediately adjacent to the shoreline. In recent years bear harvest has increased in western PWS following the opening of the Whittier tunnel to private vehicles. There has also been an increase in the average number of days per trip reported by black bear hunters (Crowley 2005) as well as an increase in the number of commercial operations permitted by GRD. This group includes an increasing number of visitors from outside of Alaska, because this region has received high acclaim for a unique bear hunting experience.

Based on ADF&G harvest data it is estimated that some 200+ bears are harvested annually from western PWS during the months of May and June. It is assumed that harvest success ranges between 40-50% (D. Crowley, ADF&G personal communication with A. Poe) so harvest figures likely predict only half of the actual black bear hunting activity in western PWS. Assuming this rate of success, with an average size of hunting parties ranging between 3 and 4 persons and length of trips averaging 3.5 days (D. Crowley personal communication with A. Poe.), black bear hunters (both commercially guided and private hunts) may represent as many as 4,900 user days in the WSLA study

area. Given these numbers some 1,400 individuals could be participating in black bear hunting each year in western PWS during May and June alone. This group likely represents the greatest number of individuals using western PWS in May and early June.

In recent years there have been some reported conflicts between this group and other shoreline recreationists. Conflicts have occurred when individuals engaged in wildlife viewing or other non-consumptive use have found themselves in close proximity to hunting parties. In a few cases individuals have reported feeling threatened or intimidated by bear hunting parties; conversely, non-consumptive users have attempted to chase away bears being pursued by hunters, which is illegal under state law. The practice of bear baiting during the harvest season has exacerbated the potential for conflict. There are public safety concerns when hunters establish bait stations on beaches which are commonly used by other recreation groups. In response to these concerns, beginning in 2006 ADF&G will not allow bear baiting in Blackstone Bay and Harriman Fiord / Barry Arm, two high use recreation areas. Bear baiting is also not allowed to occur within 1 mile of any developed site within PWS including USFS cabins, USFS and State hardened campsites and permanent research camps. Some limited educational efforts have been made by both ADF&G and GRD to make these user groups aware of one another and to promote mutual respect of each other's recreation practices.

Given the number of recreationists engaged in black bear hunting, an overall increase in human use, and that much of the use in western PWS is focused on the shoreline, such conflicts may become more common. A change in harvest regulations for 2006 shortens the spring harvest from continuing through the end of June to ending on June 10. This shorter season may alleviate conflicts happening later in June when more kayakers are using western PWS. However, this restricted harvest period will likely concentrate the numbers of bear hunters, potentially increasing competition within this group for quality hunting locations and campsites. An expected higher density of hunters may also result in increased conflicts between other early season recreation users (e.g., pleasure boaters).

Harvest records provided by ADF&G for 1,199 western PWS hunting parties between 1995 and 2004 were used in the development of a simulation model to predict the distribution of black bear hunting in western PWS. These results are preliminary and are only representative of hunting parties that report a successful kill, and therefore probably only represent half of the total bear hunting in western PWS (**Figure 4.2**). Results of this work may also help us understand patterns of use between private and commercial black bear hunters. Although the majority of black bear hunting in western PWS is conducted by private individuals, there is a significant amount of commercial use (guided or non-guided hunts). It is important to note that Capacity Analysis Areas 5 (Eaglek/Unakwik), 16 (Icy/Whale Bays), and 17 (Port Bainbridge) are the sites most frequently visited used both by commercial operators and private hunters, exhibit the longest duration of stay and the most overnight activity, and are also the areas where the most bears are harvested.

The predicted distribution of this important recreation user group by Capacity Analysis Area may be helpful for future Forest management activities. The utility of this information will be further enhanced when integrated with results from the PWS *Human Use Study*. These two studies will allow CNF to identify potential recreation user conflict areas and allocate use more effectively to mitigate potential conflicts.

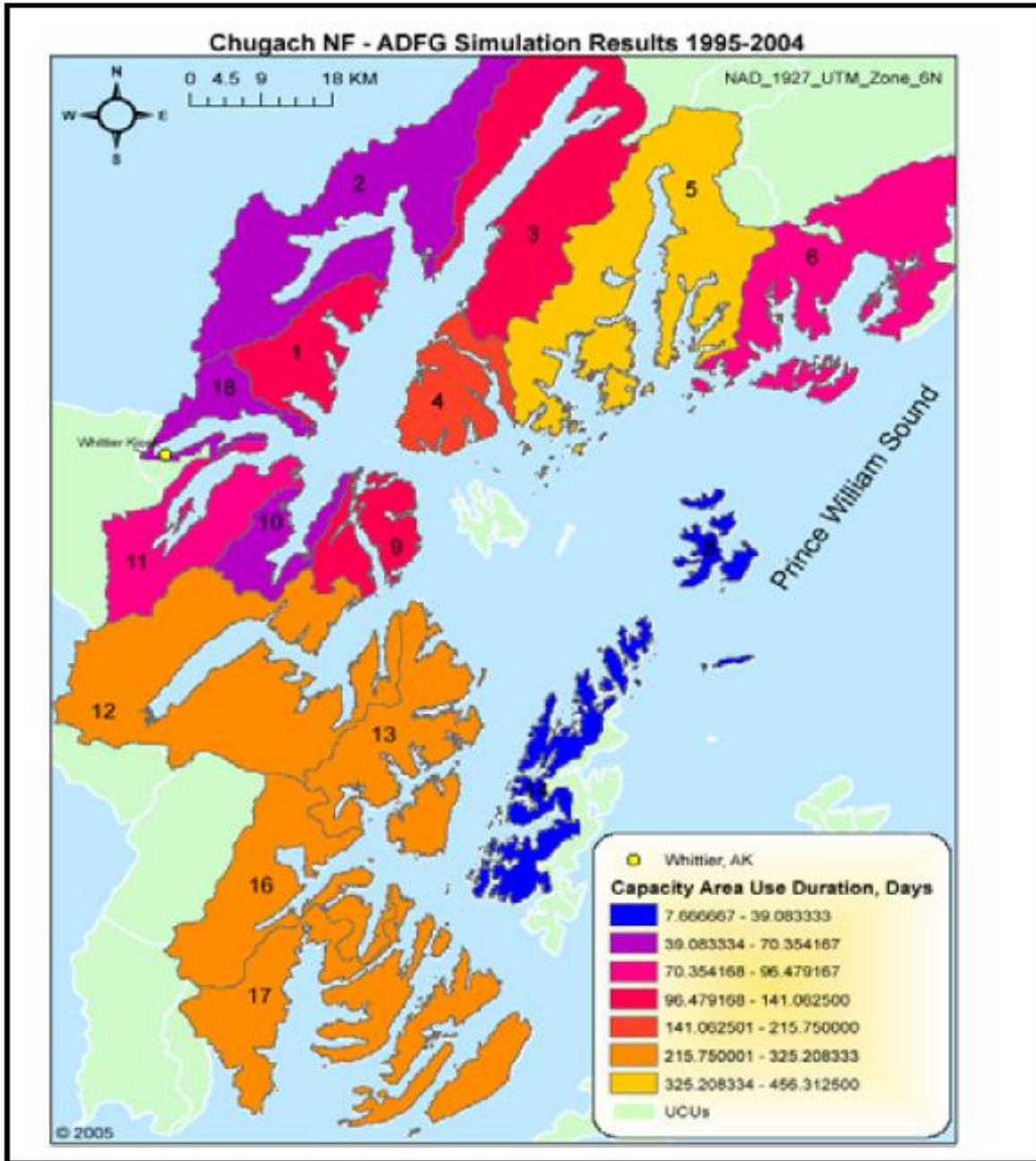


Figure 4.2. The predicted distribution of black bear hunters in western PWS based on 1,199 trip records provided by ADF&G for successful hunts between 1995 and 2004.

Subsistence

Historically, subsistence communities have expressed concern that activities such as timber harvest, road building, and recreation development could impact fish and wildlife populations or increase competition for subsistence resources. In western PWS, subsistence users from the community of Chenega Bay are concerned about increased competition for wildlife and fish resources from increasing numbers of private, urban users and commercial operations (J. Fall, ADF&G, Division of Subsistence, personal

communication with A. Poe). They are also concerned about increased commercial recreation activity interfering with their subsistence practices. Within the WSLA area, residents of Chenega Bay regularly use lands near their homes on Evans Island including Chenega Island and Port Bainbridge. Additional areas in western PWS are also used by various tribal members for subsistence harvest ranging from land mammals to birds, eggs, fish and vegetation (Statton et al 1986). Many of the traditional harvest areas used by the people of Chenega Bay have become popular for recreation activities and it is reasonable to assume that this may result in increase contact between these two user groups. Given that some recreationists using western PWS may not understand the harvest traditions and rights of subsistence users, conflict is even more plausible.

While conflicts may occur between subsistence users and the general public, the Forest Service has the ability to influence only the location and timing of use by commercial operators under permit. Due to the seasonal nature of many subsistence activities, special use administrators and recreation planners may have opportunities to work with tribal representatives to regulate permitted commercial activities in identified subsistence use areas during key time periods. A study currently underway by ADF&G, Division of Subsistence will evaluate the spatial and temporal distribution of subsistence use in PWS and results expected in 2006 would be available for comparison to results from the *PWS Human Use Study*. Evaluation and management of this overlap could be used to lessen the potential for impacts to both the recreation experience and subsistence values.

Current Capacity

Currently, recommended recreation carrying capacity is not being reached for the WSLA area overall. Because we do not have current data regarding independent public use, we will focus on permitted outfitter-guide use. The 2005 allocation of outfitter-guide service days in relation to the recommended maximum capacity is found in **Figure 2.12**. These data show that the Capacity Analysis Area with the highest percentage of service day capacity allocated is Area 2 (Harriman Fjord/Barry Arm), which had 49% of recommended commercial days allocated in 2005.

An alternative to using service days as a measure of capacity is to use Groups At One Time, or GAOT. This refers to the number of groups (in most cases the maximum group size allowed in the WSLA area is 15 people) using the forest during the same day. The capacity analysis allows for 27 outfitter-guide groups to be operating simultaneously throughout the WSLA project area. Outfitter-guide data has been analyzed in relation to capacity since 2002. The highest use year was 2002 with a total of 1,006 group days recorded. In 2003 and 2004, total outfitter-guide group reporting totals were 768 and 477 respectively. The most outfitter-guides operating at one time on any day for the entire study area in 2002 was 15 with an average during the primary use season of 7.7. A summary of the reported outfitter-guide GAOT for the core use season (June 15-August 15) from 2002-2004 is given in **Table 4.1**.

Some Capacity Analysis Areas have consistently reached or exceeded recommended outfitter-guide capacity during the core use season. Four areas have been identified by backcountry rangers as potential areas of capacity concern (**Figure 4.3**) These areas are: Blackstone Bay (AA11) and Harriman Fiord/Barry Arm (AA2), both in close proximity to Whittier; and Icy and Whale Bays (AA16) and Columbia Bay (AA6). Although these two areas do not show percentage at or above GAOT capacity as high as other Capacity Areas, they have been identified by backcountry rangers as areas of capacity concern for

other reasons. These reasons include the number of available durable campsites, level of current use by both commercial and independent uses, and high potential to provide solitude and wilderness experiences. (Note that although Esther Island/Passage (AA4) and West Knight Island Passage (AA13) also show higher percentage of days at or above the originally recommended GAOT capacity, the capacity recommendations in these two areas are currently under review and will likely be increased to reflect updated information in the number of available campsites and the influence of adjacent non-NFS lands in these areas.)

Table 4.1. Summary of the percentage of the core season (June 15 – August 15) outfitter-guide use was at or above recommended GAOT capacity for western PWS Capacity Analysis Areas, 2002-2004.

Analysis Area Name and Number	GAOT (Max group size)	% of 2002 core season at or above GAOT capacity	% of 2003 core season at or above GAOT capacity	% of 2004 core season at or above GAOT capacity
Blackstone Bay (AA11)	2 (15)	77%	58%	37%
Cochrane Bay (AA10)	1 (15)	29%	15%	11%
College Fjord (AA3)	1 (15)	19%	5%	10%
Columbia Bay (AA6)	2 (15)	37%	15%	18%
Culross Island Group (AA9)	2 (1/15 and 1/10)	31%	18%	13%
Eaglek/Unakwik Bays (AA5)	2 (15)	15%	11%	6%
East Knight Island (AA15)	1 (15)	21%	6%	19%
Esther Island/Passage (AA4)	1 (15)	29%	32%	23%
Harriman Fjord/Barry Arm (AA2)	2 (1/15 and 1/10)	79%	56%	61%
Icy/Whale Bay (16)	2(15)	37%	40%	18%
Kings Bay/Port Nellie Juan (AA12)	2(15)	16%	19%	10%
Naked Island Group (AA8)	1 (15)	21%	3%	3%
Passage Canal (AA18)	None allocated	n/a	n/a	n/a
Perry/Lone Island (AA7)	1 (15)	40%	21%	11%
Port Bainbridge (AA17)	2 (15)	3%	0%	3%
West Knight Island (AA14)	2 (1/15, 1/6)	0%	5%	5%
West Knight Island Passage (AA13)	1 (15)	48%	53%	52%
West Port Wells (AA1)	2 (1/15 and 1/10)	26%	0%	3%

Outfitter and guide use does not represent all shoreline based recreation use in PWS. Independent visitors account for a large proportion of use, especially within a 30-mile radius of access communities such as Whittier and Valdez. Shoreline use is also associated with commercial fishing operations and subsistence uses of PWS.

The recommendations in the Capacity Study are intended to preserve the social systems desired conditions to meet requirements for wilderness management, as defined in the Forest Plan. Several limitations exist regarding the application of the Capacity Study to various types of recreation users. Some weaknesses of the Capacity Study are that group size, method of shoreline access, time spent on NFS land, activities conducted on NFS

lands, and mobility are not weighted in any way at this time. The Capacity Study in its current form is most appropriate for slower moving craft such as sea kayaks, which represent a large portion of commercial and overall recreational use of PWS. It does not do an effective job of addressing recreational use of motorized vessels, which appears to be increasing. Sea kayaking groups tend to remain together for the duration of the trip, and commonly move at a pace where only one Analysis Area is visited during a day.

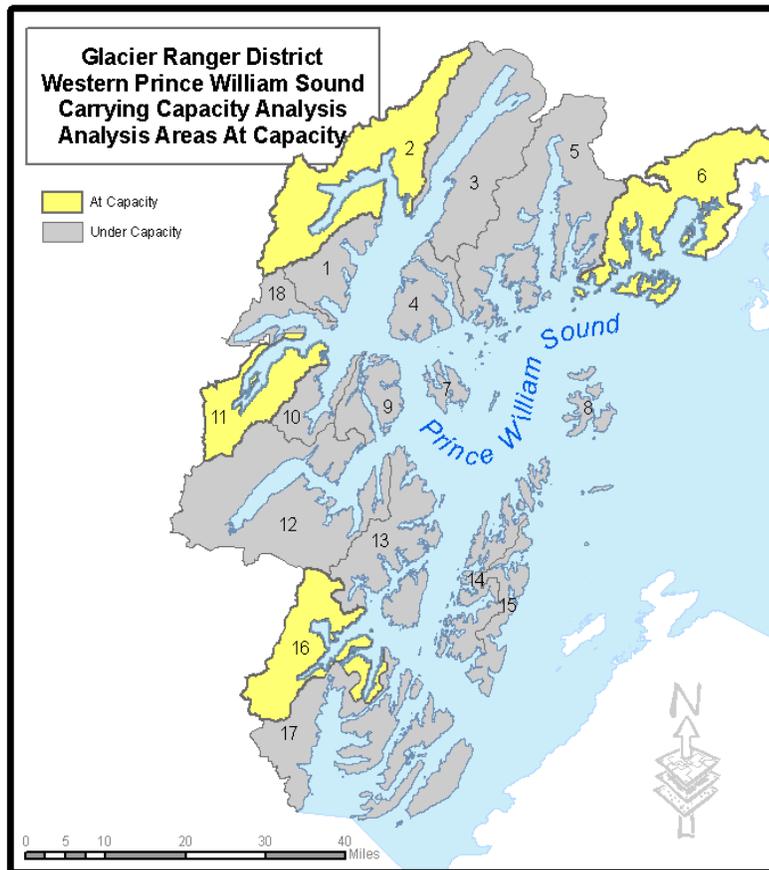


Figure 4.3. Capacity Analysis Areas that have been identified by backcountry rangers as areas of potential recreation capacity concern.

GAOT capacity recommendations are best suited to meet management intent for those areas where the predominant travel mode is by kayak. Use of the GAOT measure of capacity may not be appropriate for all user groups, because different modes of transportation afford varying abilities to cover distance in the Sound. For example: if one group of 15 people spends 8 hours on land in one analysis area, this would be recorded as one user day (GAOT) in that analysis area. If another group of 3 people in a motor vessel spends a few minutes on shore in several analysis areas during the same day, this would be recorded as multiple user days, or one GAOT in multiple analysis areas. Consideration of these factors requires examination and review to maximize efficacy for management purposes. Extensive discussion concerning this topic has occurred on the Tongass National Forest during a recently completed shoreline outfitter/guide Environmental Impact Statement, available for download at http://www.fs.fed.us/r10/tongass/projects/shoreline/shoreline_feis.shtml.

A potential source of impact to the recreation experience in PWS is that new high capacity tour vessels are now requesting access to NFS lands for their clients. These floating lodges can carry hundreds of passengers and make multiple shore excursions using smaller landing craft. This type of use is new to PWS and presents further challenges to management of the Nellie Juan/College Fiord Wilderness Study Area. Although technically a “mother ship” at anchor in a bay in the Sound does not constitute actual use of forest lands, the association made between shore visitation by such a vessel is generally identified as more intrusive than shore-based use from a smaller vessel or sea kayak. The high numbers of people, mobility and visual impacts associated with these large operators have generated debate about appropriate commercial uses of Wilderness.

IMPACTS TO RECREATION EXPERIENCE

According to the Forest Plan (FEIS, Chapter 3, page 3-294): “The goal of most recreationists is to have a positive experience by engaging in outdoor recreation activities. . . . Participating in activities in appropriate settings creates a user’s recreation experience and consequent level of satisfaction (USDA Forest Service 1986). Matching one’s desired experience with a setting that can allow the realization of that experience is the key to a satisfactory, positive recreation experience.”

When considering impacts to the recreation experience, we consider whether the experience has met, fallen short of, or exceeded expectations of the individual recreationist. A diversity of recreational uses occurs within western PWS, and the range of visitor expectations is also widely varied. Many recreational activities share fundamental qualities that are considered essential to the overall experience. Each individual will rank the importance of these qualities according to personal values and expectations. These qualities may include but are not limited to: Feelings of solitude and isolation, opportunities for challenge and risk in a wild environment, viewing wildlife, landscape and natural features, and feelings of spirituality or closeness to the earth. Measuring these experiential qualities is challenging. A wide range of measurement indicators exist to address these qualities such as number of encounters, visual impacts to the natural appearance of the landscape, types of transportation modes observed, view shed, natural “soundscape” and others. Other more measurable expectations may include how many fish are caught during a visit, or how many black bears are sighted.

While we cannot directly manage the recreation experience of individuals, we can manage the settings in which recreation occurs. Direction regarding this concept is found in the Forest Plan (FEIS, Chapter 3, page 3-295):

“Settings are described by defining the attributes that people can expect to find at a particular location. Knowing the attributes characteristic of a given setting assists people in matching their desires to appropriate settings. For example, individuals seeking solitude, challenge, and remoteness will seek settings that are distant, inaccessible, and undeveloped. In contrast, a person desiring easy access, comfort, and opportunities to interact with many other people will seek convenient highly used settings that provide modern facilities.

The Forest Service utilizes a system, called the Recreation Opportunity Spectrum (ROS), to describe different settings across the Forest. The ROS can be used in two ways for recreation planning: (1) it can be used to inventory recreation settings that currently exist on the Forest, sometimes referred to as “inventoried ROS” or “existing condition ROS”, and (2) it can be used to describe management direction for the future, also referred to as “proposed ROS”. The ROS system describes settings as classes with specific, defined attributes. The ROS classes range from highly modified and developed places to primitive, undeveloped settings.

Attributes typically considered in describing the settings are scenic quality; type and degree of access; remoteness; level of development; social encounters; and the amount of on-site management (USDA Forest Service 1986, also referred to as the “ROS Book”).”

The ROS classes in the WSLA are dominated by Primitive and Semi-Primitive Non-Motorized classes. Both of these classes focus on low-impact uses, little development of facilities, and resource protection. Full descriptions and a comparison of the different ROS classes can be found in the Forest Plan’s FEIS, Chapter 3, pages 3-296 and 3-297.

Impacts to the recreation experience may be due to social or physical factors. Physical factors that may impact recreation experiences are largely those associated with evidence of other recreational and commercial users, including but not limited to: vegetation damage, soil erosion and compaction, presence of fire rings, structures, garbage and feces. (Impacts to other resources in western PWS are addressed in Issue 2 of this chapter.) Social factors that may impact the recreation experience include but are not limited to: feelings of crowding, noise, impacts to scenery, incompatible use types and site occupancy.

Impacts to Dispersed Campsites

Inventories from 1997 to 2005 of coastal dispersed campsites have been analyzed by GRD backcountry rangers (**Figure 4.4**). **Table 4.2** displays the results of the analysis. Specific attributes in the analysis include the following:

- **Number inventoried campsites-** this is the total number of campsites that have received an initial inventory.
- **Number observed use campsites-** observed use includes any indication that human use has occurred on site. This includes measurable impact to vegetation or soils in confined use areas, presence of litter or waste associated with camping activities, limbed trees, presence or remains of a fire ring.
- **Percent of total observed use-** this is the percentage of observed use campsites in each individual analysis area compared to the total number of observed use campsites in western PWS.
- **Inventoried durable surface campsites-** this is the total number of campsites with opportunities to camp on durable surfaces. Durable surfaces include any surface without vegetation or organic soils. In this area of study it will mostly include beach gravel surfaces and will be limited to those surfaces available at all tide levels.
- **Observed use site with tree damage-** tree damages include any recent cuts to live trees or shrubs associated with camping activities. Typically this includes clearing areas for tent pads and cutting for firewood. This number reflects the campsites with damaged trees present, rather than total damaged trees.
- **Average condition class-** an average condition rating of all observed use sites within each analysis area. Condition classes are defined as follows:
 - **Level 1 Minimal Impacts:** Sign of very little use, a piece of litter, a couple hacked branches, small fire ring (or none), little or no trampled vegetation, trails not obvious.
 - **Level 2 Moderate Impacts:** Vegetation loss becoming noticeable, being used several nights/season, trails apparent, maybe a few trees damaged, established fire ring obvious.

- **Level 3 Heavy Impacts:** Sites are easily noticeable, extensive vegetation loss, shows a barren core, obvious trails, fire ring(s) with deep ash deposit, often trashy.

Table 4.2 Analysis of coastal campsite inventories 1997-2005.

Analysis Area	Number inventories campsites	Number observed use campsites	Percent of total observed use	Inventoried durable surface campsites	Observed use sites with tree damage	Average condition class
01-West Port Wells	5	5	2.6	3	5	1.80
02-Harriman Fjord/Barry Arm	33	28	14.8	22	25	1.82
03-College Fjord	7	2	1.1	5	2	2.00
04-Ester Island/Passage	7	2	1.1	5	1	1.50
05-Eaglek/Unakwik	52	22	12.2	42	17	1.63
06-Columbia Bay	10	8	3.7	9	6	2.25
07-Perry/Lone Islands	23	12	6.3	18	10	1.42
08-Naked Island Group	N/A	N/A	N/A	N/A	N/A	N/A
09-Culross Island/Passage	29	23	12.2	18	18	2.00
10-Cochrane Bay	10	4	2.1	2	1	1.00
11-Blackstone Bay	19	19	9.9	13	13	1.57
12-Kings Bay/Port Nellie Juan	29	18	9.5	23	12	1.72
13-West Knight Island Passage	15	9	4.8	10	4	1.78
14-West Knight Island	27	15	7.9	17	8	2.00
15-East Knight Island	4	4	2.1	4	1	1.25
16-Icy/Whale Bay	18	13	6.8	12	4	1.30
17-Port Bainbridge	20	7	3.7	16	3	1.00
18- Passage Canal	N/A	N/A	N/A	N/A	N/A	N/A
Totals	303	191(63%)	N/A	220(73%)	130(68%)	1.08

Information from the campsite inventory can help us better understand overall shoreline recreational use in the absence of data on independent users. Although there is no direct way to measure the amount of recreational use with this information, it does provide insight into physical locations where use is occurring. Columbia Bay, College Fjord, Culross Island/Passage, and West Knight Island all show average condition class rating of at least Level 2, Moderate Impacts (**Table 4.2**). **Figure 4.4** displays the condition class of all campsites with signs of use.

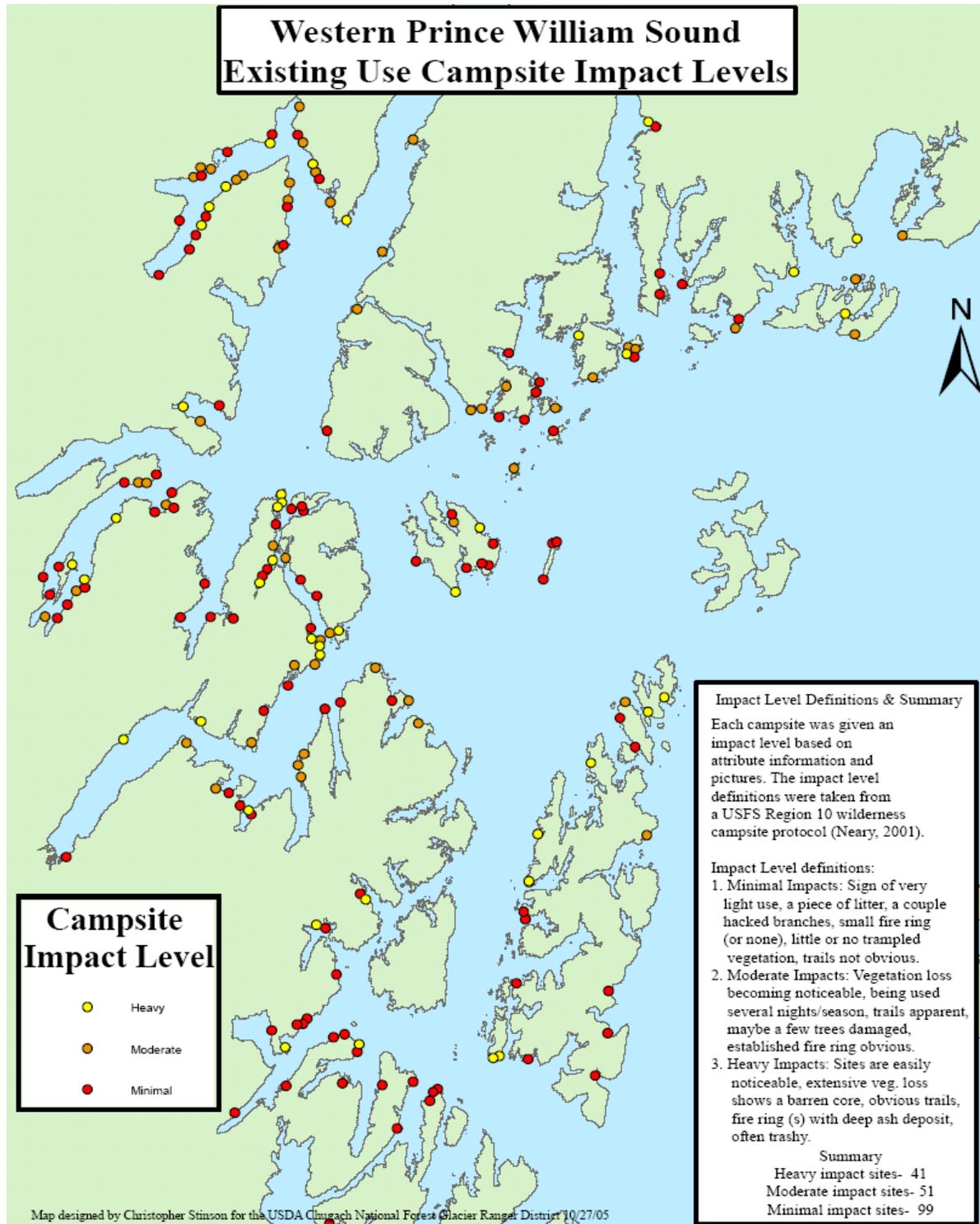


Figure 4.4. Dispersed Campsites in western PWS by Impact Level.

The significance of impacts to the recreation experience in the study area is unknown. If impacts are identified through the *PWS Human Use Study*, the significance of these impacts in relation to recreation management guidelines in the Forest Plan should be examined and monitoring strategy put in place.

INFORMATION NEEDED

As mentioned previously, independent recreational use of western PWS is poorly understood. The *PWS Human Use Study* may provide some insight to the distribution and level of non-commercial recreational use of the area. Historically, the distribution of commercial use in western PWS has also been poorly understood; however, the recently developed special uses GIS database can be used to further this understanding. Further analysis of outfitter-guide use will be necessary to gain a better understanding of the potential impacts to the recreation experience of commercial and private individuals.

Additional areas in which we need more information include the following:

- How do marine travel corridors, mode of transport and type of use affect the bio-physical and social resource? How do we define and measure limits of acceptable change to these resources? At what point should management action be initiated to mitigate impacts?
- What are the perceptions of wilderness setting and experience related to capacity recommendations and current use levels in the study area?
- How does the ROS concept apply to the social systems desired conditions established in the Forest Plan? Do these recommendations achieve a social setting that is consistent with the recommendations for the social setting of the Wilderness Study Area (WSA)?
- How is balance achieved to provide recreational opportunities for independent visitors and permitted operators while preserving ecological and archeological resources?
- How is the Forest Plan's recommendation for congressionally designated wilderness applied to management of the WSA? Do the recommended prescriptions have application to management of the WSA?
- How many groups are present within specific management areas at one time including independent visitors?
- How is group size, mode of shoreline access, frequency of landings, amount of time spent together as a group and split groups or time ashore considered when reviewing capacity recommendations?

Limited human use data has been collected as part of black oystercatcher studies conducted by District wildlife staff. These data include field observations and aerial surveys to identify boat traffic and tent sites in specific areas of western PWS. If a need is identified for future collection of human use data or verification of predictive models, these techniques could be adapted to suit future needs.

The National Wildlife Federation contracted with Craciun Research Group Inc. to conduct a survey to assess the attitudes, opinions and values of Alaskans with respect to PWS conservation issues. The project included secondary research, qualitative research in the form of focus groups and quantitative research in a survey of Anchorage and Valdez residents. This research provides insight into public opinion about how PWS should be managed. Some generalizations from the study show that regardless of the activity, most respondents who

have an opinion on the subject think PWS is being managed adequately. The areas with the highest percentages of dissatisfaction are jet skiing, logging and cruise ships. It should be noted that the percentage of respondents who did not have an opinion is very high on all questions.

OPTIONS TO REDUCE IMPACTS TO RECREATION

After the results of the *PWS Human Use Study* have been summarized, areas of potential conflict may be identified. Because the Forest Service does not generally manage independent public use in PWS, the best avenue to address recreation conflicts may be to work with special use authorization holders. The newly designed special uses GIS database will allow managers to identify specific geographic locations receiving high levels of commercial use. Identification of popular areas will enable managers to design an efficient monitoring strategy, focusing on high-use areas.

Options to alleviate any existing conflict or to avoid future predicted conflict may include placing restrictions on the season of use of specified areas, removing locations from eligibility for use by outfitter-guide companies, or spatially segregating certain types of activities. Some of the greatest potential for impacts on and from recreation may be the presence of various types of vessels on the waters of PWS, which the Forest Service has no authority to regulate. There are no conflict management programs or policies in place at this time, as no outstanding or recurring conflicts have been identified.

SAFETY CONCERNS

Safety concerns associated with increased recreation are generally concerns due to increased ease of access to PWS by a large population base in Anchorage. More people using this remote and often harsh and challenging environment for recreation opportunities may lead to an increased number of potentially unsafe situations created when people are not prepared with proper equipment or skills to comfortably and safely spend time in the steep terrain and cold waters of PWS. Every holder of a special use authorization is required to submit a detail Safety and Operating Plan, which is required to be updated annually and signed by the permit holder and the District Ranger. These plans detail emergency response, safety equipment and other topics such as bear safety and communications. However, while we can require commercial operators to provide us with this information, there is little we can require of the independent public recreationist. The backcountry information yurt that is set up during the summer in Whittier is an important tool for distributing safety information.

***Issue 2:** As recreation, non-recreation, and lands activities increase or change, they have the potential to impact other resource values such as wildlife, fisheries, hydrology, soils, minerals, vegetation, heritage, wilderness, and scenery integrity objectives.*

Key Questions

- What resources are being impacted, what are the impacts, and how significant are these impacts?
- In what areas do we need more information or not yet know the impacts?
- What are potential options to reduce impacts, such as management, partnerships, agreements, and educational/interpretive materials?
- What management measures are currently working or not working?

IMPACTS TO WATER AND SOIL RESOURCES

Concentrated human uses occur along some coastal areas of western PWS. Some of these areas include public use cabin sites, campsites, and salmon streams. With the increase in recreational uses that has occurred over the past several decades, these areas are experiencing some degree of resource degradation. The effects of these impacts on water resources can be considerable where heavy uses occur in environmentally sensitive areas. Currently, these impacts are seen throughout the WSLA area, but the magnitude of these impacts is not large. However, little data have been collected quantifying impacts to wetlands, stream banks, and water quality in western PWS from recreational and other uses.

Although human-induced erosion is not a significant issue at this time, it could change as access to the area continues to increase. Particularly vulnerable are stream banks, alpine regions, and wetland areas. Many salmon streams, including those situated near public use cabins are experiencing increased fishing pressure. Streambanks in unconfined stream channels in western PWS are at risk of degradation from angler trampling, particularly those channels in the Floodplain, Palustrine, and Moderate Gradient Mixed Control process groups (**Figure 2.4**). Trampling can damage vegetation along the banks, and the loss of rooting structure in the banks can lead to bank erosion and channel widening. The loss of the surface layer of soil is critical because of its productivity. The nutrients from decomposing organic material enrich the topsoil and provide a fertile bed for re-vegetation. Losing this layer requires that topsoil be brought in from elsewhere in order to reestablish riparian vegetation and reinforce the stream banks. Sediment from eroding banks can enter the stream channel, degrading water quality, filling pools, and shifting the grain size distribution. These processes can negatively affect salmon spawning and rearing habitat. Some of the specific areas of potential concern include the outlet of Coghill Lake, tributary streams in Jackpot Bay, and the outlet stream from Shrode Lake. At these particular sites, the effects of recreational use are relatively small at this time, but the potential exists for increased channel degradation.

Public use cabins and campsites are limited in western PWS and therefore receive heavy use throughout the summer season. Concerns in these areas include damage to nearby wetlands from visitors repeatedly walking through them, often creating multiple trails. Trampling of these sensitive wetlands can create mud bogs and impair water quality of nearby streams. Trampling of small streams near these sites can also lead to bank degradation and impaired water quality. The vegetation in these areas is easily damaged, which lessens their ability to hold mineral material together and consequently increasing the rate of surface erosion. The magnitude of these effects is not currently large, but the potential exists for increased degradation to wetlands and small streams.

Additional water resource impacts arise from the disposal of human waste at campsites, which may potentially affect water quality in these areas. Many of these backcountry campsites are frequently used by sea kayakers and other users, with limited areas in which to dig cat holes. Human waste disposed around these campsites can contain a variety of infectious bacteria that can enter water sources (Cilimburg et al., 2000). It is recommended that campers dispose of waste at least 200 feet from any water source, but this is difficult in many areas because of topographic confinement and the abundance of small streams and other water bodies. Many factors influence coliform levels, as well as the survival time of these pathogens in water. The heavy rainfall that is common in western PWS may have the effect of allowing bacteria to migrate from soils into water sources. However, little is known

about these processes, especially in coastal environments, and more research is needed. No water quality data on fecal coliform levels currently exist at campsites within western PWS. With increased use, the health risk associated with fecal bacteria around campsites has the potential to become a more serious issue in the future.

Other activities in western PWS area have varying effects on water resources. Water withdrawals for fish hatcheries at Eshamy Bay, Cannery Creek, and Main Bay de-water the lower portions of the streams that supply their water. These withdrawals may have an effect on channel morphology and fish habitat, although data have not been collected to address this issue. Several copper mines and other abandoned mines in the WSLA area, particularly those on Knight Island, have resulted in damaged resources, trash, debris, and acid mine runoff. It is unknown how these abandoned mines affect water quality, although heavy metals have been detected in soils at the Granite Mine (PRC Environmental Management, Inc., 1996).

IMPACTS TO FISH

Many physical, biological, and human activities can have potentially negative impacts to the fisheries resource and aquatic habitat in the assessment area. Natural occurrences such as floods, earthquakes, landslides, extreme cold temperatures, stream channel migrations, glacial recession, disease, and invasive species can affect fish populations. Human activities that potentially impact the fishery resource can include commercial and sport fishing, subsistence harvest, poaching, recreational use around streams and lakes, upland and riparian timber harvest, mining operations, and fish hatcheries. Specific effects on aquatic habitat and fish populations can vary depending on the location, extent, and timing of the activity. Additionally, these processes and their primary and cumulative effects may interact in complex ways that make it difficult or impossible to determine the cause of an impact.

In the WSLA area, recreational impacts associated with outfitter-guide, special uses, and general public use may be the greatest concern on NFS lands. Commercial and subsistence fishing and hatchery operations can also have detrimental effects to the fisheries resource, however, these activities are closely managed and monitored by State agencies.

The effects of commercial and private recreation use, and development of recreation facilities on fish habitat and fish populations in western PWS have received little investigation. Recreational activities and development in western PWS, such as cabins, dispersed campsites, and trails, are often located adjacent to streams and lakes. Effects of these developments on riparian vegetation can include removal of understory and overstory layers, loss of tree vigor, and loss of ground cover. These processes can reduce overhead streambank cover, recruitment of large wood into a stream, and bank stability. Localized effects to riparian soils can increase sediment delivery to stream channels reducing substrate quality, habitat complexity, and pool quality. Additionally, because recreational development in western PWS can increase human density around certain streams or lakes, direct impacts to fish populations in the form of increased harvest may occur. Currently, recreational use in upland, tidal, or riparian areas of the assessment area will have some effects on aquatic habitat and fish populations but impacts are likely to be minor. However, as recreation and outfitter-guide activities continue to increase, the potential for adverse effects on the fisheries resource also increases.

Fortunately, it does not appear that any fish stocks in western PWS are experiencing significant impacts related to management activities. However, efforts to reduce future impacts and monitor fish populations should continue. Murphy et al. (2004) presented several

approaches that likely would help reduce impacts to aquatic habitat and fish populations, as well as other resources. Some of these include: public education, enforcement of existing laws and regulations, excluding people from high density or sensitive areas, and habitat manipulation. The use of Management Indicator Species (MIS) has also been identified (coho salmon and Dolly Varden char) in the Forest Plan as a method to determine impacts associated with forest practices and management. Monitoring protocols for MIS using standardized methods are currently being developed to generate baseline data for MIS populations that will allow meaningful comparisons with future trends.

IMPACTS TO WILDLIFE

Understanding the effects of human-caused disturbance to wildlife is extremely difficult. Activities without immediate effects may cause cumulative impacts that are not apparent until long after the disturbance. Conversely, disturbances that cause immediate effects may not necessarily result in effects to wildlife populations. Unlike activities that physically alter habitat, disturbance may leave behind no obvious sign of impact making it more difficult to assess changes to habitat quality.

Whether or not disturbance will cause a change in population of a particular species depends on a variety of factors that are specific to each situation. Factors that influence the vulnerability of a species to disturbance include the biological activity occurring at the time of disturbance, group size, feeding location, response behavior, and degree of intrinsic wariness. Similarly, the frequency and form of human activity will influence the potential for disturbance.

When attempting to mitigate potential disturbance to wildlife from human activity the most important factors under control of the land manager are the location and timing of the human activity (Liddle 1997, Knight and Gutzwiller 1995). Murphy et al (2004) emphasize the importance of understanding these two variables for the wildlife species in western PWS. The seasonal sensitivity for most species in this area is associated with breeding and caring for young. This generally ranges from May through August (USDA Forest Service 2002a) which also coincides with peak recreation activity in western PWS (Murphy et al 2004). The Forest Plan identifies the importance of location and season by establishing a number of season-dependent separation buffers around sensitive wildlife resources (USDA Forest Service 2002a). Species or species groups within the WSLA analysis area which have defined buffer distances include: brown bear, black oystercatcher, mountain goat, bald eagle, Steller sea lion, harbor seal, waterfowl, shorebirds and seabirds. Of these we have adequate distribution information only for Black Oystercatcher, Bald Eagle, Steller sea lion, harbor seal and seabirds.

Forest Service jurisdiction is restricted to lands above mean high tide, which when combined with our current management practices for western PWS makes the separation of private recreation use from wildlife resources in western PWS difficult. However the GRD does permit a number of commercial operations under special use authorizations in western PWS and we are responsible for assessing potential impacts of these activities on wildlife resources. An exploratory assessment of spatial overlap between permitted commercial activities and important wildlife resources with known distributions and recommended separation distances has been completed for the WSLA area.

Three species and one species group (Black Oystercatchers, Bald Eagles, harbor seals and seabirds) were analyzed to determine the degree of overlap between special use authorization

permit areas and known nesting areas, haulout sites or colonies. Mapped special use authorization permits were buffered to the separation distance recommended by the Forest Plan for Black Oystercatchers (330 ft); Bald Eagles (330 ft); and harbor seals (750 ft). The separation distance for seabird colonies (330 ft) was selected in order to make relative comparisons to the other bird species included in this analysis³. These buffered polygons were then intersected with GIS point data representing known wildlife sites for the above species. The total percentage of overlap between wildlife resources and Special Use Permit areas within the WLSA area were: 48% of 105 known Black Oystercatcher nests, 37% of 853 known Bald Eagle nests, 24% of 38 known harbor seal haulouts, and 42% of 182 known seabird colonies. Figures for each species (**Figures 4.5 – 4.8**) plot the percent overlap, by Capacity Analysis Area, relative to the percent of total user days allocated to outfitter-guide permit holders within each area in 2005. This comparison allows the visualization of overlap relative to a theoretical maximum of allocated use for commercial operations permitted by GRD.

Of the sites that do overlap with permit areas, many overlapped with multiple permits. Of the nests which overlapped permit areas, 61% of Black Oystercatcher nests exhibiting overlap were overlapped by more than one permit area, while more than one permit overlapped with 42% of the Bald Eagle nests within the WLSA area that exhibited overlap with permit areas. The highest numbers of individual permits overlapped by a single wildlife site were found at two separate oystercatcher nests in Harriman Fjord, that were each overlapped by 9 separate permits.

It is clear that the majority of allocated commercial use occurs in Harriman Fjord, Columbia and Blackstone bays. The high relative levels of allocated use within Harriman coincide with a greater amount of overlap with Black Oystercatchers; approximately 20% of the nests in this Capacity Area overlap with activities permitted under special use authorizations. Not coincidentally, this area has been the focus of several years of oystercatcher nest success monitoring and a recent nesting behavior and radio telemetry study initiated by GRD (Spiegel et al. 2005). Two remote areas of western PWS, Western Knight Island and Naked Island, have relatively few permitted commercial user days but still exhibit notable overlap between commercially permitted areas and wildlife resources. Western Knight Island has high levels of overlap for oystercatchers, eagles, and harbor seals and Naked Island exhibits high overlap for seabird colonies, as well as eagle and oystercatcher nests.

³ No specific distance is recommended within the plan. Exact language states that separation distances will be determined in collaboration with USFWS which has recommended even greater buffer distances for seabird colonies outside of PWS.

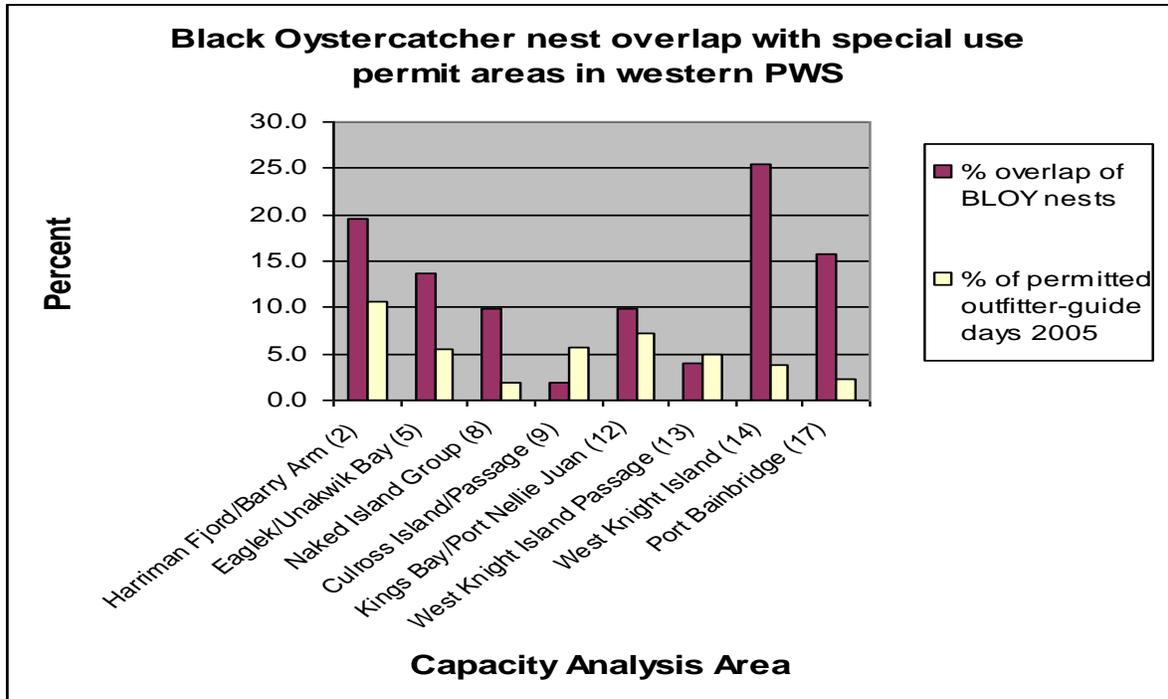


Figure 4.5. The percentage of known Black Oystercatcher nesting territories in western PWS that overlap with areas permitted for at least one outfitter-guide operation, in relation to the percent of total days (14,150) allocated to permitted outfitter-guide companies in 2005. Results are shown for each Capacity Analysis Area in which overlap with Black Oystercatcher nests is known to occur.

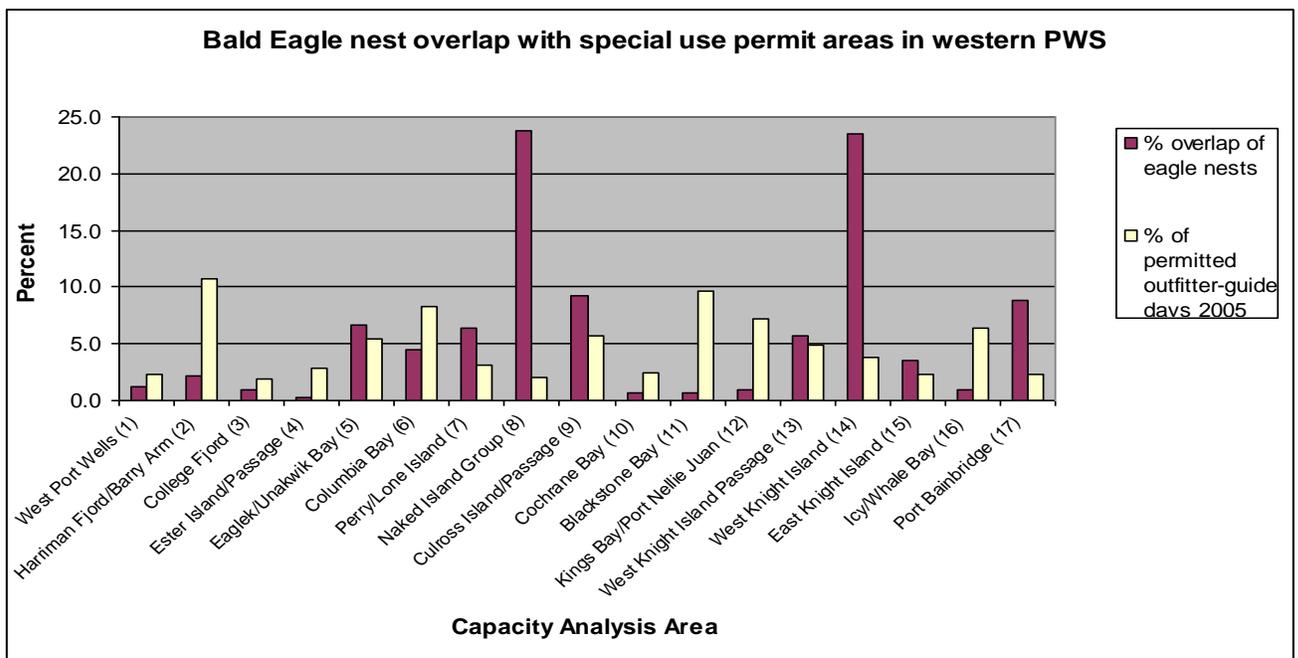


Figure 4.6. The percentage of 853 known Bald Eagle nests in western PWS that overlap with areas permitted for at least one outfitter-guide operation, in relation to the percent of total days (14,150) allocated to permitted outfitter-guide companies in 2005.

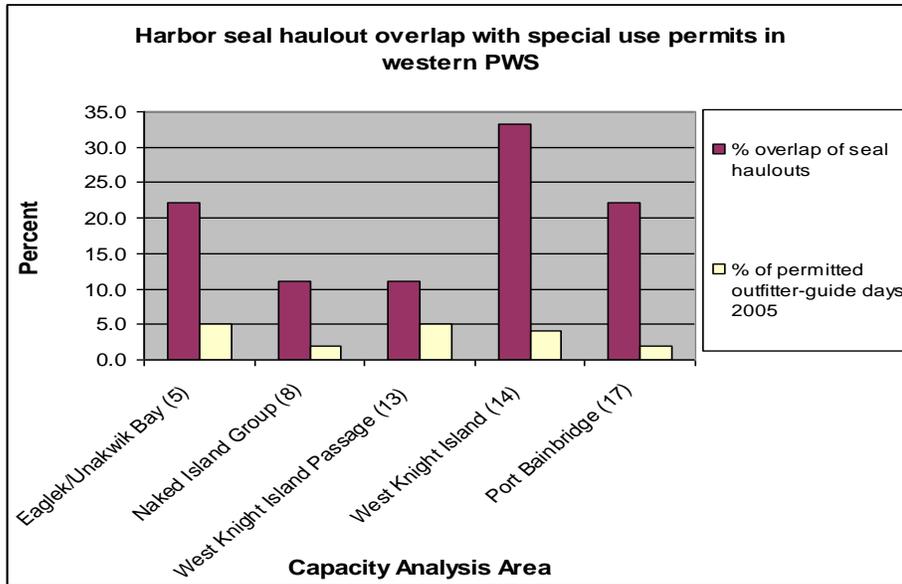


Figure 4.7. The percentage of 38 known harbor seal haulouts in western PWS that overlap with areas permitted for at least one outfitter-guide operation, in relation to the percent of total service days (14,150) allocated to permitted outfitter-guide companies in 2005. Results are shown for each Capacity Analysis Area in which overlap with harbor seal haulouts is known to occur.

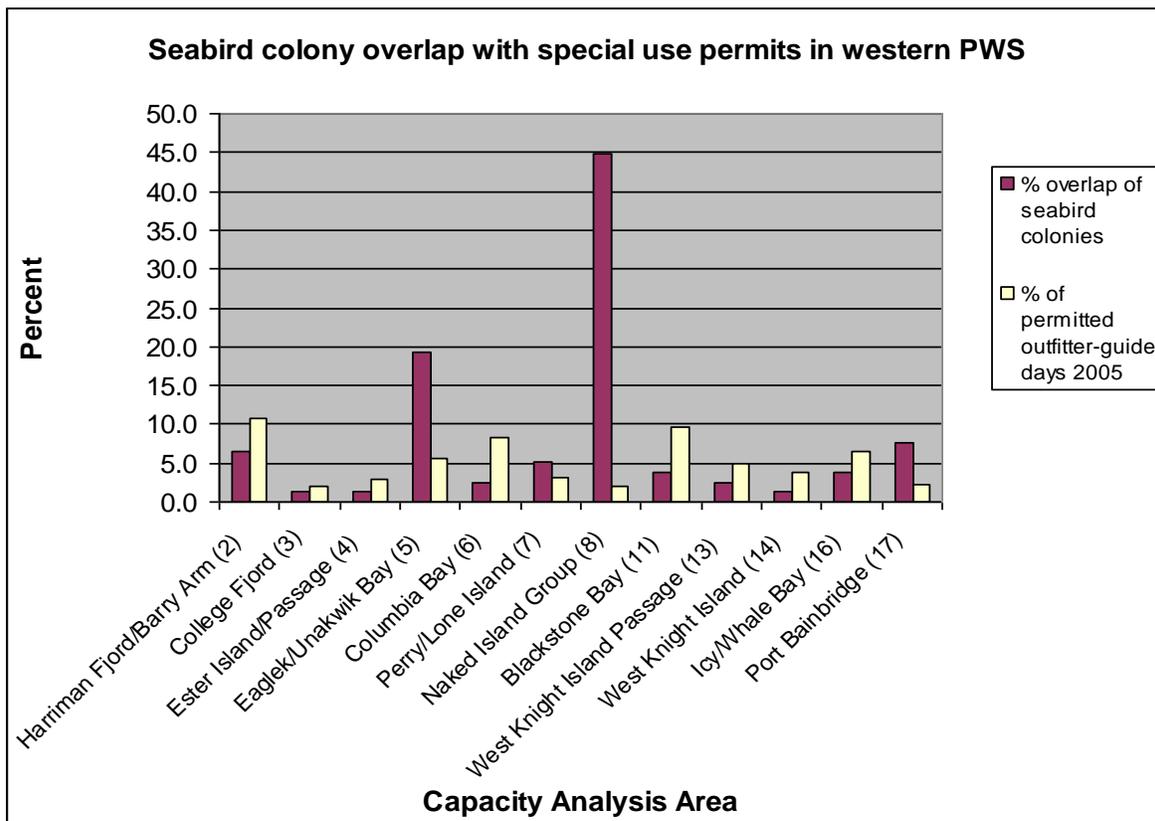


Figure 4.8. The percentage of 182 known seabird colonies in western PWS that overlap with areas permitted for at least one outfitter-guide operation, in relation to the percent of total service days (14,150) allocated to permitted outfitter-guide companies in 2005.

There are several limitations to this initial exploratory analysis. The distributions of these wildlife resources, with the exception of oystercatchers, are based on datasets ranging from 5-8 years of age and there may have been some change in wildlife distribution. This is especially a concern for Bald Eagles which exhibit varying levels of nest site fidelity from year to year in PWS.

It is also important to realize that simple spatial overlap does not necessarily equate to impact on these wildlife species. Wildlife disturbance responses are complex and vary between and within species (Liddle 1997, Knight and Gutzwieler 1995). Furthermore, GRD issues guidelines within individual special use authorizations requesting commercial operators to attempt avoidance and minimize disturbance of these wildlife resources. The above data regarding percent of commercial recreation service days in each Capacity Analysis Area refer to the allocated service days, not the actual number of days used by outfitter-guides. The most recent actual use numbers as reported by outfitter-guide permit holders were not available for this analysis as will not be reported and compiled until later in 2005. The evaluation of *actual* commercial use relative to these sites will improve the utility of this analysis.

It should also be emphasized that analysis related to commercial use does not constitute a complete evaluation of the overlap with *all* recreation in western PWS. An unknown number of private individuals are likely to favor many of the same camping beaches, anchorages, and recreational opportunities enjoyed by clients of commercial operations. Assuming this is true the level of human activity related to these sites is likely greater than that which is described here.

Another important missing component is the magnitude of temporal overlap (ie. the number of visits to these sites per week or day). An analysis predicting numbers of visits to important wildlife sites (Pigeon Guillemot colonies, harbor seal haulouts, and concentration areas for cutthroat trout) was completed based on data from the late 1990s predicting human use patterns in western PWS (Murphy et al. 2004). This important study, conducted prior to the Whittier Tunnel opening, established a baseline for overlap with some key wildlife resources and confirmed the feasibility of applying human use simulation modeling (Gimblett 2002, Cole 2005) to the management of recreation in western PWS. Current research by the Pacific Northwest Research Station (PWS Human Use Study), aims to evaluate existing human use patterns throughout PWS. Results from this work will help to describe contemporary spatial and temporal overlap between both private and commercial human use and important wildlife areas. Perhaps more importantly it will allow the evaluation of how human use patterns and intensity have changed since the opening of the Whittier Tunnel and inform the allocation of Forest monitoring efforts relative to important wildlife resources.

Many of the activities that are occurring in PWS today, and probably for the foreseeable future, may not show immediate impacts to wildlife. Many people may think that the disturbance that they cause is inconsequential and will not directly harm the animals. While they may be correct, the cumulative effects of disturbance may often be significant or they may be disturbing an animal at a crucial time period, which could lead to the eventual loss of their offspring or other serious consequences.

IMPACTS TO VEGETATION

Invasive Plants

Of particular concern in western PWS is the potential for introduction and spread of non-native invasive plants. As discussed in Chapter 2, non-native plants have been found within the WSLA area in areas with obvious human use. Specifically, non-native plants have been found in all Forest Service cabin locations, a dispersed campsite on Willard Island in Blackstone Bay, and a spawning channel in Pigot Bay. Species found include *Poa annua*, *Plantago major*, and *Papaver nudicaule*. None of these species is considered an aggressive invasive; however, future plans could include the removal of these plants to prevent future spread. Other actions as described in the Chugach National Forest Invasive Plant Management Plan (2005) can be implemented to protect natural ecosystems from invasive plants. Since early detection and treatment of invasive plant populations can effectively prevent spread, areas of high human use should be periodically monitored for non-native plants. Additionally public education is another important tool in preventing the introduction and spread of invasive plants.

Rare Plants

Coastal areas contain the greatest potential to support habitat for the greatest number of Region 10 sensitive plant species. As shown in **Figure 2.9**, areas shown in orange and red have habitat characteristics for the greatest number of sensitive species (five to eight species). Areas shown in yellow and light green have potential for a moderate number of sensitive species (three to four). Darker green areas have potential for only one or two sensitive species while gray areas would not support habitat conditions for any sensitive species.

Based upon the results of the bioenvironmental analysis shown in **Figure 2.9** the areas of most concern occur along the coastal fringe, which is also where most human use occurs. Specific areas of concern include: all islands, Cochrane Bay, Pigot Bay, Port Wells, Barry Arm, College Fjord, Nellie Juan River, Knight Island Passage, Bainbridge Passage, Port Bainbridge, Eaglek Bay, Unakwik Inlet, Wells Bay, and Long Bay. Similar results have also been documented in a draft report for the Big Islands Landscape Assessment, which used the analytical tool Netweaver to assess plant areas of concern. The Big Islands Landscape Assessment area consists of islands in the eastern portion of PWS with similar conditions and site characteristics as the WSLA area. This report suggests that proposed projects in most of the lower elevation coastal areas would likely need more intensive sensitive plant biological evaluation work than projects at higher elevations.

IMPACTS TO HERITAGE RESOURCES

Cultural resources documented in the WSLA area are experiencing negative impacts from increased recreation and permitted use. Those sites located in areas of heavy water traffic are subject to erosion from boat wakes and are also being negatively impacted from the practice of digging holes to dispose of human waste. In addition, frequent use by recreational campers has degraded the features of many sites. One prehistoric archaeological site in particular has been severely impacted from increased use in Culross Passage. An ANCSA 14(h)(1) site that is eligible for conveyance to the Regional Native Corporation, Chugach Alaska Corporation, this site is popular with recreational boaters and kayakers because of the close proximity to Whittier and the protected cove where it is located. Sound management decisions need to be made to protect this non-renewable resource that is subject to irreversible damage. The extent

of the impacts to the site should be adequately assessed. Periodic monitoring by the Heritage Program specialists and also the Chugach Alaska Corporation specialists has been accomplished recently to track the damage and collect information. This particular site has reached a critical stage of damage and will likely need to be closed to public use to arrest and mitigate the damage.

Unknown Impacts

Although over 99% of the Chugach National Forest remains to be inventoried for cultural resources, previously documented prehistoric and historical 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 150 feet elevation above high tide level and historic use followed similar patterns, this strip of land is considered to have the highest probability for cultural resources. Prehistoric uses which differ from this general model include specific hunting, gathering, and burial practices. Recent 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 beyond identified beach ridges in the high probability zone.

The current level of monitoring of archaeological sites is not providing adequate resource protection. During the past five years, an average of 10 archaeological sites have been monitored annually in the WSLA area. This low level of site monitoring is not adequate to provide the level of information necessary to provide adequate management decisions. Without current site condition information, determining whether disturbance is from natural weathering or recreational user visits is often difficult. Partnering with the backcountry kayak rangers has provided valuable information on the current condition of sites and the frequency of use by boaters and kayakers. Providing information to the public can also help protect cultural resources. For example, the Heritage Program has participated in trips with school groups to visit archaeological sites with the site steward. In addition, Passport in Time volunteer projects has given Forest visitors the opportunity to participate in protecting, monitoring, and recording archaeological sites in western PWS.

Potential Options to Reduce Impacts

The recent Presidential Executive Order 13287 directs agencies to search out partners for cultural resource interpretation, preservation, and heritage tourism. A large number of opportunities for partnership exist, some of which include Cultural Resource Stewardship agreements with commercial outfitter-guide companies, and partnerships with groups that have specific interests.

Fostering partnerships with interested entities for documentation, preservation, and interpretation of prehistoric and historic sites, cultural landscapes, and rehabilitation of historic buildings will provide additional management options. Developing collaborative stewardship relationships with interested parties could provide protection and interpretation of cultural resources. Establishing partnerships with university programs for research work will provide background information for management and interpretation of cultural resources.

The Heritage Program currently has one stewardship agreement in place with an outfitter guide to monitor historic sites in western PWS on GRD. Establishing additional partnerships and stewardship agreements within the WSLA area in the future will provide protection to

archaeological sites. By establishing these agreements with reputable partners, the Heritage Program will increase the frequency of site monitoring.

Various historical societies in Alaska, including the Cordova Historical Society and the Alaska Historical Society, have demonstrated interest in becoming partners with the Chugach National Forest on documentation, preservation and interpretation of cultural resources. Potential future partners in historic research and documentation are the State of Alaska's Office of History and Archaeology, and the departments of Anthropology and History at the University of Alaska.

Issue 3: *As human use approaches capacity in some areas, management options are needed to maintain capacity objectives, which ensure compatibility with wildlife, fisheries, hydrology, soils, minerals, vegetation, heritage, wilderness, and scenery integrity objectives.*

Key Questions

- Which areas are highly sensitive to increased use?
- In what areas is there a need to close/restrict use, and how would this be accomplished?
- In what areas could hardened campsites, cabins, trails or other infrastructure be built?
- What partnerships or agreements are needed to maintain capacity objectives?
- What educational and interpretive materials are needed to maintain capacity objectives?
- How do we work with our permittees, non-permitted recreation users, and adjacent landowners to maintain capacity objectives?

AREAS SENSITIVE TO INCREASED USE

Monitoring efforts to understand the impacts of increased use should be focused in areas of high recreational use, as identified through the special uses GIS database, inventory of dispersed campsites and other sources including the *PWS Human Use Study*. Areas of high value for biological resources that also receive high levels of use should be the focus of monitoring efforts.

Fish

As mentioned previously under Issue 2, areas of developed recreation (cabins, hardened campsites, and trails) present an increased chance of detrimental impacts to the fisheries resource and associated aquatic habitat. Such areas may be considered highly sensitive to the fisheries resource depending on the habitat quality of the stream, the size of the fish population using the stream, and the level of human activity.

According to the latest completed human use study for the western Sound (Murphy et al. 2004), user groups most likely to come ashore on the National Forest (kayakers and recreational motor boaters) were documented most frequently in Blackstone Bay, Harriman Fiord, Culross Pass area, Main Bay area, and the southern shoreline of Esther Island. Popular landing and camping sites in these areas are almost always associated with a freshwater stream (D. Sanders, USFS, Girdwood, personal communication). Fortunately, Blackstone Bay (highest density of boaters) and Harriman Fiord do not support any significant populations of anadromous fish (Johnson et al. 2004). However, due to the ubiquitous nature

of pink and chum salmon in the assessment area, smaller populations of these species may exist in several of the streams that drain into these bays. These small populations may be highly sensitive to increasing densities of human activities.

Culross Pass is another area that receives substantial boating and camping use and probably has one of the highest densities of recreational motor boaters in the western sound (D. Sanders, USFS, Girdwood, personal communication). Access to this area is within range of most motor boats leaving from the Whittier Harbor, the sheltered waters here provide reasonable anchorages, and the many freshwater streams provide desirable areas to camp along the shoreline. This area also provides quality spawning habitat for pink and chum salmon. Regrettably, it is this recreational motor boat user group that is probably most often associated with higher impacts to these areas. This mode of transportation allows heavier supplies and tools of which associated impacts in the form of garbage and chainsaw use have been observed and documented on a regular basis. It is not known if this level of disturbance has had an impact on fish populations and aquatic habitat in the Culross Pass area.

Wildlife

The Capacity Study completed by GRD in 2001 to establish guidelines for managing human use in western PWS did not consider potential impacts to wildlife resources. It was developed solely to manage levels of human encounters as a recreation parties moved within Capacity Analysis Areas. It was presumed at the time of development that if human activities were generally low throughout western PWS, impacts to biological resources would be negligible. Analyses since that time (Murphy et al. 2004) have shown that use tends to concentrate in specific areas leading to the possibility of localized impacts to biological resources. Given subsequent direction within our Forest Plan with regard to separation of human activity and wildlife, as well as the apparent increasing levels of human use, it will be necessary to include some sort of assessment of sensitive biological areas within future capacity analysis studies.

Specific areas of concern would likely be those where significant overlap occurs between human use and wildlife resources. Preliminary work to identify areas of concern has already been discussed under Issue 2 with regard to Special Use Authorization permit areas. This information could be updated in the future to incorporate all recreation use information from sources such as the *PWS Human Use Study* as well as updated wildlife information.

Plants

As stated in Issue 2, highly sensitive areas would include areas vulnerable to invasive plant introduction and spread. Areas of high potential habitat for sensitive species would also be considered areas of concern. However, those areas with known locations of sensitive plants would be of highest priority. These include: Evans Island, Whale Bay, Knight Island, and possibly Perry Island. As other high potential areas are surveyed and sensitive plant populations are found, they would be added to this list.

Heritage Resources

The high sensitivity zones for cultural resources in the WSLA are:

- 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, or lake terrace systems.
- Lake and stream systems containing, or known to have contained, anadromous fish runs; including a focus on barrier falls locations in such systems.
- Caves and rock shelters, and igneous rock formations known for caves and rock shelters.
- Known sources of potential raw materials (as suggested by exceptional concentrations of culturally modified trees or cedar trees, etc.).
- Other areas identified through literature or oral history research/sources.

AREAS TO CLOSE OR RESTRICT USE

Areas close to Whittier including Blackstone Bay and Harriman Fjord/Barry Arm will likely be among the first areas where use restrictions or closures may potentially occur in the future. At this time, however, no specific sites or large general areas have been identified for use restrictions or closures. If a potential need for any such actions is identified in the future, public input should play a large role in the management process.

Closure may become necessary for those archaeological sites that are being looted and disturbed from increased use by recreational visitors. Eligible ANCSA 14(h)(1) sites that are selected for conveyance should be closed to public use to protect the sensitive resource from irreversible damage. Closing the site without drawing attention will be a challenge, but not unmanageable. Posted signs may need to have generic language that directs visitors to respect and protect the sensitive resources in the area without actually identifying the nature of the resource or the exact location. The Regional Native Corporation that has selected the ANCSA 14(h)(1) sites, will likely face a similar management challenge to protect their sites from visitors that are habituated to using these areas for recreation. A mutual agreement with the Native Corporations could be explored to design effective methods to close or restrict the sites from public use.

AREAS TO HARDEN CAMPSITES OR BUILD CABINS OR TRAILS

A coastal campsite management strategy is currently being developed by District backcountry recreation staff. Sites that are potentially suitable for campsite *hardening*, *improvement* or *reclamation* have been identified. Sites that are naturally durable that could withstand higher use levels without further work are also identified. Campsite *development* is addressed only in Blackstone Bay. Terminology is defined below for clarification.

Campsite hardening: The intent of hardening projects is to protect sensitive resources from degradation. Durable camping/use surfaces are created with the intent of reducing impact to sensitive resources (typically organic soils) by containing impact within an established area. Site design is generally contained to impacted areas. In the WSLA study area, improved durable surfaces are generally beach gravels or other mineral substrates.

Campsite improvement: The intent of campsite improvement projects is to enhance recreation opportunities at a site or within an area. Campsite improvements may include amenities beyond durable surfacing such as food storage facilities, outhouse facilities, signage or boardwalk trails. Building durable surface use areas outside already impacted areas would also qualify as campsite improvement. Campsite improvement may occur at a site that has been hardened or at a naturally occurring durable surface site.

Campsite reclamation: Is a process where the causal factor of resource damage is removed or curtailed and measures are taken to allow a campsite or portions of a campsite to return to a natural state. This process may involve a combination of hardening, improvement or development. Generally, some form of education and compliance work is needed.

Campsite development: Is the construction of a campsite in an otherwise unused area or in an area that does not provide suitable durable surface camping in its natural state.

Naturally durable campsites: These are campsites that have natural durable surfaces available for camping such as raised beach gravel shelves, glacial scoured rock or glacial outwash fans. It may be appropriate to encourage more use at these sites relative to other, less durable sites. Improvements can be made to these sites to make them more amenable and encourage higher levels of use.

Combinations of the above measures may be used for coastal campsite management. The management method selected will depend on the management objectives for specific areas. Generally, campsite projects will fall under two categories of management intent: resource protection, or recreation opportunity enhancement.

Resource Protection

Resource protection projects may occur at impacted sites that are experiencing resource degradation, with a goal of reducing or eliminating further degradation. In addition to site-specific resource protection goals, these projects may be undertaken to reduce resource degradation in a larger area by providing desirable, durable sites for focused use.

Fish: Another opportunity to alleviate impacts to areas where freshwater streams drain into the saltwater environment is to promote shoreline access and camping in areas that are not immediately adjacent to streams. This could be accomplished using hardened and dispersed campsites. Hardened campsites are highly desirable in the western Sound because they provide a level, flat, well-drained pad up off the native vegetation for visitors to place a tent. Hardened campsites in Blackstone Bay are very popular with recreationists and help prevent extensive damage to low-lying vegetation. By placing these improved sites away from streams, visitors may opt to stay there instead of setting up a camp adjacent to a stream.

Heritage: Building hardened campsites within proximity to archaeological sites could offer protection to the sites if the established camping areas are more attractive to recreation users than the archaeological site location. The disadvantage could occur when the hardened campsite has reached capacity, and the archaeological site location becomes the next best option for a campsite. Survey by archaeologists has recently occurred in response to the need for hardening campsites in coastal areas. While some of the locations posed no potential to affect archaeological sites, other preferred locations for hardening occurred directly on pre-existing cultural sites and will need to undergo further review and consultation. Consultation with the native tribes is required prior to making any management decisions on new campsites, trail, cabins, or other infrastructures. Concern has been expressed regarding development occurring on National Forest lands adjacent private lands in comments received from Chugach Alaska Corporation in response to other landscape assessments recently completed on the Chugach National Forest (CAC 2004).

Recreation Opportunity Enhancement

Campsite projects may also be undertaken for recreation opportunity enhancement goals, to provide opportunity for recreational use in areas where desirable campsites are lacking.

Projects undertaken for resource protection will generally increase recreation opportunity at the same time. Any projects to be undertaken should be a part of a multi-disciplinary coastal campsite management plan. District staffs are currently initiating review of a potential coastal campsite management strategy and will make specific recommendations after further analysis.

The majority of western PWS is managed as the Nellie Juan – College Fjord Wilderness Study Area. It is to be managed according to the provisions of the Wilderness Act of 1964 and ANILCA of 1980. According to the Forest Plan, hardened and dispersed camping sites are allowed within the WSA. Campgrounds, docks, ramps or transfer facilities are not. All projects undertaken within the WSA are subject to a Minimum Requirement Decision Guide process to minimize to the greatest extent possible impacts to the Wilderness resource.

Campsite hardening work has already been completed in Blackstone Bay at two sites. Blackstone Bay presents an opportunity to develop a comprehensive land and resource and recreation management plan for an identified area of concentrated recreation use. A comprehensive review of wildlife, archeological, fisheries, botanical and Wilderness resources should be conducted. Campsite projects within the area should be addressed as one form of mitigation and used in conjunction with other management tools (education, outreach, compliance and permits) where appropriate. Upon completion of the management plan, project work should be initiated and completed within a specified time frame. Public and internal review should then take place. Lessons learned from this project can then be applied to other area management plans and campsite projects in the WSA.

Potential campsite project sites have been identified in Harriman Fjord (view beach), Barry Arm (blacksand beach at Coxe Glacier), College Fjord (Coghill Point), East Flank Island and the northern end of Esther Passage, Culross Passage/Island, Perry Island, additional sites in Blackstone Bay, and Dual Head area in Icy/Whale Bays.

PARTNERSHIPS OR AGREEMENTS

Input from and discussion with the public, outfitter-guide permit holders, Native Corporations, the State of Alaska and the City of Whittier, as well as other interested parties needs to continue on a regular basis. The PWS Recreation Use Issues Workshop that has been held in Portage Valley at the Begich, Boggs Visitor Center should be continued and expanded. Special uses, especially outfitter-guide companies, should be added as a component of the symposium.

Partnerships and communication with other land owners should be developed to work toward integrated management of the western Sound. It should be recognized that any shoreline issues will inextricably involve the State of Alaska, as they currently manage land below mean high tide through a 1992 MOU with the Forest Service.

Given land management jurisdiction in the Sound is complex, public education may be one of the strongest tools available to managers to mitigate impacts to wildlife resources. As use approaches capacity it will become increasingly important for GRD to collaborate with other federal and state agency partners as well as private groups to coordinate education efforts related to wildlife viewing ethics in western PWS. Both ADF&G and USFWS have staff positions dedicated to environmental education that have been active in western PWS. The recently founded private group, The Prince William Sound Keeper or others like them may also serve as an excellent potential partner for assisting in the education of recreationists in western PWS.

EDUCATIONAL AND INTERPRETIVE MATERIALS

Summaries of recreation use data, including permitted commercial use and data summaries from other sources such as the Whittier backcountry kiosk, should be made available to the public in a concise, easy-to-read format with maps and figures clearly illustrating known use numbers. Educational materials including Leave No Trace guidelines, wildlife awareness literature (such as bear safety, Black Oystercatcher awareness, etc.) should continue to be made available to visitors at the Whittier kiosk. These materials are currently distributed to all western PWS outfitter-guide permit holders at issuance of their permits, and reminders are sent out annually in a pre-season letter.

Public education and closely monitoring impacts at high-use areas are two management options that may help prevent further degradation of aquatic habitat and fish populations. Because the Whittier Harbor is the closest facility to these higher-use areas in the western Sound and the Forest Service maintains an information yurt there, this would be an excellent opportunity to provide educational materials to visitors explaining the importance of the fisheries resource to the ecology of Prince William Sound. Posters and pamphlets could also emphasize low impact recreational use and potential recreational impacts to aquatic habitat (and other natural resources).

Finally, maintaining a presence in these high use areas would give managers direct contact with visitors, allowing further education and an opportunity to express concerns if needed. Because the District only has one law enforcement officer it is a challenge to maintain a presence over such a large area. However, many other Forest Service crews are working on projects in the western Sound and they can contribute to non-confrontational public contact. Further, the District's kayak ranger program has been expanded to include a total of four employees. This crew is constantly monitoring boating and camping activities in the western Sound and educating visitors on the principles of "Leave No Trace" low impact recreation.

PERMIT HOLDERS, INDEPENDENT RECREATION USERS, AND ADJACENT LANDOWNERS

Capacity objectives are currently under review, and necessary changes can best be identified by communication with permit holders, independent members of the public, environmental organizations, state land managers and Native Corporation representatives. Of the various groups with which Forest managers must communicate for effective land management, the independent recreationists of western PWS are the people that are the most challenging to identify effectively. Forums such as the PWS Recreation Use Issues Workshop are key to the effort to identify and communicate with this group.

Scoping for requested special use authorizations should include representatives of the State of Alaska Department of Natural Resources, particularly the State Marine Park system. Native Corporations with adjacent land holdings should be included in the scoping lists for permit requests, as should other Native groups that depend on these areas for subsistence hunting. Land ownership should be clearly displayed on permit maps associated with special use authorizations.

Issue 4: *The assessment area supports many wildlife and fish species that contribute significantly to the economic, recreational, and subsistence needs of both local residents and visitors. Also, demand for opportunities to hunt, fish, and watch wildlife in Prince William Sound appears to be increasing. To preserve these biological resources, the Alaska National*

Interest Lands Conservation Act (ANILCA) states that fisheries research, management, enhancement, and rehabilitation activities are allowable within wilderness study areas to maintain fish production at optimum sustained yield levels. Additionally, the Forest Plan directs that lands within Prince William Sound be managed primarily to maintain the wild character of the area and sustain its unique fish and wildlife. However, basic information on many species is insufficient or lacking, making it difficult to know if these species are being sustained and whether or not enhancement activities are necessary.

Key Questions

- For what species or populations do we need more information?
- What opportunities exist for monitoring of appropriate management indicator species in western Prince William Sound?
- Can we obtain adequate information on the distribution and relative abundance of these species to meet this goal?
- What opportunities exist for partnerships or agreements to obtain this information?
- What fish and wildlife enhancement opportunities exist?

FISH

Currently, no resident or anadromous fish species in the assessment area is listed as endangered, threatened, or sensitive. Because these fish populations appear relatively healthy, an urgency to obtain more detailed information than what is already known does not exist. Between the *Catalog of Waters Important for Spawning, Rearing, or Migration of Anadromous Fishes* (ADF&G 2004) and the US Forest Service fish distribution GIS data layer, presence and absence of commercially important freshwater fish species in western PWS is well documented. Whereas distribution of Dolly Varden char and coastal cutthroat trout is also documented, it may not be mapped as thoroughly in the assessment area because their economic value is not as significant as the five species of Pacific salmon.

Exact population estimates for fish species in the western sound do not exist. However, ADF&G and USFS monitor escapements (number of adult fish returning to spawning grounds) of several salmon species important to commercial and subsistence fishing through the use of weirs, aerial counts, and stream counts. Whereas weirs provide a more accurate estimate of escapement, the costs and maintenance associated with this technique limit their application in western PWS. Aerial and foot escapement counts are less accurate and often limited by environmental conditions but can still be used to generate an index of run-timing, peak escapements, and year-to-year variability in escapement numbers within a particular stream. Additionally, ADF&G closely monitors commercial fishery harvest on a regular basis providing additional information on the health of salmon stocks in the assessment area.

In an effort to better understand impacts associated with forest management, the Forest Service is mandated to select representative species, both aquatic and terrestrial, that can be monitored to determine population trends and their relationship to changes in habitat. This requires the ability of managers to understand habitat use by these species, detect population changes, and determine when population changes are the result of habitat impacts associated with management actions. To have an effective monitoring plan, the species population needs to be widely distributed throughout the forest and sampling methods need to be sensitive enough to detect changes in those populations over time.

Dolly Varden char and coho salmon were selected as the aquatic MIS for the Chugach National Forest because of their value to commercial, subsistence, or recreational fishing, and their wide distributions throughout the Forest; also, they can be considered ecological indicators of forest health. However, both of these species have complex life history characterizations that include spending part of their existence in the saltwater environment (anadromy). This will make it very difficult to determine if changes in population structure are the result of forest management activities or some other impact outside the control of the Forest.

Fortunately, resident forms of Dolly Varden char exist in the assessment area. These are populations that spend their entire life in the freshwater environment, usually above instream barriers that prevent anadromous fish from accessing upstream habitat. These resident species provide a better opportunity for detecting impacts associated with Forest management activities because their habitat quality is almost exclusively associated with the surrounding uplands.

However, several issues associated with an effective aquatic MIS monitoring plan for western PWS still exist. Because lakes in the assessment area may be less susceptible to impacts associated with forest management activities, they may be acting as a buffer for resident fish populations. This can reduce our ability to detect population changes due to management impacts. Therefore, it is recommended to monitor resident fish populations in streams above barriers not associated with a lake. After four years of exploring and sampling various stream systems in the assessment area, a fish population meeting these habitat requirements has not yet been located.

A further complication in seeking opportunities to monitor an appropriate MIS is that stream selection should be based on increased risk of management activities affecting MIS habitat. Because western PWS is managed as a wilderness study area, many management activities often detrimental to aquatic habitat such as logging, roads, mining, or grazing do not occur or are very limited. Currently, the greatest concerns for managers in the WSLA area are probably impacts associated with recreation and recreational fishing. Considering the majority of recreational activities in the assessment area occur within a short distance from the saltwater and well below most instream barriers, selecting an appropriate monitoring site and fish population may be futile.

Finally, aquatic productivity and population trends can be affected by natural events such as floods, droughts, landslides, severe winter conditions, disease, and trophic conditions. Separating natural variation from changes associated with management activities in the assessment area can be a difficult task and may present a significant challenge to the application and objectives of the MIS monitoring protocol.

WILDLIFE

There are a number of species within western PWS for which we do not have complete distribution information. Perhaps most important among them are those for which we have specified separation distance between important concentration areas and human activity. According to the Forest Plan, these include waterfowl and mountain goats. Potential impacts are likely a greater threat to waterfowl within western PWS given their direct spatial and temporal association with shoreline based recreation. Of specific concern are potential impacts to Harlequin Ducks and Scoters which undergo molt during peak summer recreation

periods (late July and early August) at which time they are flightless and must expend great amounts of energy to move away from disturbance stimuli.

Impacts to mountain goats are most likely to occur as a result of increased fixed-wing activity in western PWS. There is currently an undefined amount of fixed wing activity in western PWS which may increase as commercial sight-seeing operations become established. Much of the analysis area is in Wilderness Study Area status and would preclude helicopter access under special use authorizations; however, areas adjacent to Passage Canal have been proposed for helicopter supported tourist activities. In contrast to the Kenai Peninsula we do not have a very good understanding of the distribution of goat habitat within PWS and thus creating effective mitigation alternatives is difficult.

According to Forest Plan direction continued monitoring of Black Oystercatcher population and distribution relative to human use is required. It is also necessary to refine our knowledge of active bald eagle nests within western PWS. Based on existing knowledge of distribution, 315 known nest sites appear to be overlapped by USFS permitted activity. It is impossible to know the relative proportion of those that actively support nesting eagles. It will also be important to collaborate with the USFWS in their efforts with regard to seabird colony surveys to ensure that we have contemporary location and status information.

***Issue 5:** Production of natural resources has historically occurred in the area. Mineral resources are known to exist and their production may conflict with other uses and resources.*

Key Questions

- What Forest Service lands are underlain by private mineral estate?
- What lands are open to mineral entry, mineral leasing, and mineral material sales?
- What mineral deposits and occurrences are known and what is the potential for mineral development?
- What opportunities exist for other resource production?
- Are there conflicts between resource production and other resource values?
- What effect have mining operations, logging, and the related camps had on the cultural landscape of the Sound? Some of these mines, millsites, and logging camps may now be considered historic and afforded protection.

HERITAGE

Currently a cleanup effort is underway to mitigate petroleum, oil and lubricant contaminants that may exist on National Forest Lands. Since many of the mines and mill sites are either eligible or potentially eligible for the National Register of Historic Places, consultation with the State Historic Preservation Office is necessary and concurrence is desired prior to cleanup efforts being undertaken. In addition, for those sites that are considered eligible, an archaeological monitor is required to be present on site while the cleanup occurs.

Open mining shafts are also being actively closed to mitigate for safety hazards to visitors. The Heritage Program has participated in the closures of mine adits and shafts for National Register eligible sites. Abandoned canneries are also being investigated for safety hazards and cleanup efforts. The Heritage Program is working with the Regional office to compile a

list of the high priority sites and will accomplish site visits to complete assessment work in FY2006.

Issue 6: *Past and potential future activities and existing trends that are out of our control (fast ferry, development on non-National Forest land, the Exxon Valdez oil spill, introduction of invasive species, geologic hazards, and climate change) may create conflicts or opportunities for recreation and other resources.*

Key Questions

- What are the past, present, and potential future events, activities, and existing trends that may affect resource values and human use?
- How do these events, activities, and trends affect resource values and human use, what are the impacts, and how significant are these impacts?
- If there are impacts/opportunities how do we manage and plan to ensure they are compatible with Forest Service management objectives?

PHYSICAL CONDITIONS

Climate Change

The climate throughout Alaska has gradually become warmer over the past century. Temperature data from Whittier, Alaska over the last 50 years show a trend of increasing average temperatures, with average annual temperatures increasing on the order of 3 to 4 degrees F since 1950 (**Figure 4.9**) (Western Regional Climate Center, 2005). Although natural climatic oscillations explain some of the variations in temperatures, a warming trend is apparent.

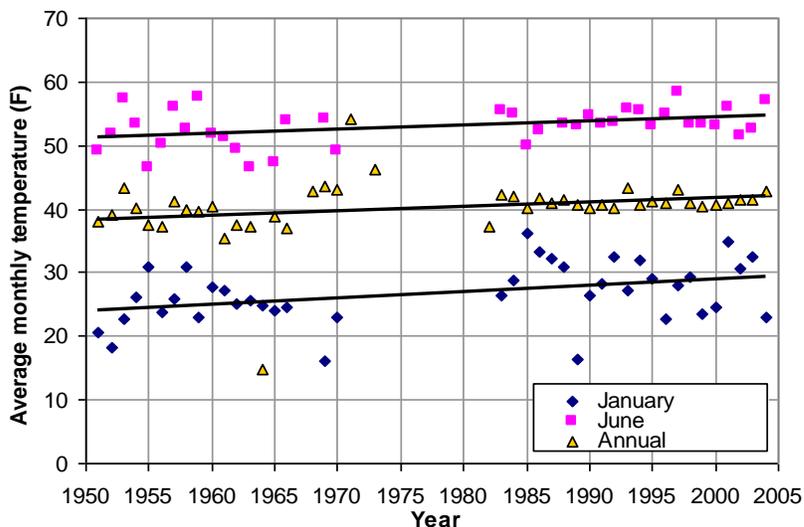


Figure 4.9: Average daily temperature trends for Whittier, AK, 1951-2004. Data from Western Regional Climate Center (2005).

Climatic changes also include changes in the magnitude, distribution, and timing of precipitation, but these trends are not well defined from the available data. Changes in both

temperature and precipitation have large effects on other hydrologic processes, including glacial recession, streamflows, water quality, and channel morphology. At the current rate of change, these trends will continue to have considerable impacts in the Western Sound area, primarily in terms of glacial recession and some of the activities that take place in the area, as discussed in the following sections.

Glacial Processes

Approximately 14 large tidewater glaciers currently exist in western PWS. These glaciers are generally located at the ends of long fiords or bays, having sculpted these U-shaped valleys in the Pleistocene and receded during the last 12,000 years in the Holocene. Currently, many of these glaciers are continuing to recede at a rapid rate, with the exception of the Mears and Harvard Glaciers.

Tidewater glaciers in PWS can move down-valley at rates as high as 100 feet per day during the summer, as measured on the Columbia Glacier (Pfeffer et al., 2000). However, depending on the glacial dynamics at the terminus, rates of glacial recession from calving ice can be hundreds or even thousands of feet per year. Glacial recession occurs more rapidly when the glacial terminus is in deep water, as increased heat transfer leads to glacial calving. Because of this, glacial recession occurs much more slowly in glaciers that have receded to the point at which bedrock is exposed at the end of the fiord, although glacial thinning generally continues to occur.

The most dramatic glacial changes that are occurring and will continue to occur are those in the larger glaciers, and particularly the Columbia Glacier, which is experiencing rapid recession and glacial thinning. The Columbia Glacier has receded over 7.5 miles and thinned hundreds of feet since it began retreating in 1982 (**Figure 4.10, Figure 4.11**) (Pfeffer et al., 2000). As a result, Columbia Bay has increased in size, but a large mass of floating ice several miles long remains at the glacial terminus, impounded by a shallow shoal. This ice is periodically flushed out of the bay by winds, and icebergs can enter Prince William Sound and create hazards for shipping traffic. With continued glacial recession, the Columbia Glacier may eventually recede as far as 15 miles from the present terminus, exposing a large fiord (Pfeffer et al., 2000).

Glacial recession can also alter other hydrologic conditions. Numerous glacial outburst systems once existed on the Columbia Glacier, where the glacier dammed off side tributaries, creating lakes that would periodically fill and release (Post and Mayo, 1971). Many of these still occur, but some no longer exist or are smaller because of glacial recession and thinning. In places, streams that were once blocked by glaciers have become accessible to anadromous fish. Sediment loads from glacial sources will continue to decrease as glaciers diminish in size, also affecting the channel morphology of glacial rivers. Braided glacial channels will tend to stabilize into single thread channels in the future, as lower sediment loads will be provided from the glaciers and vegetative growth will stabilize the banks.

Glacial recession will likely have a gradual effect on the locations that people visit for recreation. Calving tidewater glaciers may attract numerous visitors, but some of these glaciers will eventually recede onto land. Recession of the Columbia Glacier will open new areas for recreational users to explore. Campsite availability may increase as glaciers expose new land. Also, changes in the iceberg dynamics can change the locations that larger boats can safely access.

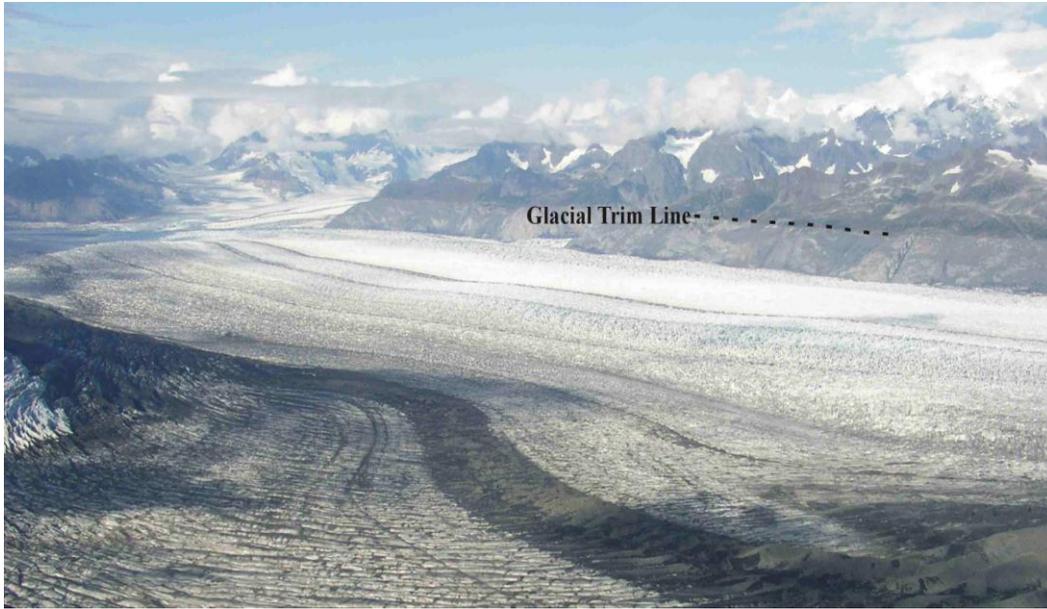


Figure 4.11: Glacial thinning of the Columbia Glacier. The trim line, representing a previous glacial elevation, is hundreds of feet higher than the present elevation of the glacier.

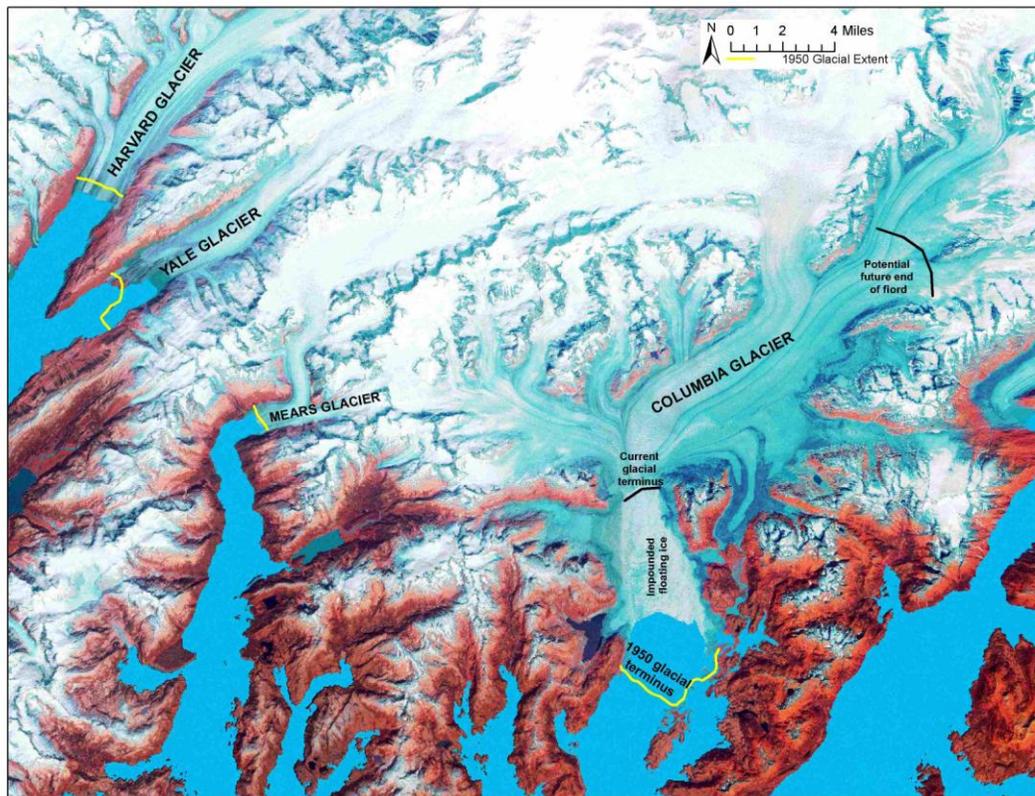


Figure 4.10: Glacial dynamics of the Harvard, Yale, Mears, and Columbia Glaciers, showing the 1950 glacial extent.

Human Activities

EVOS: The most well-known external force that has impacted the social and physical setting of PWS is arguably the *Exxon Valdez* oil spill of 1989, which spilled 11 million gallons of oil into PWS. Oil from this spill is still found on some beaches, buried beneath the substrate. Water quality effects from this oil spill are primarily confined to the marine environment. Research is still continuing into potential lingering effects of this disaster on wildlife species and the environment. As long as there are large vessels shipping cargo in northern oceans, there will be the potential for another oil spill or other cargo spill (for example the loss of oil and 132 million pounds of soybeans resulting from the grounding of the *Selendang* in the Aleutian Islands in December 2004). Oil spills may also result from damage to large cruise ships or ferries, and the catastrophic effects of earthquakes and tsunamis affecting oil storage facilities.

Hydropower: Hydropower development is non-existent in the WSLA area. However, a small hydroelectric project was proposed but never constructed on a small stream on private lands at Cedar Bay. Also, Chugach Alaska Corporation owns a hydropower withdrawal on the Nellie Juan River, but hydropower development is hampered by the remote location of this site. Hydropower development at this site could have potential negative impacts on channel morphology and salmon habitat.

Access: Development on land may also impact PWS, as demonstrated by the opening of Whittier's Anton Anderson tunnel to private vehicle traffic. Increased ease of access has led not only to increased use of PWS by small water craft, but also the addition of Whittier to the tour itineraries of major cruise companies, changing the pattern of large cruise ship traffic in PWS. Further expansion and improvement of the Whittier harbor will occur in the next couple of years and will likely have more impact on recreation and the environment in PWS. Potential future development of Cordova, Valdez, and Chenega Bay may also impact use levels and patterns in PWS.

Recreation: On-water activities also fall outside of USFS jurisdiction. Impacts from these activities on the recreation experience may include noise, visual impacts to on-shore recreationists and other water-based users, and feelings of crowding or lack of isolation. Impacts to resources may include the effects of boat wakes, particularly large wakes from large tour and cruise vessels at high tides. Disturbance to wildlife from boat-based wildlife viewing may also be an impact. Increasing recreational air traffic is another factor outside of USFS management jurisdiction that may impact recreation and biological resources.

Land Ownership: The land ownership in western PWS is also a source of potential activities outside of the management control of the USFS. The largest example of this is the 1992 MOU under which the State of Alaska manages lands in PWS below mean high tide. The potential for high amounts of unregulated use on these tidelands may be the greatest difficulty encountered in trying to mitigate impacts of human activities on wildlife and other resources.

Management Opportunities

Given the marine environment, large number of potential external factors that may influence Forest resources (from biological to recreation resources), and multi-agency management pattern of PWS, the most effective strategy for the USFS may be to focus on partnerships and cooperative agreements with other agencies and private groups. Examples of these partnerships include the presence of USFS interpretive staff on Alaska Marine Highway

ferries and some commercial vessels, and also cooperative wildlife research projects involving USFS, USFWS and ADF&G as well as external university partners. Additional opportunities for partnerships should be identified and developed to continue to improve the overall management of PWS, and address any specific concerns that may arise.

Communication with adjacent landowners such as Alaska State Marine Parks, Chugach Alaska Corporation and Chenega Corporation will be vital to future planning efforts.

CHAPTER 5 – RECOMMENDATIONS

This chapter describes recommendations developed to address issues and key questions the Western Sound Landscape Assessment is intended to address.

PHYSICAL CHARACTERISTICS

HYDROLOGY

Many natural processes occur in western PWS, including climate change, glacial dynamics, and tectonics. Although the majority of the area is managed as wilderness, human uses can impact certain areas, primarily along the coast where concentrated uses occur. Management activities should focus on these areas. Recommendations relating to water resources include the following:

Data Needs

- Collect channel morphology data at heavily used salmon streams and other streams near areas of concentrated use. Such studies would be useful to determine the magnitude of the impacts of angler trampling, and these data could be used as a baseline to measure future impacts. Some possible study areas include the Coghill Lake outlet stream, the Shrode Lake outlet stream, and tributaries of Jackpot Bay.
- Collect water quality data at established campsites. Because of the high numbers of visitors that use these sites, fresh waters near the campsites are at risk of contamination by fecal bacteria. No such data currently exist, and little is known about the fate of fecal bacteria in coastal areas. Background levels and future trends will be useful for developing regulations regarding the disposal of human waste.
- Collect water quality data at abandoned mines. Heavy metals are known to exist at some of these locations, but water quality data are limited.

Projects and Interpretive Needs

- Continue work to create hardened surfaces at established campsites. Because of the high volume of use at these areas, this will help preserve water quality and control sediment erosion during rain storms and snowmelt runoff.
- Develop interpretive materials that highlight the glacial dynamics in the area. The Columbia Glacier has had an interesting history of large-scale recession over a short period of time, and future trends are apparent. Abundant research has been conducted on this glacier. Brochures could be developed, and a Chugach National Forest glacier website providing information and status of this and other glaciers could provide excellent experiences for “virtual” travelers interested in glaciers.
- Develop additional educational materials to encourage backcountry users to help protect water resources in the sensitive environments around backcountry campsites. Brochures, websites, and signs at launching areas can inform users of human waste disposal issues and regulations at campsites, as well as recommendations for minimizing impacts to water quality, wetlands, and streambanks.

SOILS

Soil information is limited to broad generalizations based on work done throughout the Chugach National Forest. Particularly important are the wetland and alpine areas which are sensitive to disturbance and have a long recovery cycle. Greater detail on the soil and wetland composition of these areas will provide better guidance for management.

The standards set forth in the Chugach National Forest Plan require that a land risk analysis be conducted prior to any ground disturbing activities on slopes greater than 72 percent when the site is larger than 0.1 acres. On slopes between 56 and 72 percent, a land risk analysis is necessary if the site to be disturbed is larger than 0.5 acres. The analysis process is fully described in the Appendix B. The results should be used in conjunction with a general assessment of the surrounding area for signs of previous mass wasting. This information should be used to determine if the soil resource objectives proposed in the Forest Plan will be met by the management activity proposed.

As access to the study area increases, particularly into the wetland and alpine areas, it is recommended that monitoring take place in order to evaluate its effects of soil conditions.

BIOLOGICAL CHARACTERISTICS

FISHERIES

Identify streams in western PWS supporting resident MIS and initiate a monitoring program: As mentioned in chapter 4, a resident population of Dolly Varden char above an instream barrier and not associated with a lake has not been documented in the assessment area. If the Forest is mandated to monitor select species and it has been determined that a resident Dolly Varden char population would fulfill the needs of the protocol, efforts should continue to locate several resident populations in the assessment area so monitoring can begin.

Gain a better understanding of the amount of recreational fishing effort and harvest associated with outfitters and guides permitted on the Forest: Out of the 38 Forest permits for outfitters and guides in 2005, only two were specifically for guided recreational fishing. These two permit holders are expected to provide a year-end summary to the District providing the number of angler user days accumulated on their permit. However, the remaining 36 permit holders can allow their clients to fish when they are on shore even though their permits are not specifically for recreational angling. We ask them to volunteer information about the amount of angling occurring on their permit but it is not required. Therefore, to better understand potential recreational impacts of outfitter/guides and their clients to the fisheries resource, summaries should require information on angler use and harvest for all permitted outfitters.

Closely monitor high use camping sites adjacent to freshwater streams in the WSLA area: Several areas in PWS are very popular as overnight sites. Some of these sites maintain a nearly continuous occupancy throughout the summer season. This can be very damaging to the riparian vegetation along freshwater streams adjacent to these sites. In turn, this damage to the riparian vegetation can directly affect aquatic habitat and fish. Efforts should occur to coordinate with the kayak ranger program to arrange streamside

monitoring efforts at higher use locations. If significant damage is occurring, sensitive areas can be protected and restored.

Provide information and educational materials to western PWS visitors concerning the potential impacts of increasing recreation on the fisheries resource: Such pamphlets could be distributed at the Forest Service yurt in Whittier and could encourage use techniques that minimize impacts to aquatic habitat and fish populations. Catch and release angling could also be emphasized.

Determine if fisheries habitat enhancement is needed in the assessment area: Even though western PWS is in a wilderness study area, ANILCA states that fisheries research and enhancement activities are allowed to maintain fish production at optimum sustained yield levels. However, because anthropogenic impacts in the area are relatively insignificant, aquatic habitat remains pristine, and fish production is probably near optimum levels, should habitat enhancement projects still occur? The Chugach Forest Plan directs that lands in the wilderness study area be managed to maintain the wild character of the area and sustain its unique fish and wildlife populations. This could be interpreted as leaving the land alone as long as mitigation is not needed for management activities. It could also be argued that enhancing freshwater habitat can mitigate for natural changes that may be impacting the fishery resource or human-related impacts such as over-harvest in the commercial fishery.

Gain a better understanding of the distribution and population trends of coastal cutthroat trout in western PWS: Western PWS is the northernmost geographical range of the coastal cutthroat trout. When a species exists in the outer most limits of its range, they can be highly vulnerable to anthropogenic impacts and natural changes. By monitoring populations and mapping the distribution of this ecologically and recreationally important species in the assessment area, we can determine which lakes and streams will be most sensitive to the increased human use that continues to occur in western PWS. This will also allow us to provide biological advice during the application process for special use permits in PWS.

Use low profile habitat enhancement techniques to reduce aesthetic impacts in the wilderness study area: If it has been determined that habitat enhancement structures are needed or will be used in the assessment area, build them in a way that blends with the natural environment using natural materials. If an existing structure stands out against the natural setting (aluminum steeppasses or concrete walls), determine if it can be rebuilt in a way that blends more with the surrounding conditions or if native vegetation can be planted nearby to help hide the structure.

Incorporate digital video recording technology to better monitor adult salmon escapements at key locations in the assessment area: DVR's have recently proven to be an effective fisheries tool to accurately monitor adult salmon escapements in individual streams. This technology would allow managers to accurately monitor the efficiency of our fishpasses in western PWS without the high costs associated with a weir. Population trends could be established and a baseline determined to use for comparison with any future enhancement work in the watershed.

Provide educational pamphlet containing information about Atlantic Salmon: Atlantic salmon are an invasive species along the Pacific coast and along Alaskan waters. Fish farmers in British Columbia use this species extensively but cannot always keep them

contained in pens. Adult and juvenile Atlantic salmon have been located in streams in southeast Alaska indicating their distribution is expanding north and they are successfully reproducing. This species will compete aggressively for quality habitat and food sources with Pacific salmon, steelhead, Dolly Varden char, and coastal cutthroat trout. A pamphlet containing identification keys and information on potential impacts of this invasive species can be distributed to recreational anglers, commercial fishermen, and cannery workers asking to keep watch for this species and report any sightings.

WILDLIFE

An exhaustive literature review completed by Murphy et al. (2004) suggested the following approach to mitigating potential recreation impacts to wildlife in western PWS:

“Education programs should be developed that identify situations and habitats to be avoided. New recreation sites should be developed to divert use away from sensitive areas. Consideration should be given to closing selected existing sites or discouraging their use. A greater presence in the Sound by management agencies is needed to implement education efforts, enforce existing regulations, and assure adherence to closed-area policies.”

Based on their analysis of human-wildlife interactions in western PWS they recommended: “(1) public education, (2) enforcement of existing laws and regulations, (3) exclusion of specific forms of transportation (ranging from cars to jet skis), (4) exclusion of dogs and the removal of other introduced predators, (5) excluding people from large or small areas, (6) redirecting public access, and (7) habitat manipulation.”

As human use in the Sound increases, there is an increasing potential that human disturbance will play a major role in the distribution and population dynamics of many wildlife species. What effect these changes may have on sensitive species will depend on our ability to understand and mitigate the effects of human activity. Future management of the Sound should incorporate an understanding of the human activity that occurs in that area and how that activity may relate to the local wildlife and fish populations. The anticipated changes associated with new road access are in addition to other changes in human use of the Sound that have been occurring over the last decade.

Recommendations for the future:

- Use results of the 2005-2006 *PWS Human Use Study* to compare current private and commercial recreational use patterns with those found by Murphy et al. (2004) regarding the spatial and temporal overlap of human use with fish and wildlife species of concern.
- Develop a stratification system for monitoring of Black Oystercatchers and other species of management concern (potentially cutthroat trout, Bald Eagles, other species identified in the Forest Plan) based on levels of permitted and independent human use.
- Coordinate with USFWS to develop research strategies to assess annual Bald Eagle nest occupation and/or potential for effects of human use on Bald Eagle nesting patterns in western PWS. This recommendation is based on the high percentage of Bald Eagle nests currently thought to occur in areas permitted for use by outfitter-guide companies.

- Collaborate with sister agencies including USFWS, NOAA and ADF&G (and others as identified) to validate GIS species distribution data and share information regarding known patterns of human use. Updating these data layers and increasing information exchange with other agencies regarding data needs and availability will increase the efficacy of monitoring plans.
- Identify summer waterfowl concentration areas in western PWS and assess potential risk to waterfowl from human disturbance, as per Forest Plan direction. The requirement for a 330 ft separation between waterfowl concentration areas and human activity cannot be effectively incorporated into permit issuance without a solid understanding of where these concentration areas are located.
- Work with Forest interpretive staff, USFWS, ADF&G and other non-governmental partners to develop educational materials related to wildlife viewing ethics and regulations.
- Conduct GIS analyses to identify biologically sensitive areas within western PWS to assist with Special Use Permit allocation, campsite hardening, and impact monitoring efforts.
- Continue research to spatially and temporally describe the activity of sport and subsistence hunting groups within western PWS; these human use activities are poorly understood and current management practices may not be addressing the needs of these individuals.

VEGETATION

Recommendations

- Use the CNF Invasive Plant plan (USDA Forest Service 2005) as a guide to control or eradicate known non-native plant populations.
- Continue to monitor for invasive plant introduction and spread within the WSLA area.
- Develop educational material to distribute to outfitter/guides in the area.
- Make sure invasive plant information and mitigation measures are incorporated into special use permits.
- Monitor known sensitive plant locations to ensure current management practices are not harming those populations.
- Conduct plant surveys in areas with the greatest potential number of sensitive plants based on the bioenvironmental analysis.
- Develop educational and interpretive material about R10 sensitive plants to distribute to outfitter/guides in the area.

SOCIAL CHARACTERISTICS

SPECIAL USES

Recommendations

- Coordination between Human Use Study researchers, recreation and special uses staff to work toward a holistic understanding of human use patterns and levels in western PWS.
- Continue to maintain and refine database of outfitter-guide reported use; add prior years' data as time allows. Maintaining this information should be the responsibility of the special uses program.
- Summarize yearly permit activity (number of permit requests, number of new permits, renewals, amendments; change in number of days allocated; final use reported from previous year) in an annual report to be made available on the CNF web site.
- Populate the special uses GIS database to include all currently issued special use authorizations of all use types.
- Investigate the most efficient and practical approach to spatial allocation of service days to outfitter-guide companies offering hunting activities; i.e. should these days be allocated by capacity area, and if so, how should the number of days in each area be determined; should allocation of days vary according to shore-based camping versus charter boat operations.
- Continue to work with the backcountry ranger program to ensure that recreation capacity issues are adequately addressed in the permitting process.
- Develop a forum for members of the public and outfitter-guide permit holders to give feedback and input to District staff regarding current and future use levels in western PWS, and to identify any areas of specific concern for recreation quality or resource protection.

HERITAGE

Recommendations for inventory, monitoring and potential projects

Managing cultural resources through complete survey and inventory and building on a current predictive model. Complete the inventory and evaluation of cultural resources within the analysis area over a period of 20 years, building a predictive model from existing samples after completion of archaeological survey of 25% of the analysis area located on National Forest Lands. An estimate of the time necessary to complete a 25% sample is about five years. Although some of the districts, cultural landscapes, sites, buildings, structures and objects that are in the analysis area have been documented to current national standards, less than 1% of the analysis area has been inventoried for cultural resources. A complete inventory will allow better interpretation of the significant historic resources in the analysis area related to Native Alaskans and early twentieth century mining. In addition to bringing the Forest into closer compliance with NHPA section 106, resources and their eligibility for the National Register will already be known for specific project areas.

Manage cultural resources in conjunction with other options for other resources. Human use of the analysis area has been generally due to the presence of various biological, botanical, geological and hydrological resources. Managing, and interpreting for the public, other resources simultaneously will provide a holistic view of the natural resources that were important to the people who created the existing cultural resources of a given site.

Continue the inventory of cultural resources in support of federally funded undertakings to satisfy the Section 106 requirements. Historic properties and cultural landscapes would be evaluated for the National Register for management purposes. Adverse affects to historic properties would be avoided.

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 of archaeological sites, archeological districts and cultural landscapes for the public; and archaeological site protection and interpretation through stewardship programs.

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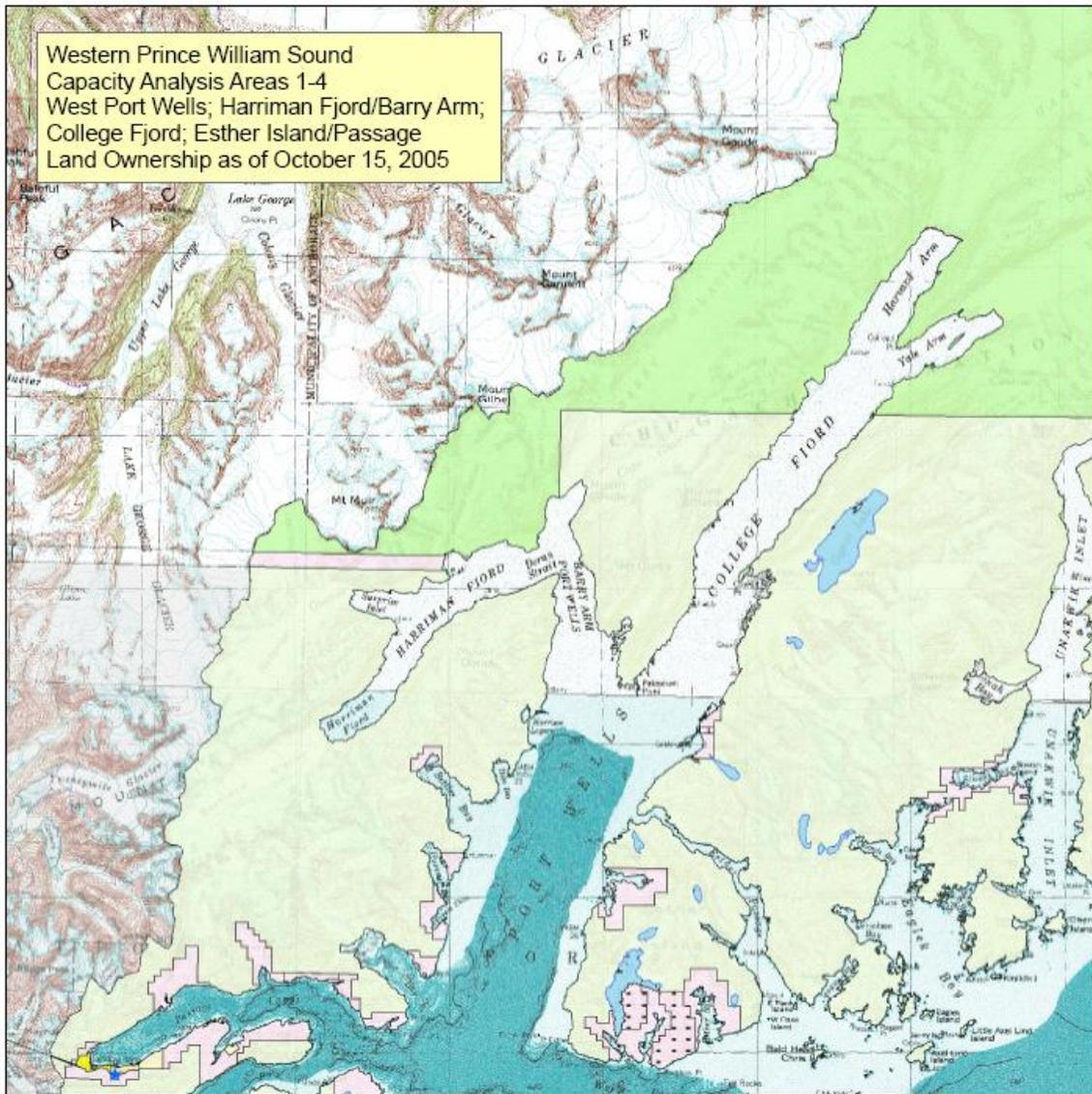
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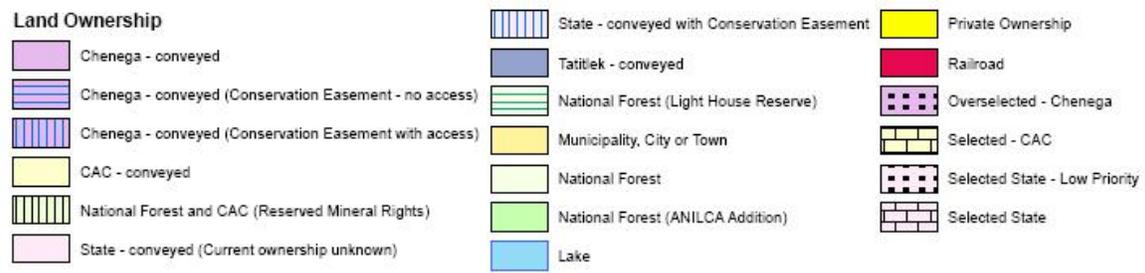
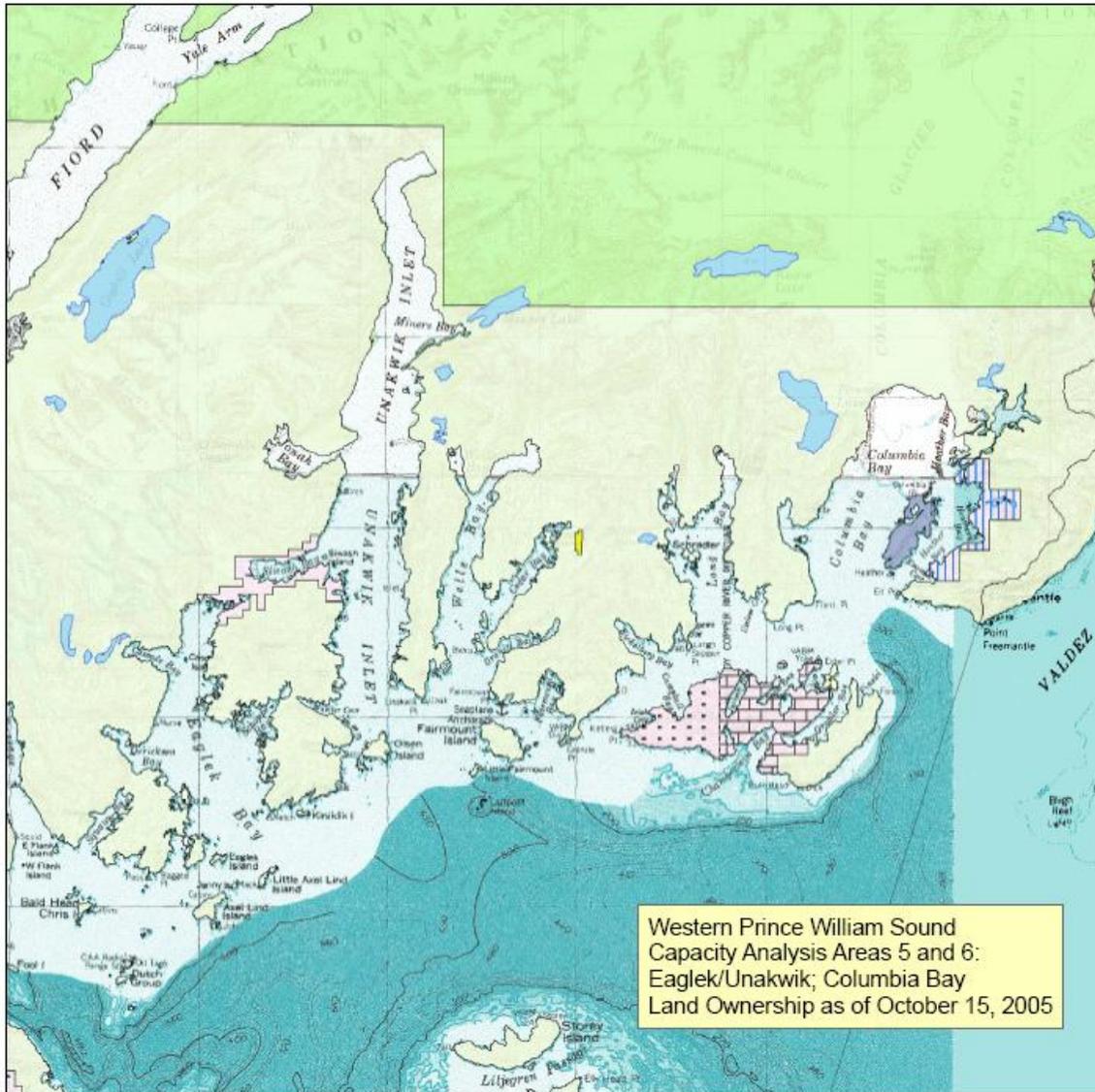
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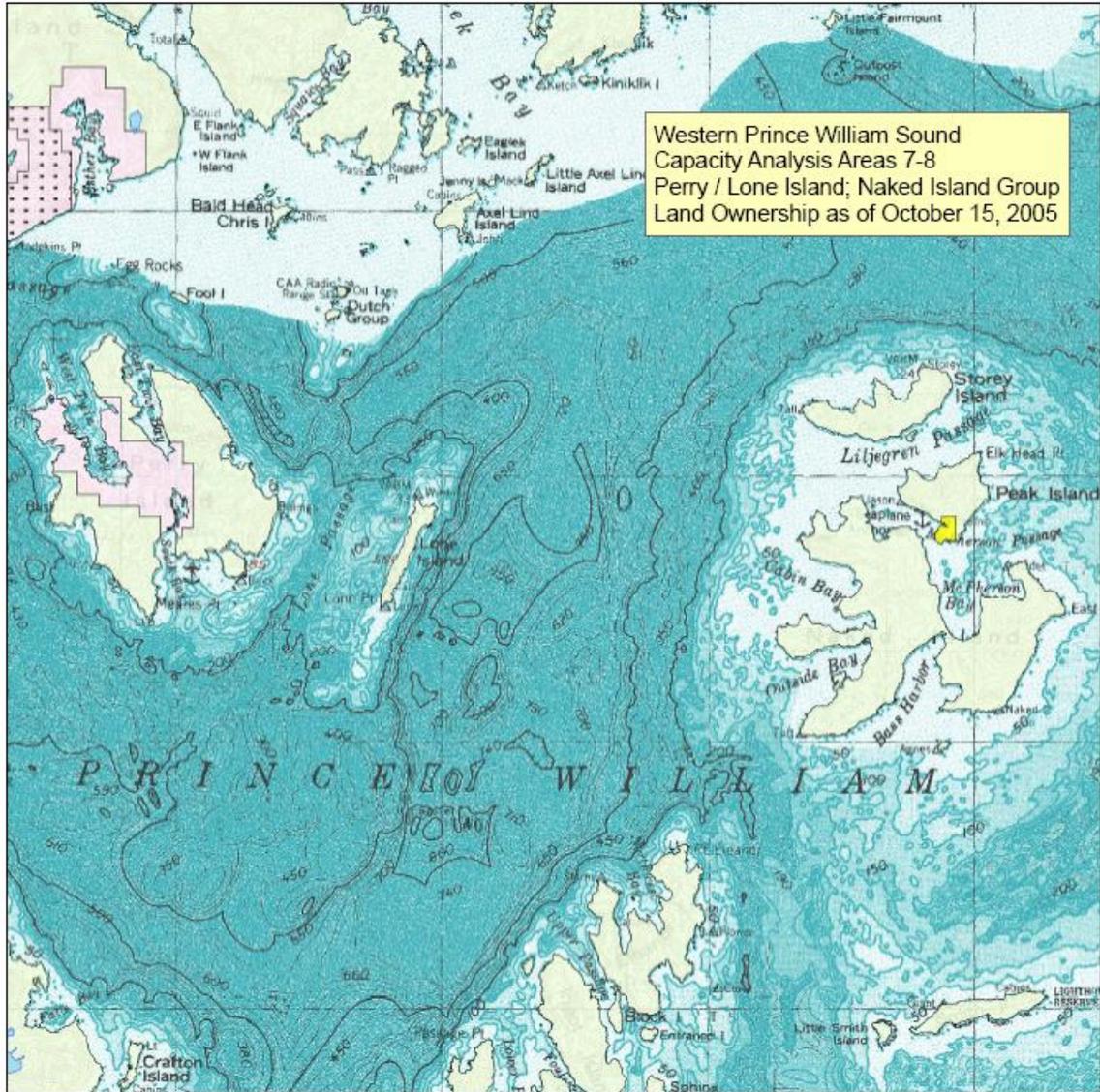
APPENDIX A



Land Ownership

- | | | |
|--|---|-------------------------------|
| Chenega - conveyed | State - conveyed with Conservation Easement | Private Ownership |
| Chenega - conveyed (Conservation Easement - no access) | Tatitlek - conveyed | Railroad |
| Chenega - conveyed (Conservation Easement with access) | National Forest (Light House Reserve) | Overselected - Chenega |
| CAC - conveyed | Municipality, City or Town | Selected - CAC |
| National Forest and CAC (Reserved Mineral Rights) | National Forest | Selected State - Low Priority |
| State - conveyed (Current ownership unknown) | National Forest (ANILCA Addition) | Selected State |
| | Lake | |



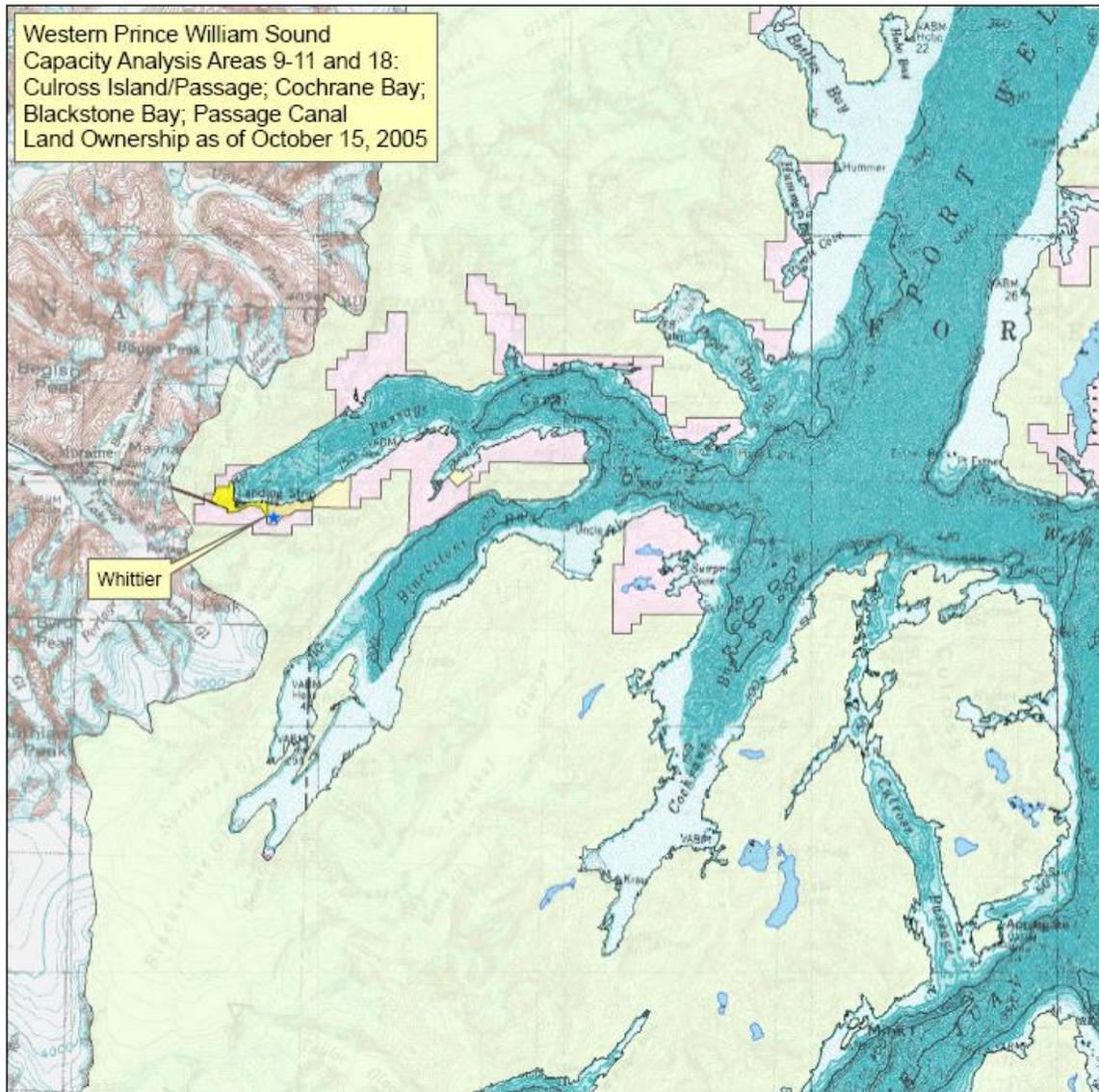


Western Prince William Sound
Capacity Analysis Areas 7-8
Perry / Lone Island; Naked Island Group
Land Ownership as of October 15, 2005



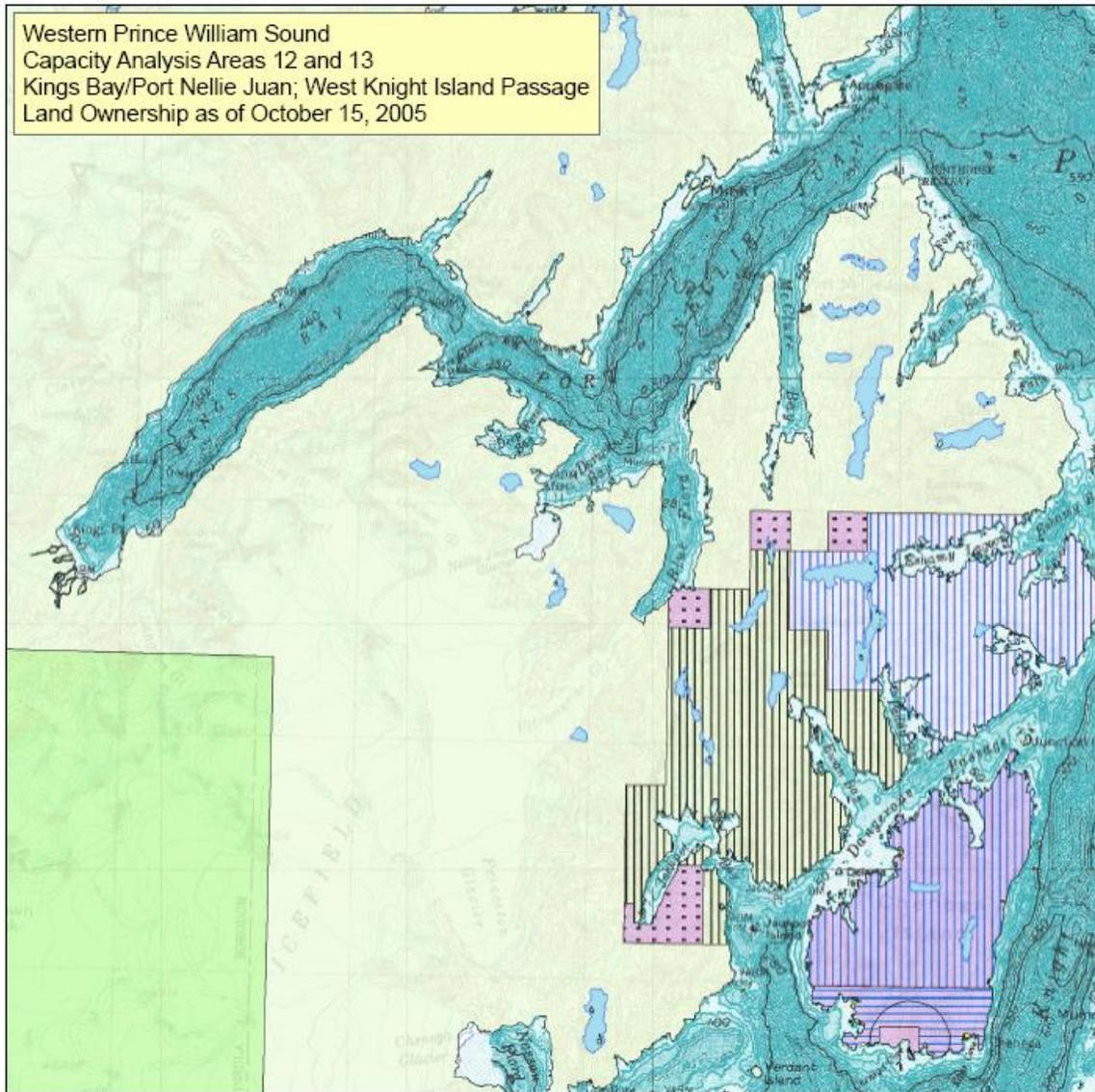
Land Ownership

Chenega - conveyed	State - conveyed with Conservation Easement	Private Ownership
Chenega - conveyed (Conservation Easement - no access)	Tatitlek - conveyed	Railroad
Chenega - conveyed (Conservation Easement with access)	National Forest (Light House Reserve)	Overselected - Chenega
CAC - conveyed	Municipality, City or Town	Selected - CAC
National Forest and CAC (Reserved Mineral Rights)	National Forest	Selected State - Low Priority
State - conveyed (Current ownership unknown)	National Forest (ANILCA Addition)	Selected State
	Lake	



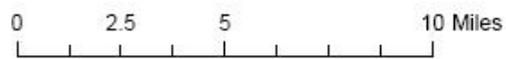
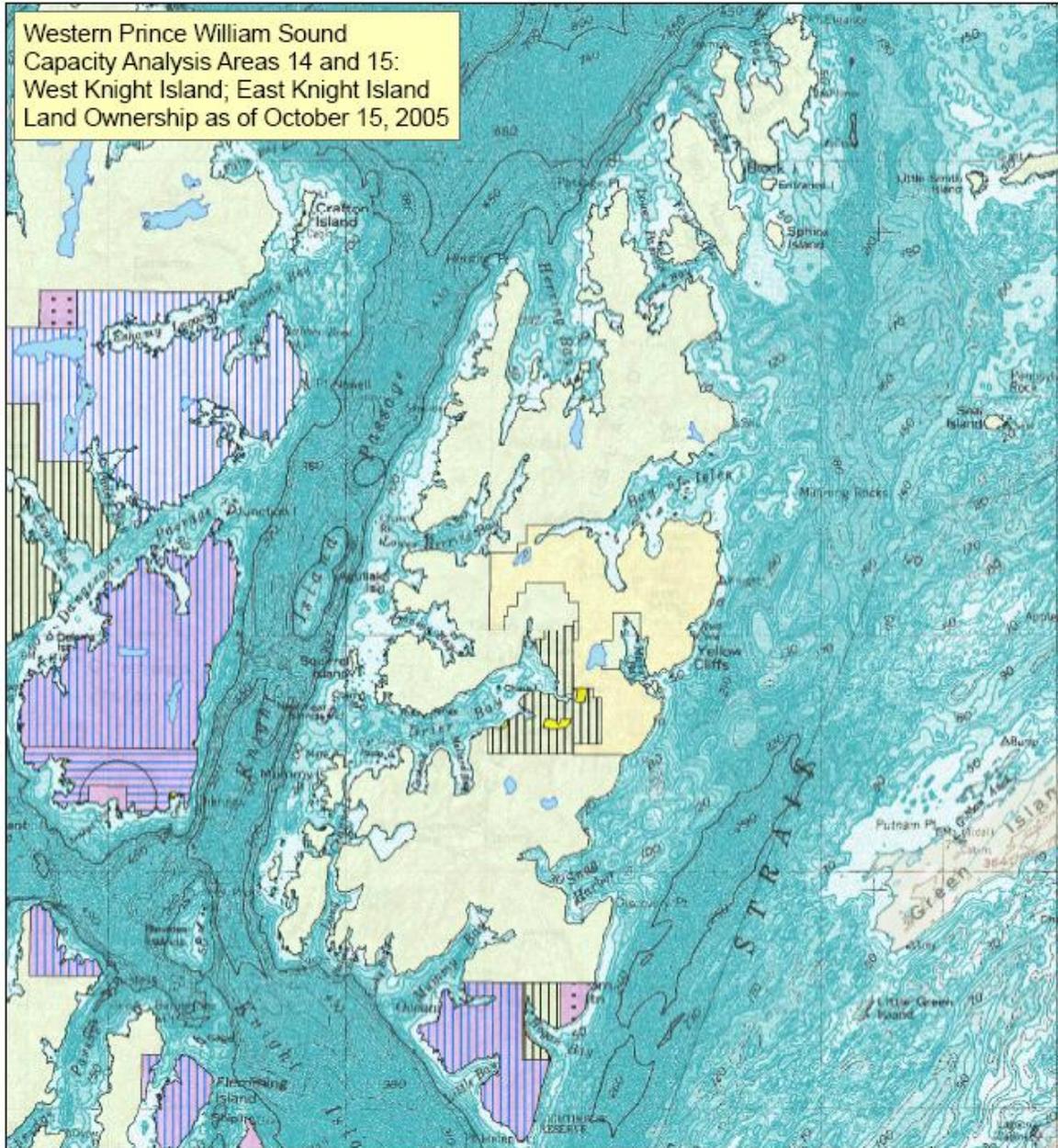
Land Ownership

- | | | |
|--|---|-------------------------------|
| Chenega - conveyed | State - conveyed with Conservation Easement | Private Ownership |
| Chenega - conveyed (Conservation Easement - no access) | Tatitlek - conveyed | Railroad |
| Chenega - conveyed (Conservation Easement with access) | National Forest (Light House Reserve) | Overselected - Chenega |
| CAC - conveyed | Municipality, City or Town | Selected - CAC |
| National Forest and CAC (Reserved Mineral Rights) | National Forest | Selected State - Low Priority |
| State - conveyed (Current ownership unknown) | National Forest (ANILCA Addition) | Selected State |
| | Lake | |



Land Ownership

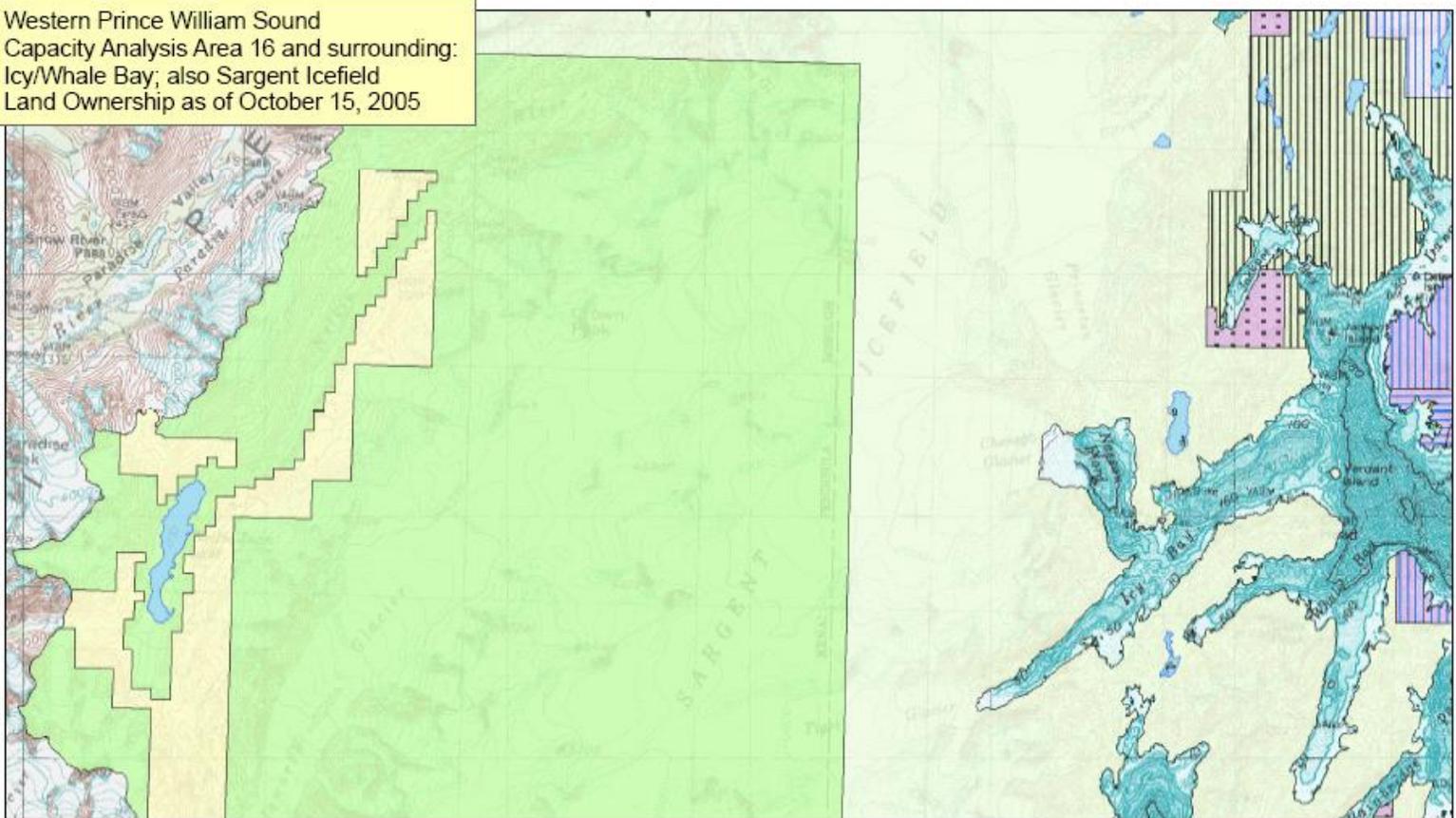
- | | | |
|--|---|-------------------------------|
| Chenega - conveyed | State - conveyed with Conservation Easement | Private Ownership |
| Chenega - conveyed (Conservation Easement - no access) | Tatitlek - conveyed | Railroad |
| Chenega - conveyed (Conservation Easement with access) | National Forest (Light House Reserve) | Overselected - Chenega |
| CAC - conveyed | Municipality, City or Town | Selected - CAC |
| National Forest and CAC (Reserved Mineral Rights) | National Forest | Selected State - Low Priority |
| State - conveyed (Current ownership unknown) | National Forest (ANILCA Addition) | Selected State |
| | Lake | |



Land Ownership

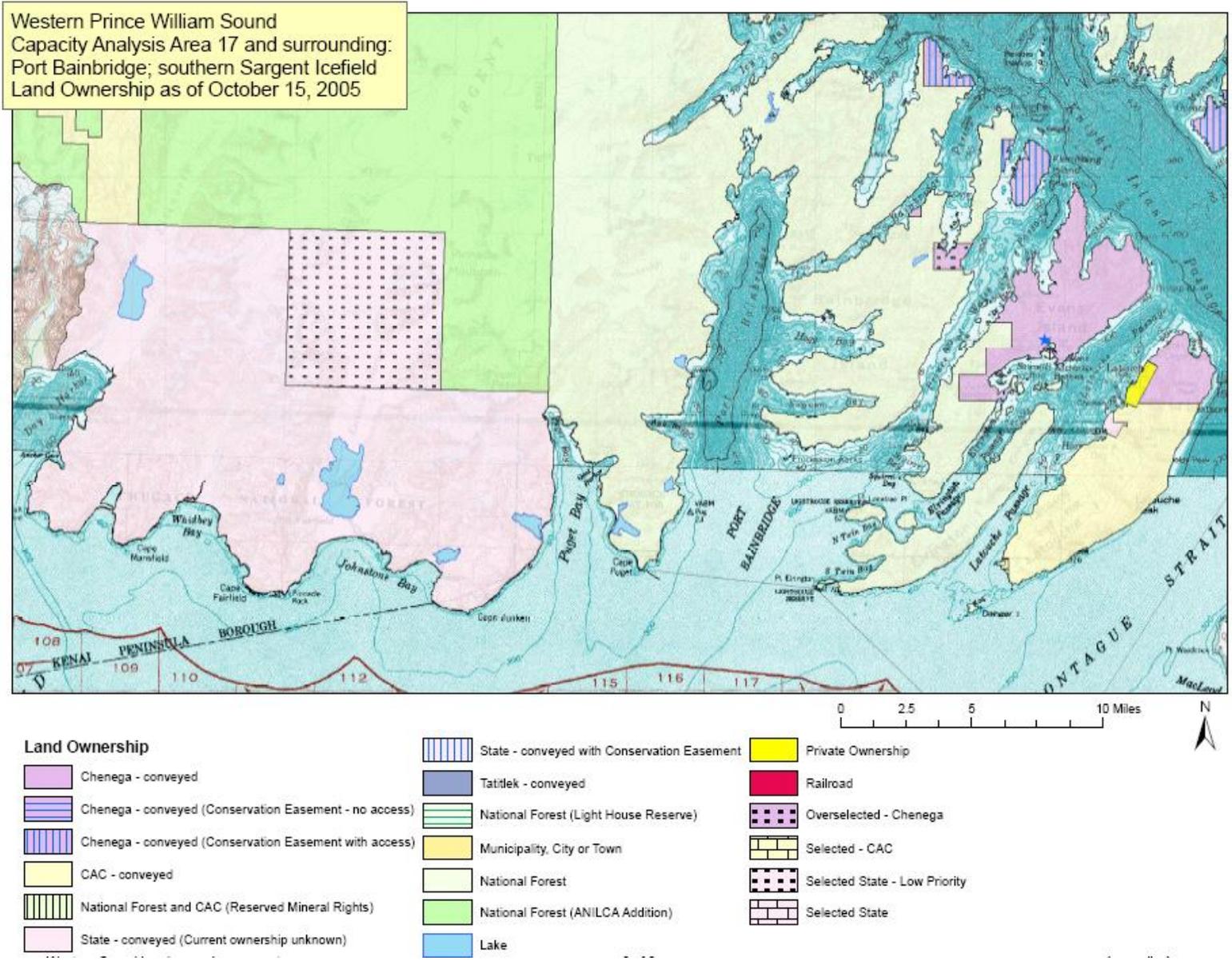
Chenega - conveyed	State - conveyed with Conservation Easement	Private Owned
Chenega - conveyed (Conservation Easement - no access)	Tattletie - conveyed	Railroad
Chenega - conveyed (Conservation Easement with access)	National Forest (Light House Reserve)	Overselected
CAC - conveyed	Municipality, City or Town	Selected - CA
National Forest and CAC (Reserved Mineral Rights)	National Forest	Selected State
State - conveyed (Current ownership unknown)	National Forest (ANILCA Addition)	Selected State
	Lake	

Western Prince William Sound
Capacity Analysis Area 16 and surrounding:
Icy/Whale Bay; also Sargent Icefield
Land Ownership as of October 15, 2005



Land Ownership

- | | | |
|--|---|-------------------------------|
| Chenega - conveyed | State - conveyed with Conservation Easement | Private Ownership |
| Chenega - conveyed (Conservation Easement - no access) | Tatitlek - conveyed | Railroad |
| Chenega - conveyed (Conservation Easement with access) | National Forest (Light House Reserve) | Overselected - Chenega |
| CAC - conveyed | Municipality, City or Town | Selected - CAC |
| National Forest and CAC (Reserved Mineral Rights) | National Forest | Selected State - Low Priority |
| State - conveyed (Current ownership unknown) | National Forest (ANILCA Addition) | Selected State |
| | Lake | |



APPENDIX B

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 as a result 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 collectable in the field; such as soil properties that include 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							