Southeast Chichagof Landscape Analysis

Technical Report R10-TP-68

U.S. Department of Agriculture
Forest Service
Tongass National Forest, Chatham Area
Sitka Ranger District
Sitka, Alaska
November, 1999

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Abstract

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U.S. Department of Agriculture, Forest Service, Region10, Tongass National Forest, Chatham Area, Sitka Ranger District. 210 p. (Landscape ecosystem analysis of the southeast portion of Chichagof Island in the Alexander Archipelago, Southeast Alaska.)

This is the first full-scale landscape analysis on the Chatham Area of the Tongass National Forest. It was initiated to collect and analyze information in advance of two timber sale projects scheduled for this area. While Forest Planning and Project Planning are both guided by the National Environmental Policy Act (NEPA), this document is **NOT** a NEPA document and has no decision making authority. Its purpose is to provide managers and the public with the most current resource information known for the Analysis Area. It describes the physical characteristics (location, climate, geology/soils and hydrology); biological characteristics (vegetation, wildlife and fish); and human utilization of a 260,000 acre peninsula of Chichagof Island.

The report focuses on site-specific conditions and trends, summarizing information about the biodiversity, landscape, ecological/ geological characterization, forest vegetation, old-growth diversity, wildlife habitat, riparian and aquatic habitat, and human use of the area. Future scenarios are developed utilizing the Spectrum Model for Long Range Analysis, and the information is organized and summarized to provide guidance for project planners and the public.

Keywords: ecosystem management, resource management, landscape analysis, biodiversity, old growth, second growth, habitat, landtype associations, Spectrum Model, conservation strategy, National Forest management.

Preface

In a statement on February 3, 1994, before the U.S. House of Representatives Subcommittee on National Parks, Forests, and Public Lands, Chief of the Forest Service Jack Ward Thomas stated:

> "I must say that my optimism is somewhat tempered by what I see as a growing perception that, with enough science, we can find an impeccable solution to any resource management problem. We live in a society that seems to demand instant and perfect and perennially acceptable answers, but the Forest Service manages a resource that responds to human activity over time frames of millennia. Through science, we can describe options for addressing management problems and provide assessments of the consequences. But science simply will not and can not give society 'the answer.' Science is only a tool--in the end, all managerial decisions are moral, not technical."

The Southeast Chichagof Landscape Analysis was designed to be a tool to help managers find answers to difficult questions. These difficult questions will be asked as project level planning proceeds within the Southeast Chichagof Analysis Area.

The effort we have undertaken was limited somewhat by the resources, support, and time available. This resulted in our inability to do all the things we wanted. One area for which we had great intentions but limited activity was the desire to involve interested and affected people in this analysis, or at least keep them informed of the work. We hope to strengthen this area during subsequent project level planning.

I would like to acknowledge the considerable effort of all the members of the analysis team. This analysis and report happened as a direct result of the interest and effort of the individual members. I merely asked the analysis team to perform the necessary analysis and get the report done. They did! As a result, they deserve all the credit, and I accept any criticism of the work or product.

The members of the Southeast Chichagof Landscape Analysis Team included Michael Shephard, Brad Flynn, Rachel Myron, Lisa Winn, Ted Allio, John Silbaugh, Kent Barkhau, Greg Killinger, Jake Winn, Terry Suminski, Sheila Jacobson, Lorraine Thomas, Su Beall, Eric Ouderkirk, and Ted Schenck. In addition, considerable support was provided by Ginny Lutz, Libby Dougan, Pat Bower, Lisa Stocker, and Jean Kleinert.

The challenge in all analysis is to recognize what you have attempted, understand what you have accomplished, and be outspoken in your acknowledgement of what was not accomplished and what you do not know. Please contact me if you have any comments, criticisms, or suggestions.

James Thomas
Group Leader

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Chapter 1 - Introduction

Purpose

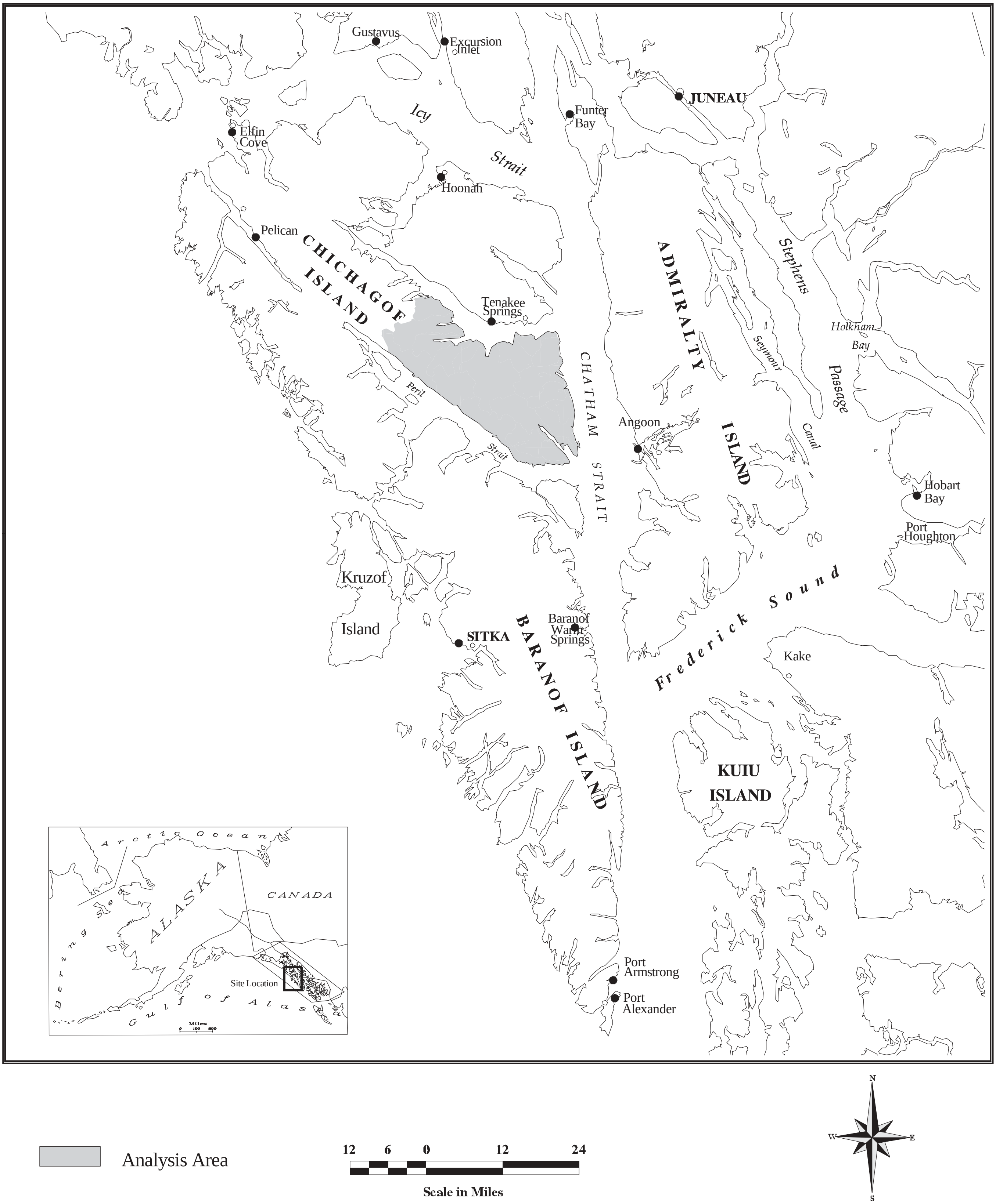
The purpose of this landscape analysis is three-fold: provide a description of conditions that will be used in the Affected Environment section of future National Environmental Policy Act (NEPA) analysis; increase our knowledge and understanding of the ecological systems and past and present human use within the Analysis Area; make recommendations and suggestions based on the above information and the new Tongass Land Managment Plan for the Analysis Area (Figure 1-1). *This document is a precursor to NEPA analysis, **not** a decision document, and should be considered a working document*. As new information is obtained, it will be incorporated. An additional benefit of this landscape analysis is that all the information for a contiguous area is compiled for future reference.

For this analysis, we have utilized a systematic, interdisciplinary approach for gathering information and evaluating the condition of key ecosystem structures and functions. This information and analysis can help identify management opportunities while sustaining the diversity and productivity of the Analysis Area. Subsequent analysis and project planning will strengthen our understanding of the Southeast Chichagof Analysis Area and our abilities to apply ecosystem management to the Tongass National Forest. Better understanding of the systems and use will enable us to:

1) Manage the renewable resources of the Analysis Area so that they are utilized in the combination that will best meet the needs of the American people and produce a regular periodic output without impairment of the productivity of the land (Multiple-Use Sustained-Yield Act of 1960).
2) Use an ecological approach to achieve the multiple-use management of the Analysis Area and blend the needs of the people and environmental values in such a way that the Tongass National Forest represents diverse, healthy, productive, and sustainable ecosystems (Robertson June 4, 1992).
3) Initiate project-level planning within the Analysis Area that seeks to implement the Tongass Land Management Plan (TLMP) and help provide a timber supply from the Tongass National Forest consistent with sound multiple-use and sustained-yield objectives.

The Southeast Chichagof Landscape Analysis is the first full landscape analysis on the Chatham Area of the Tongass National Forest. It was initiated to collection and analysis information in advance of two timber sale projects scheduled for this area. These two timber sale projects are Finger Mountain on the west end of the Analysis Area and False Island on the east end. In addition, the Southeast Chichagof Analysis Area is one of the largest areas designated for timber production on the Sitka Ranger District. Substantial timber harvest has already occurred on the east end of the analysis area and it is important to have better information and understanding of the affected environment prior to planning for additional timber harvest.

Figure 1-1. Southeast Chichagof Vicinity Map



The Analysis Area

The Southeast Chichagof Analysis Area is located on Chichagof Island in Southeast Alaska. Chichagof Island is the second largest island in the Alexander Archipelago. Glacially carved fjords along major fault lines have divided Chichagof Island into nearly separate peninsulas. As a result, the Southeast Chichagof Analysis Area is an ecological entity - a peninsula - connected to the rest of Chichagof Island only along the northwest side. Although most analysis was confined to this portion of Chichagof Island, linkages to the rest of the island are recognized, particularly with respect to wildlife issues.

The Southeast Chichagof Analysis Area covers approximately 260,048 acres on Chichagof Island. It is defined by Tenakee Inlet on the north, Chatham Strait on the east, Peril Strait on the south, and the rest of Chichagof Island on the northwest. It is located about 30 air miles north of Sitka, 10 air miles west of Angoon, and 3 air miles south of Tenakee Springs. The Analysis Area is administered by the Sitka Ranger District on the Chatham Area of the Tongass National Forest.

Background

Resource Planning

Resource planning for the natural resources within the Southeast Chichagof Analysis Area has occurred in the past at a variety of scales and purposes. For example, the Tongass Land Management Plan of 1979 and the 1997 revision analyzed the management situation and provided general management direction for all lands and resources on the National Forest. On the other hand, the Timber Management Plan of 1958 focused on a single resource and provided a 10-year timber management plan for the Forest.

Resource planning on the same scale as the Southeast Chichagof Landscape Analysis has occurred; however, it has focused solely on timber management. Between 1971 and 1990, the Forest Service prepared operating plans for the Alaska Pulp Corporation (APC) 50-year timber sale contract for successive 5-year periods. These operating plans were for portions of Kuiu, Baranof and Chichagof Islands (including the Southeast Chichagof Analysis Area) and were considered by the Forest Service to be major Federal actions significantly affecting the human environment. Thus, they required the preparation of Environmental Impact Statements (EISs). The Final EIS for the 1976-1981 Operating Period of the Alaska Lumber and Pulp Company Timber Sale was released in February, 1976. This document marked the first integrated National Environmental Policy Act (NEPA) analysis for proposed timber harvest in the Southeast Chichagof Analysis Area. Subsequent NEPA analysis for the 1981-86 and the 1986-90 operating periods also proposed timber harvest activities in the Analysis Area.

In 1989, the Forest Service initiated Project-level EISs for timber sale planning on the Tongass National Forest. One of the first Project-level EISs was for the Southeast Chichagof Project Area, which included almost all of the Analysis Area. In September, 1992, the Final EIS for APC Long-term Timber Sale Contract activities in the Southeast Chichagof Project Area was released. Although this EIS focused on timber sale planning, it included analysis of multiple resources and uses to determine what management actions should be proposed.

Legislative and Management History

Logically, the history of the Southeast Chichagof Analysis Area is linked to national and state legislation and policies. Legislation has affected land ownership in the analysis area while management policies have had an impact on land use. This section is an overview of legislative and management history. A more complete presentation of the legislation is presented in Appendix B while a further discussion of timber harvest levels is given in Chapter 4.

On December 18, 1971 Congress passed the Alaska Native Claims Settlement Act (ANCSA). The act gave Alaska Natives $962 million and approximately 44 million acres of land including 2 million acres for Native Cemetery and Historic Sites (Rakestraw 1981). The Analysis Area, includes selected lands in Value Comparison Units 239 to 243 and 245. In addition, four Native Cemetery and Historic Sites in the Analysis Area have been conveyed to Sealaska Corporation under ANSCA. These include 10.66 acres at Hoonah Sound Village, 14.54 acres at Basket Bay Village, 17.50 acres at the Sitkoh Creek Petroglyphs, and 7.0 acres at Point Craven Village near the east end of Peril Strait. Subsequent legislation (ANILCA, see below) provides that timber on these lands may not be cut except by agreement with the Native corporations. There are approximately 269 acres of private land in the analysis area. These are located along the shore in small parcels (see Appendix C, for location, acreage and ownership). Additionally, approximately 10,545 acres are overselected by Kootznoowoo Inc. and Sealaska Regional Corporation in what is called the Angoon Withdrawal. These overselected lands are currently restricted from timber harvest until the conveyance process is completed.

In 1979 the Chief of the Forest Service signed the Tongass Land Management Plan (TLMP), the first Forest-wide Management Plan. This established geographic areas, Value Comparison Units and Management Areas, and Land Use Designations (see Relationship to TLMP later in this chapter).

In 1980 Congress passed the Alaska National Interest Lands Conservation Act (ANILCA) which recognized the importance of subsistence resource gathering to rural residents of Alaska. Subsistence was defined as: "The customary and traditional uses by rural residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of nonedible by-products of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade." ANILCA provided for "the continuation of the opportunity for subsistence uses by rural residents of Alaska, including both Natives and non-Natives, on public lands." It also stated as policy that subsistence uses of renewable resources shall be the priority consumptive uses of all such resources on the public lands of Alaska. ANILCA also authorized the Tongass Timber Fund to augment timber sales and mandated a timber supply rate of 4.5 billion board feet per decade. ANILCA also required the evaluation of effects of National Forest management on subsistence uses and the evaluation of alternatives to minimize adverse effects.

In 1990 Congress passed the Tongass Timber Reform Act (TTRA). The TTRA repealed the 4.5 billion board feet per decade timber harvest mandate and the set aside of Tongass Timber Funds specified by ANILCA. The TTRA also required that operators working on the long-term contracts harvest higher volume class timber only in proportion to its occurrence. It also mandated 100 foot minimum buffers on all Class I streams and those Class II streams which flow into Class I streams. The TTRA designated five new Wilderness Areas and 12 new legislated LUD II areas including the Kadashan drainage, the north shore of Hoonah Sound, and Trap Bay in the Analysis Area (VCUs 235, 237, and 247). In total TTRA prohibited logging on 700,000 acres of previously available forest.

On September 30, 1993 Alaska Pulp Corporation indefinitely suspended operations of its pulp mill in Sitka, and on April 14, 1994 the U.S. Forest Service cancelled the long-term contract with APC due to a provision which required APC to operate a pulp mill or similar facility.

In 1996 KPC attempted to obtain a 15-year extension to its long-term timber sale contract. The extension was denied. KPC closed the Ketchikan pulp mill in March of 1997. In May of 1997 Phil Janik, the Regional Forester, signed the TLMP revision.

In April of 1999 Jim Lyons, Under Secretary of Agriculture for Natural Resources and Environment, signed a new Record of Decision for the TLMP.

Relationship to TLMP

The management of the Southeast Chichagof Analysis Area is guided by the TLMP (1997) and the Record of Decision (1999). The TLMP assigned each Value Comparison Unit (VCU) to a specific Land Use Designation (LUD). VCUs generally encompass a drainage basin or watershed containing one or more large stream systems. Boundaries usually follow easily recognizable watershed divides. These units provide areas for resource inventory and interpretation. The Analysis Area contains 18 VCUs (Figure 1-2). We decided early in the analysis to use refined VCU boundaries for the Analysis Area. As a result, the VCU boundaries and their acreages vary from those within TLMP. These acreage discrepancies are not significant.

The **1979** TLMP had four different Land Use Designations and Management Areas to facilitate Forest Plan implementation (Table 1-1). The **1999** TLMP has 19 LUDs of which eight occur within the Analysis Area (Table 1-2, Figure 1-2). Also note that in Figure 1-2 a parcel of land that is private has been added. This parcel on the shore of Chatham Strait was transfered to SeaAlaska Corporation in 1999. This is the only location that this private land will be mentioned, we have chosen not to redo the entire analysis. Although this is a significant change for the Analysis Area, a land ownership change does not invalidate the work completed.

The newly revised TLMP includes new Goals and Objectives, Management Prescriptions, and Forest-wide Standards and Guidelines. These have changed the management direction applied to much of the Southeast Chichagof Analysis Area since the original 1979 TLMP (Table 1-1). Additionally, the 1999 Record of Decision mandated a 200-year rotation in Wildlife Analysis Areas 3308 and 3627, i.e., all the VCUs from Corner Bay around Chatham Strait to False Island (see Figure 4-18).

Table 1-1. 1979 Land Use Designations for the Analysis Area (from TLMP).

LUD	VCUs	Acres	Percent
II	235, 237, 247	57,159	22.0%
III	239	17,346	6.7%
IV	230-234, 236, 238, 240-246	185,543	71.3%

Table 1-2. Land Use Designations (LUD) for the Analysis Area (from 1979 TLMP and 1999 ROD).

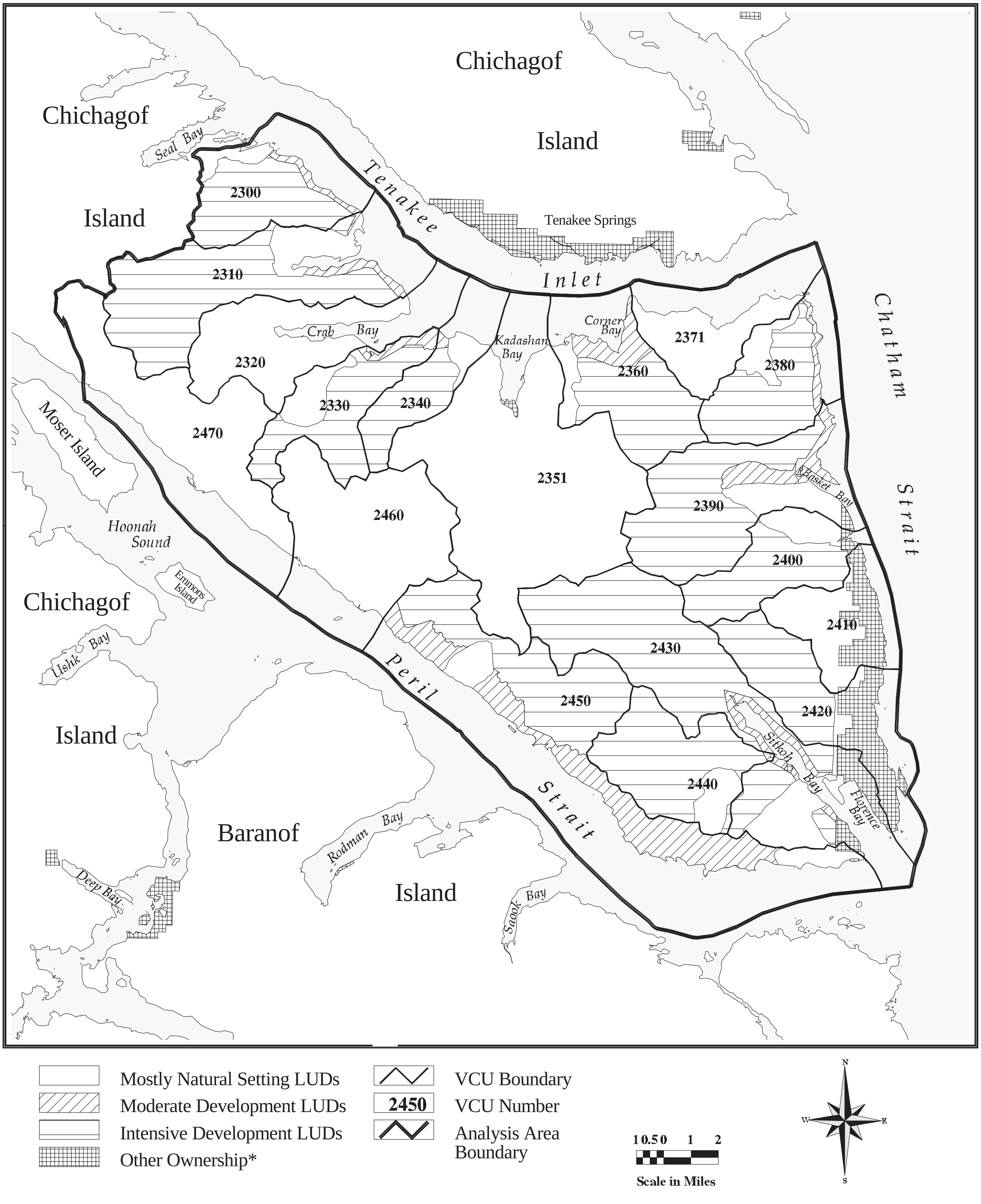
LUD	Development status	Acres*	Percent
LUD II and Wild & Scenic River	Mostly Natural	12,514	4.8%
TTRA LUD II	Mostly Natural	44,679	17.3%
Old-Growth Habitat	Mostly Natural	39,142	15.1%
Semi-remote Recreation	Mostly Natural	20,557	7.9%
Scenic Viewshed	Moderate Development	12,421	4.8%
Modified Landscape	Moderate Development	5,189	2.0%
Timber Production	Intensive Development	121,280	46.8%

*Total acreage (259,034) is slightly less because the TLMP used a less accurate shoreline layer for the whole Tongass in their analysis than what we used for this analysis (total acres 260,048).

Ecosystem Management

In 1992 Forest Service Chief F. Dale Robertson directed the Forest Service to emphasize ecosystem management and landscape analysis on the National Forests. He committed the Forest Service to an ecological approach to management and stated that this approach would be used to achieve multiple-use management and that we must blend the needs of the people and the environment in such a way that the National Forests represent diverse, healthy, productive, and sustainable ecosystems. When Jack Ward Thomas became Chief, he reiterated this commitment. Their guidelines and principles for application of ecosystem management are presented in Appendix B. These principles were applied to the Northwest Baranof and Indian River timber sale planning projects. This analysis

Figure 1-2. The Value Comparison Units (VCU's) and Land Use Designations (LUD categories) for the Southeast Chichagof Landscape Analysis Area.
*NOTE: The parcel of private land that runs from below Sitkoh Bay to Basket Bay was transfered to Sealaska Corporation in 1999.



builds upon this effort to apply landscape analysis and ecosystem management techniques to a resource management plan for southeast Chichagof Island.

As indicated by Chief Robertson, sustainable ecosystems are the goal of this approach. These have been defined as:

> ". . . the overlap between what people collectively want--for themselves and future generations--and what is biologically and physically possible in the long term. This view of sustainability identifies people as part of the ecosystem and recognizes the ecological reality that people are beginning to dominate the Earth's ecosystems. This view also suggests that the goals of management cannot be defined in purely biological terms that ignore the desires of people. If goals are so defined, society is likely to change management to better suit their needs--thereby replacing biological goals and preventing sustainability." (Bormann et al. 1994) (Figure 1-3).

Sustainability of an ecosystem can only be approximated because ecosystems are constantly changing, with and without human activity. This provides a challenge for land managers because public agency structure tends to resist change, making it difficult to adapt and apply new management approaches to local conditions. Public policy is formed in the political arena; it is often skewed by the special interests of those with power and influence, and may not reflect what is physically, biologically, or socially possible. The public's role in decisions affecting land management is increasing, and people are insistent that their demands are heard. Neighbors disagree, communities are divided, voices become shrill, and lawyers thrive (Bormann et al. 1994).

Effective communication of scientific and management concepts to the public is essential to having informed communities of interest. This document is intended to present what we know about the current conditions on southeast Chichagof and possible management options so that the public can assist in this process.

Three steps are required to calculate sustainability: 1) select the goods, services, and conditions desired by society; 2) determine ecosystem patterns and processes thought to be needed to maintain these goods, services and conditions; and 3) evaluate and set priorities that meet societies demands within an ecosystem's patterns and processes (Bormann et al. 1994). Table 1-3 lists possible items from 1 and 2 above, since these items and their "quantities" are often the items over which groups disagree.

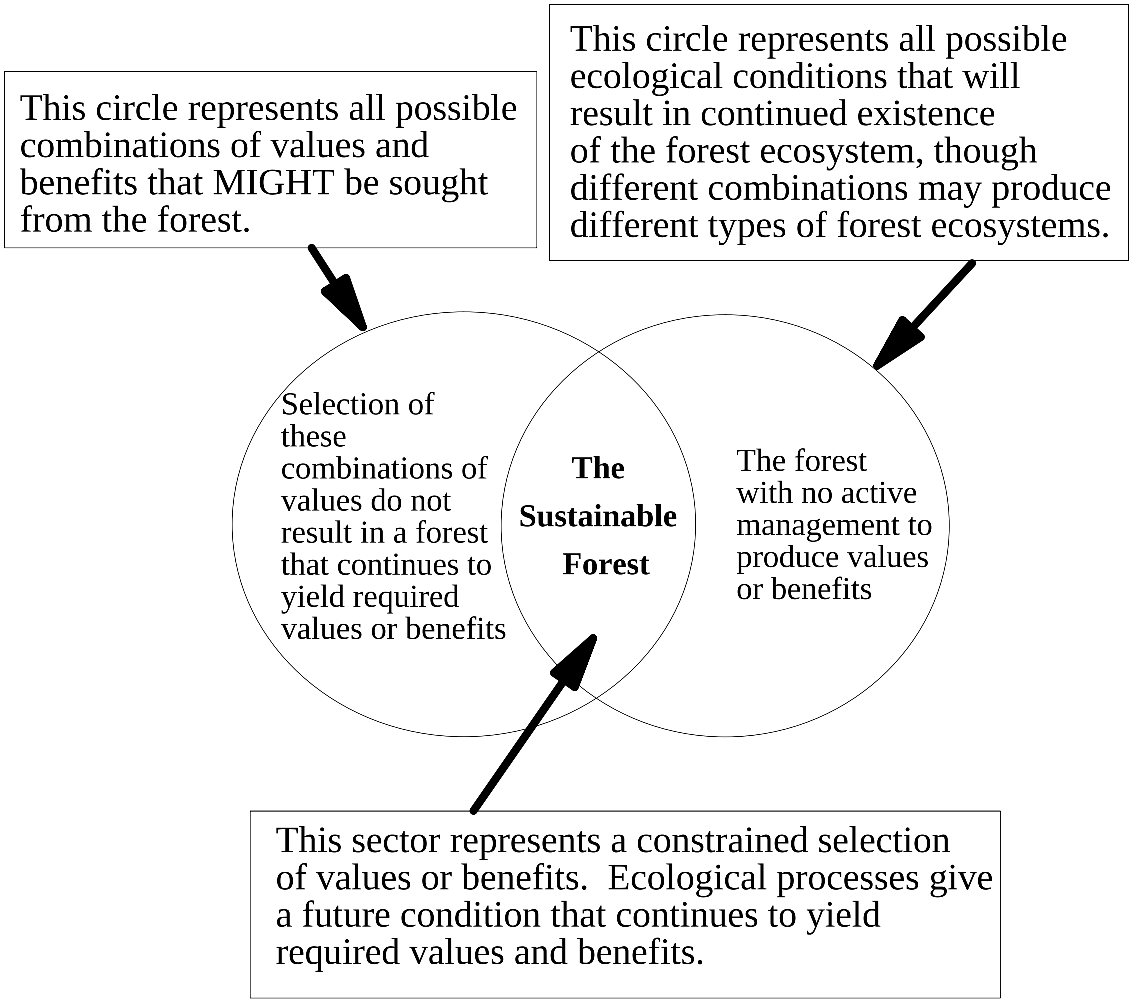


Figure 1-3. A sustainable ecosystem may require some constraint in selecting the ecosystem goods, services, and conditions that society expects from an ecosystem. This will ensure continued production of particular values. Ecosystem management may also include the requirement for managing future options for change as a means of responding to changes in societal preferences (After Bormann et al. 1994).

Generally, land uses are defined at the Forest planning level. As one moves from a coarse to fine scale, it becomes clear that not every acre can produce the desired mix of benefits. The new 1997 Forest Plan and the 1999 Record of Decision have addressed many of society's desires. We have also made management recommendations for the Analysis Area to help implement the new Forest Plan's Standards and Guidelines for this portion of the Chatham Area.

Table 1-3. Goods, Services and States Desired by Society and Some Ecosystem Patterns and Processes Needed.

Society's Desires	Ecosystem Patterns and Processes
Timber Volume (High, low, none)	Disturbance and regeneration Biological productivity Regeneration of soil nutrients
Species diversity	Sufficient old growth to maintain species distributions
Salmon production	Stream systems with natural flow rates
Stable deer population	Well distributed functional winter range

Landscape Analysis

Comprehensive assessments over large geographic areas (such as landscapes) are one tool for implementing ecosystem management. A landscape analysis should describe the physical, biological, social, and economic conditions over broad spatial and temporal scales and recommend appropriate changes in management direction. These assessments provide the foundation for determining trends toward desired futures (Thomas 1996).

There are several principles of an ecological approach to multiple-use management that are key to understanding and managing for sustainable futures: (1) use information across multiple scales; (2) determine reference conditions, establish current status and trends and cooperatively agree on desired conditions; (3) assess the role of historic disturbance factors; (4) use multiple borders and boundaries for information collection; (5) better recognize and address uncertainty and risk; (6) identify and address information needs; (7) emphasize monitoring and evaluation; and (8) use an adaptive management process (Thomas 1996).

Landscape Analysis and Timber Sale Planning

Landscape analysis fits between small-scale project planning and large-scale Forest planning. At the Forest planning level we cannot include the amount of information that is desirable with landscape analysis.

Project planning and Forest planning are both NEPA decision documents. These documents must follow rigorous procedures of analysis and public involvement. *The Southeast Chichagof Landscape Analysis is* **NOT** *a NEPA document but is at an intermediate scale between the Project and Forest planning.* Since it is not a decision document, recommendations are made that Project planning can utilize as much as makes sense. Public input is desirable with a landscape analysis, but is not required. We had very little public input because of limited time constraints and the decision we made to focus primarily on natural resources with this effort.

Traditional timber sale planning focuses on relatively small areas defined by the extent of the proposed project. Although such project planning attempts to integrate resources and assess cumulative effects, the coarser scale necessary for addressing cumulative effects and resource interactions is missed. Landscape analysis, on the other hand, assumes resource integration and emphasizes the relationships among resources on larger scales and over longer temporal spans. Additionally, the landscape analysis is not burdened by any specific proposed action. This analysis over space and through time is necessary in order to address landscape issues such as biological diversity, forest fragmentation, maintenance of viable wildlife populations, and long-term, sustained commodity production. These issues can best be addressed from the broader spatial and temporal perspective provided by landscape analysis, and can be overlooked or incompletely analyzed in traditional project planning approaches.

Scientists, environmentalists and industry representatives are now discussing the need to manage on the level of entire ecosystems instead of single resources (Wilcove 1994). Louisiana-Pacific, for example, is developing Terra Vision, a set of tools and approaches to achieve both ecological and economic goals (Louisiana-Pacific Corporation 1995). Much of this interest stemmed from the controversy surrounding the northern spotted owl. The importance of an ecosystem approach was illustrated by Thomas et al. (1993), who identified over 380 species of plants, animals, and fungi associated with old-growth forests that would not be adequately protected under the earlier 1990 plan to protect the northern spotted owl (Wilcove 1994).

Chapter 2 - Analysis Area Description

Physical Characteristics

This chapter gives brief descriptions of the physical, biological, and human-impacted characteristics of the Analysis Area; more detailed presentation are given in Chapter 4. In addition, a discussion of management boundaries within the Analysis Area is presented.

Location

The Analysis Area is in Southeast Alaska on Chichagof Island, the second largest island in the Alexander Archipelago. Glacially carved fjords along major faults lines have divided Chichagof Island into nearly separate peninsulas. The Southeast Chichagof Analysis Area (260,048 acres) is a peninsula defined by Tenakee Inlet to the north, Chatham Strait to the east, and Peril Strait on the south. This maritime setting has affected the physical and biological characteristics and the human uses of the Analysis Area.

Climate

Southeast Alaska is within a humid temperate domain where cool temperatures and moist conditions prevail year-round (ECOMAP 1994). Temperatures are moderated by the Alaska Current, which circulates counterclockwise up the coast (Johnson and Hartman 1969). Data from a climatic station in Tenakee Springs indicate a mean temperature of 28.6° F in January and 56.3° F in August. This station also indicates that the average yearly precipitation at Tenakee Springs is 63.2 inches (1605 mm) (Farr and Hard 1987). Precipitation occurs throughout the year, with June being the driest month (2.5 in; 64 mm) and October the wettest (11.3 in.; 287 mm). Additional climatic data are presented in Appendix D.

Geology/Soils

Tectonics and bedrock geology have shaped this region of the State. Southeast Alaska is composed of several bands of rock called terranes which originated far from North America in the Pacific Ocean (Brew 1990). Each band is composed of different materials and measures hundreds of kilometers long by tens of kilometers wide. The three primary terranes of the region are the Alexander (most of Chichagof Island and much of Glacier Bay), the Chugach (most of Baranof Island, and the west coast of Chichagof), and Wrangellia (a thin piece of Chichagof Island inland along the west coast) (Brew 1990). These terranes, separated by faults, have moved both vertically and horizontally. The Lynn Canal-Chatham Strait fault (between Chichagof and Admiralty Islands) has experienced 60-110 miles (100-180 km) of movement over the last 100 million years (Brew 1990). Thus, Chichagof Island has moved north relative to Admiralty Island.

The topography of southeast Chichagof is the result of folding and faulting of thick sequences of sediments and the upwelling of magma which formed granite when it cooled. Cretaceous and Silurian aged granite (Figure 2-1) make up 69% of the Area. Two calcareous formations (Kennel Creek and Paleozoic Marble) account for 6.3% of southeast Chichagof (Loney et al. 1975). All karst features occur in these calcareous formations, particularly in alpine areas. Karst is soluble rocks such as limestone, dolomite, and marble; subsurface drainage is common and collapse features such as caverns, sinkholes, and pits are numerous (Milanovic 1981). Additionally, rich fens, a relatively rare nonforested wetland type, are located on lowlands below limestone. Table 2-1 presents the acreage for each of the bedrock formations in the Analysis Area.

Table 2-1. Major Bedrock Types in Analysis Area (Loney et al. 1975).

Bedrock symbol	Bedrock Formation	Acres
Qu	Unconsolidated Sedimentary Deposits	20,593
Kt	Intrusive Igneous Rocks (Cretaceous)	142,543
Df	Freshwater Bay Formation	2,413
Dsk	Kennel Creek Limestone	13,770
Dskc	Kennel Creek Conglomerate	4,682
Pzh	Hornfels, Schist, and Gneiss	35,902
Pzm	Marble	2,548
Sa	Point Augusta Formation	1,317
Ss	Intrusive Igneous Rocks (Silurian)	36,280

Soils on mountain and hill slopes are formed of decomposed bedrock and colluvial material (deposited by gravity). Bedrock soils are generally shallow, while colluvial soils are deeper and better drained. In addition, soils formed of glacial till occur in patches plastered along mountain and hill slopes to elevations of about 1,000 feet. In the valley bottoms, soils have formed of river deposits, colluvial material, and marine sediments.

The cool, wet climate in the Analysis Area causes organic matter to decompose slowly, creating soils characterized by organic surface layers. Where drainage is restricted by topography or an impermeable layer, such as bedrock or glacial till, peatlands composed of organic matter are common. In coarse alluvium (gravels and cobbles) the soils are well drained and support forests. Where the alluvium is finer and restricts drainage, nonforested vegetation communities such as fens and bogs form. Tree root depth is shallow, primarily in the nutrient-rich organic layers and the first few inches of the mineral layers. Typically the root zone is moist, acidic, and contains most of the nutrients available for plant growth (Heilman and Gass 1972). Soils formed from limestone and marble are typically less acidic, higher in nutrients and, therefore, more productive. Large areas of these calcareous soils occur along Chatham Strait within the Little Basket Lake, Basket Lake, Kook Lake, Buckhorn Creek, Whale Creek, and Trap Bay watersheds.

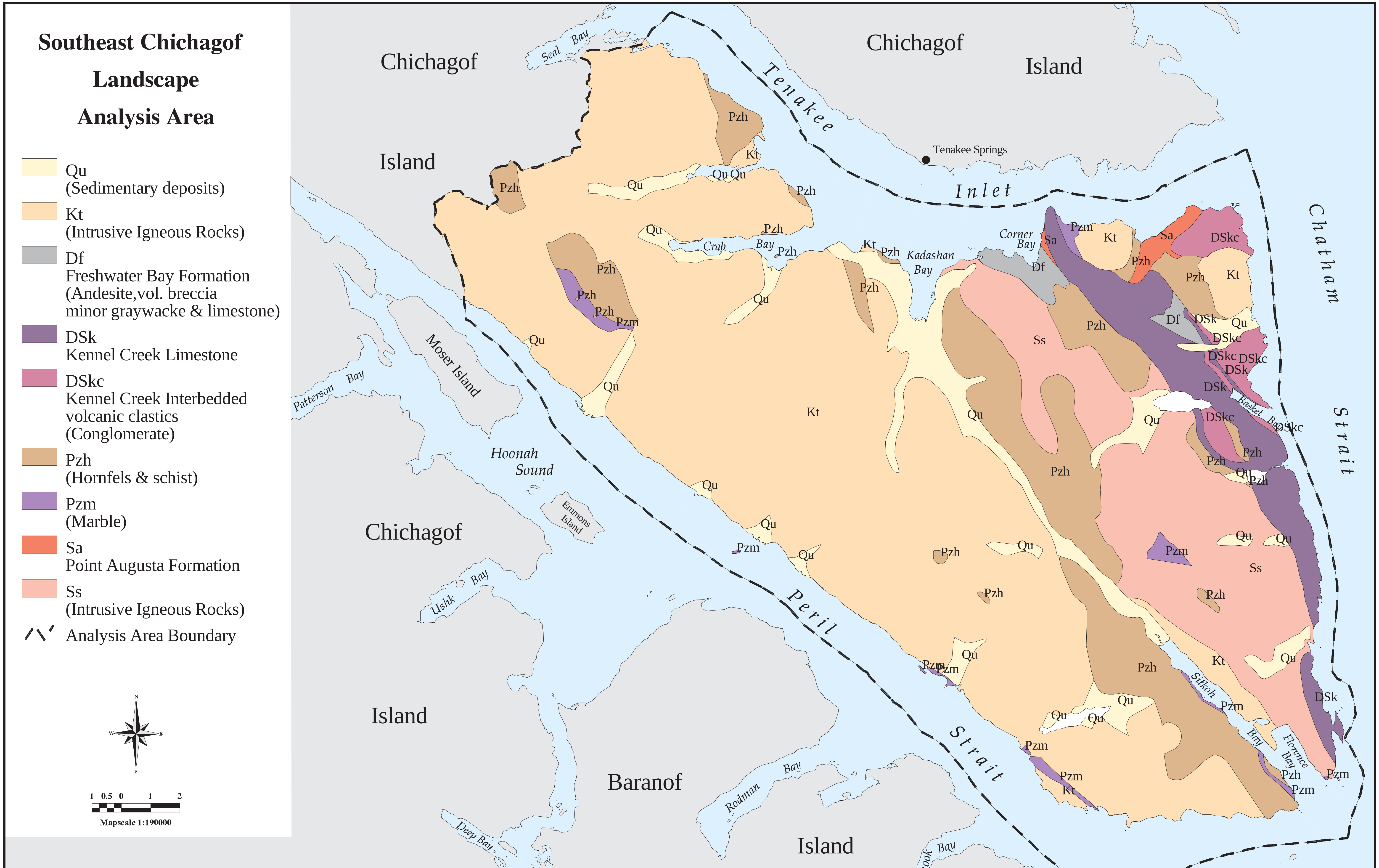


Figure 2-1. Geology of the Southeast Chichagof Landscape Analysis Area (from Loney et al. 1975).

Hydrology

The Analysis Area includes watersheds which range from small, isolated drainages (first order) up to drainages of more than 25,000 acres (fourth order). This includes 26 "key" watersheds which are greater than 2,000 acres and/or contain substantial anadromous fish habitat. Eleven of these watersheds drain north into Tenakee Inlet, eight drain east into Chatham Strait, and seven drain south into Peril Strait.

Streamflows for the Analysis Area are typical of island watersheds in Southeast Alaska (Schmiege et al. 1974). These watersheds are short, steep and have runoff patterns which respond directly to rainfall except for late spring snow melt. Generally, maximum stream discharge of 12 cfs/mi^2 occurs in October or November while snow melt in May results in a second discharge peak. Infrequent winter storm freshets may result from warm rain-on-snow events. Low flows of 3 cfs/mi^2 generally occur between June and August although low flows can also occur during prolonged winter cold periods.

Other factors which influence water flow and conditions in the Analysis Area include groundwater recharge from karst features, fens, and shallow aquifers and seeps. Karst features influence streams along Chatham Strait. These streams and watersheds with calcareous rich fens are nutrient-rich, which contributes to fish habitat quality. Shallow aquifers and seeps associated with valley floor wetlands and alluvium help sustain summer and winter base flow in main stream channels.

Biological Characteristics

Vegetation

Vegetation in the Analysis Area varies by elevation. Mountain hemlock (*Tsuga mertensiana*), heath, and alpine meadow communities occur at high elevation. Dominant species include Merten's mountain-heather (*Cassiope mertensiana*), Alaska moss heather (*Cassiope stelleriana*), and stunted stands of mountain hemlock.

Sitka alder (*Alnus sinuata)* and salmonberry (*Rubus spectabilis*) dominate on steep brush fields. Other species that are common include Sitka willow (*Salix sitchensis),* lady fern (*Athyrium filix-femina),* stink currant (*Ribes bracteosum),* and false hellebore (*Veratrum viride).*

Beside and below the brush fields are highly productive, forested slopes. Common plant associations include Sitka spruce/blueberry (*Picea sitchensis/Vaccinium spp*.), western hemlock/blueberry (*Tsuga heterophylla/Vaccinium spp*.), and western hemlock/blueberry/shield fern (*Tsuga heterophylla/Vaccinium spp*./*Dryopteris austriaca*). [See Chatham Area's Forest Plant Association Management Guide (Martin et al. 1995) for more information.]

Valley bottoms have deposits of compact till and marine silt deposits which are impervious to water penetration. On these substrates, wetlands predominate. One wetland type is rich fens, or areas of sedge peat accumulation, with a high water table and neutral pH. Also common on the valley bottom is a shorepine/crowberry (*Pinus contorta/Empetrum nigrum)* community, which is a scrub shrub blanket bog. On gently sloping landforms, mixed conifer series communities, such as mixed conifer/blueberry (mixed conifer/*Vaccinium* spp.) and mixed conifer/blueberry/skunk cabbage (mixed conifer/*Vaccinium*/*Lysichitum americanum*), are dominant. Near large streams, where drainage is better, highly productive Sitka spruce stands dominate.

Wildlife

The area supports a wide variety of wildlife species, including brown bear, marten and Sitka black-tailed deer. The wildlife of the Analysis Area contribute significantly to the economic, recreational, and subsistence needs of both local residents and visitors to the area. Demand continues to grow for opportunities to both hunt and watch wildlife.

The habitat needs of the wildlife species in the Analysis Area, the majority of which are associated with old-growth forests, must be integrated with the management of other resources. The old-growth forests of the Analysis Area are valuable as wildlife habitat and as a source of high quality timber. Balancing these important but conflicting values is critical.

Fish

The Analysis Area contains 45 fish streams catalogued by Alaska Department of Fish and Game (ADF&G) as anadromous, including the previously mentioned 26 key watersheds. Within the Analysis Area, there are 249 miles of Class I streams, 210 miles of Class II streams, and 349 miles of Class III streams. (Class I streams have anadromous fish or habitat upstream of barriers that can be enhanced, Class II streams have resident fish populations, and Class III streams have no fish populations.)

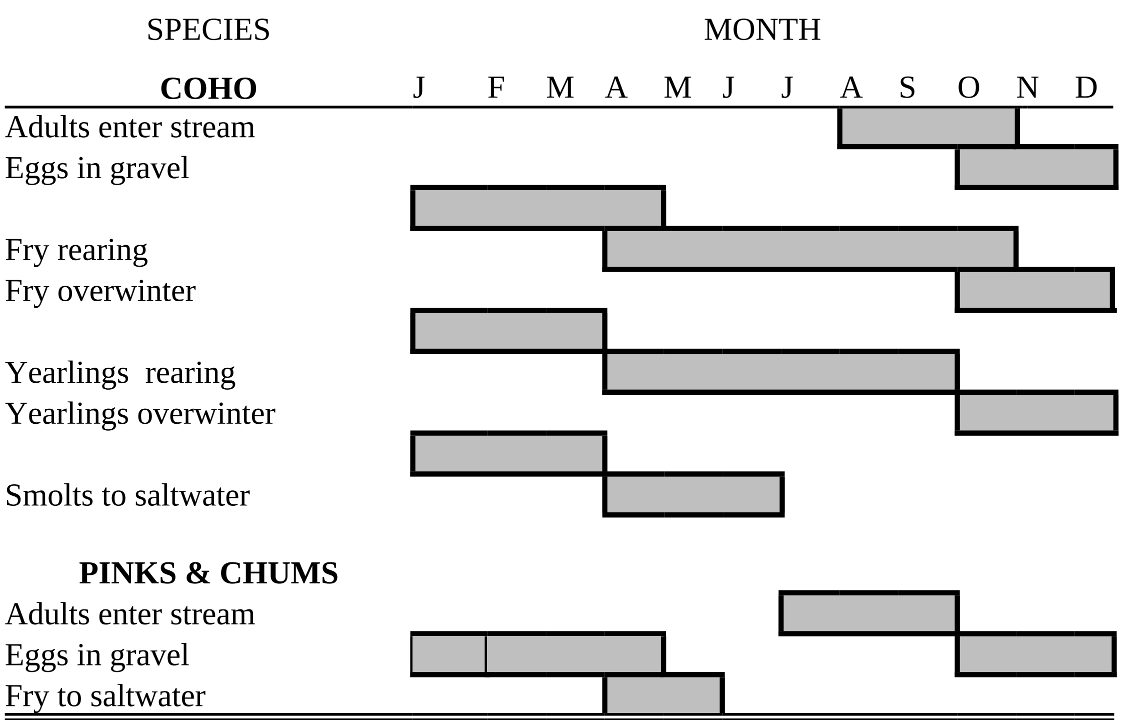
Most of the moderate to larger streams in the Analysis Area contain native runs of pink salmon (*Oncorhynchus gorbuscha*), chum salmon (*O. keta*), coho salmon (*O. kisutch*), and anadromous Dolly Varden char (*Salvelinus malma*). Estimated annual production of the streams in the Analysis Area include 1,510,000 adult pink salmon and 27,400 adult coho salmon. We calculated production estimates for these two indicator species, but there is substantial production of other fish in the Analysis Area. Sockeye salmon (*O. nerka*), an important subsistence fish, occur in the Kook, Basket, and Sitkoh Creek systems. All three watersheds have lakes accessible to anadromous fish. Cutthroat trout (*O. clarki*) (resident and anadromous), Coastal sculpin (*Cottus aleuticus*), and steelhead trout (*O. mykiss*) also occur in many of the streams in the Analysis Area.

Pink and chum salmon spawn in the freshwater in the summer and early fall and emigrate to saltwater almost immediately after emergence from gravels in the spring (Table 2-2). After spawning in streams, coho salmon, steelhead trout, cutthroat trout, Dolly Varden char and coastal sculpin spend at least part of their life cycles in streams. Sockeye salmon spawn in both lakes and streams but predominantly rear in lakes.

An assessment of Southeast Alaska salmon stocks was recently completed (Halupka et al. 1995). All available information on the biological characteristics and population status of anadromous salmon in Southeast Alaska was reviewed. Kadashan River, a north-facing drainage, has an early pink salmon run, with an average run date of July 25. For comparison, Indian River, a south-facing drainage across Tenakee Inlet, has a late pink salmon run, with a mean run date of September 10. Kook Creek also has a late pink run, with a mean run date of September 2.

Several watersheds in the Analysis Area have waterfalls on their main channels that either exclude all anadromous fish or substantially limit fish habitat accessible to anadromous fish. These barriers occur in the Whale, Little Basket, White Rock, Broad, Broad Finger, and "Pinky" Creek systems. Resident Dolly Varden char and cutthroat trout are the most common fish species present in available fish habitat upstream of waterfalls which are barriers to anadromous fish.

Table 2-2. Life History of Coho, Pink, and Chum Salmon in the Analysis Area.



Human Dimension

Historically, Native and non-Native settlements were found in the Analysis Area, while logging camps at Corner Bay and False Island are more recent. These settlements, and resources extracted from them, shaped the Analysis Area and the people who lived there. Timber harvest from the Area provided jobs and helped support the economy of the region, while the lumber and pulp from this harvest was distributed throughout the world.

Presently caretakers at the False Island and Corner Bay logging camps and the Chatham Cannery in Sitkoh Bay are the only year-round residents in the Analysis Area. This does not mean, however, that people do not affect the Area. Subsistence, recreation and commercial activities all occur here.

The anadromous fish streams produce salmon important to the commercial, sport and subsistence fisheries in Southeast Alaska. Commercial salmon fishing provides significant income for Area residents, including the seine fisheries for chum and pink salmon from Tenakee Inlet and Peril Strait and the troll fisheries for coho and chinook (which are not produced in any streams on the Analysis Area). This area is important to residents of Tenakee Springs, Angoon, Hoonah, Sitka, Juneau and Petersburg for subsistence hunting, fishing and gathering. Coho, pink, chum, sockeye and chinook salmon, steelhead and cutthroat trout, and Dolly Varden char are all targeted, while sockeye from Kook Lake Creek (Basket Bay) and Sitkoh Lake Creek are especially important for subsistence fishing. In addition, tourists from around the world come to recreate.

Chapter 3 - Issues and Key Questions

Resource Management Issues

The purpose of the Southeast Chichagof Landscape Analysis is to increase and document existing knowledge of the ecological systems and human uses within the Southeast Chichagof Analysis Area and to make some recommendations related to future managment of the area. This increased understanding will help resource managers and public stakeholders address a broad range of resource management issues. This chapter describes the resource management issues identified for this analysis and lists key questions that were addressed.

The resource management issues identified for the Area Analysis have been derived in part from public issues identified for two recent planning efforts. Although the two planning efforts are at different scales - one at the Forest scale and the other at a project scale - they both encompass all or parts of the Analysis Area. In a larger sense, the issues identified for both of these efforts are accurate reflections of the issues relating to all National Forest management on the Chatham Area of the Tongass National Forest. The first source for issues was the Tongass Land Management Plan Revision, including the Supplement to the Draft Environmental Impact Statement (USDA 1991) and the Revised Supplement to the Draft Environmental Impact Statement (USDA 1996). The second source was the Southeast Chichagof Project Area Final Environmental Impact Statement (USDA 1992).

A statement was prepared to describe each resource management issue, and key questions were developed to help focus the analysis toward specific information that is needed or desired. The following sections describe the resource management issues and questions. The results of these key questions are found in Chapter 5 and in Appendix G, which describes future management scenarios as modeled by Spectrum.

The resource management issues identified for this analysis are assembled into the following issues and sub-issues.

- **Ecological Issues**.
  Biodiversity, Karst
- **Forest Vegetation Issues.**
  Timber Management, Old Growth, Second Growth, Wildlife
- **Aquatic Issues.**
  Fish Habitat
- **Human Use Issues.**
  Heritage Resources, Recreation, Scenic Resources, Subsistence, Land Use, Transportation Systems

Ecological Issues

Biodiversity. Biodiversity is defined as the variety of life and its processes, including the variety in genes, species, ecosystems, and the ecological processes that connect everything in ecosystems (Jensen and Bourgeron 1994). The maintenance of biological diversity may be discussed using a species (*fine filter*) approach or an ecosystem (*coarse filter*) approach. In the Area Analysis we use one approach or the other, depending on the specific question being addressed.

<u>Key Questions:</u>

1) What is the distribution and variety of the landtype associations (landscapes) that make up the Analysis Area? How has management activity been distributed across the landtype associations?

2) How representative are the natural setting LUDs as compared to the moderate and intensive-development LUDs for landtype association diversity?

Additional questions that pertain to biodiversity are covered in the sections on karst, forest vegetation, and fish and wildlife.

Karst. The extent and importance of the karst and cave resources of the Tongass National Forest have only recently come to light. The recent studies and surveys, including a "Karst and Cave Resource Significance Assessment" (Aley et al. 1993) done for the Ketchikan Area, have indicated an extensive resource of significance. This information has been incorporated into the standards and guidelines in the Tongass Land Management Plan Revision (1997).

The Analysis Area includes significant karst features. Most of these features are located in the easternmost portion of the Analysis Area, although their extent and significance have not been well documented. Local individuals and regional organizations are interested in karst and cave resources on Chichagof Island.

<u>Key Questions:</u>

1) Where does karst occur within the Southeast Chichagof Analysis Area? Is any of it high-vulnerability and deserving of special consideration?

2) What restrictions, if any, does responsible stewardship of these karst resources place on future management and human use?

Forest Vegetation Issues

Timber Management. The old-growth forests of the Analysis Area are valuable for biological diversity, wildlife habitat, subsistence resources, recreation opportunities, and scenic quality. These forests are also an important source of high quality timber for maintaining a viable wood products industry in Southeast Alaska. Balancing output of these important but often conflicting resources of old-growth forests is a difficult management problem. Old-growth forests have been the only source of timber production to date within the Analysis Area. The lack of mature second growth within the Analysis Area guarantees that old-growth forests will continue to be in demand for timber production for the next 50 years.

Areas of the National Forest allocated to timber management are expected to exhibit a certain mosaic of forest conditions across the landscape. These forest conditions will vary by stand age, structure and density, species composition, site conditions, and the method and frequency of silvicultural practices. It is important to consider the desired future condition of the managed forest and to describe this condition in terms of the current mosaic that is established.

There has been considerable discussion regarding methods of timber harvest and the desirability of even-age versus uneven-age management systems. In particular, the discussion has focused on clearcutting and alternatives to clearcutting. In 1992, then Chief of the Forest Service F. Dale Robertson stated that, "In making future forest management decisions, clearcutting is to be used only where it is essential to meet specific Forest Plan objectives..." The objective is to make greater use of single tree selection, group selection, green tree retention, shelterwood, seed tree, and other regeneration cutting methods. In the Record of Decision of the new TLMP, it states "...it is estimated that 65% of harvesting will involve clearcutting, with the remaining 35% utilizing other methods" (USDA Forest Service 1997).

<u>Key Questions:</u>

1) What is the extent of the timber resources within the Southeast Chichagof Analysis Area?

2) How might concerns for visuals and deer winter range affect timber outputs? What are some possible scenarios for sustained yields from the Analysis Area?

Old Growth. Old-growth forests provide a connection to the past. They are areas that people view as pristine, undisturbed by humans. Old-growth forests give people a sense of security by preserving a part of the natural world.

There are numerous definitions of old growth, many of which are specific to different forest types. The new TLMP states "Old-growth forest is characterized by a patchy multi-layered canopy; trees that represent many age classes; large trees that dominate the overstory, large standing dead (snags) or decadent trees; and higher accumulations of large down woody material. The structure and function of an old-growth ecosystem will be influenced by its stand size and landscape position and context" (USDA Forest Service 1997).

Maintaining old-growth forests is directly related to all of the other issues discussed in this section. Old-growth forests are important for maintaining biological diversity on a given site, and they contribute significantly to diversity across the landscape. They provide structural and biological environments that are important for wildlife habitat and subsistence. Not only is the amount of old growth significant, but also its distribution across the landscape. Natural processes such as landslides and windthrow, and human activities such as timber harvest and road building, fragment old-growth forests. Fragmentation is the process of breaking contiguous blocks of old-growth forest into smaller areas. This results in the creation of more edge habitat and less core (interior) old-growth habitat.

Key Questions:

1) What is the extent of old-growth forest within the Southeast Chichagof Analysis Area? What restrictions, such as LUD II areas and old-growth reserves, need to be considered with future resource management and human use of the old-growth forest?

2) What is the existing mosaic of forest conditions within the Analysis Area, given wind disturbance and timber management? How can future management use this information?

3) What is the extent of old-growth forest fragmentation within the Analysis Area? How does this fragmentation affect future resource management and human use?

Second Growth. Many individuals concerned with protecting old growth view areas previously harvested as forever allocated to a single (or limited) resource use. Some people believe these areas will never again provide the habitat niches, visual appearance, or spiritual significance that unmanaged old growth provides.

There are opportunities for manipulating forest structure and composition to promote habitat for wildlife species. For many species, the habitat provided by old-growth structure is important and, for a few, critical. Where the emphasis of second-growth management is wildlife habitat, intermediate treatments can increase horizontal and vertical structural diversity and allow more sunlight to the understory. The goal of this type of prescription is to accelerate stand development to a mature forest condition closer to old growth.

These previously harvested areas are important as a sustainable source of raw material for the timber industry. There is widespread interest in managing second growth (perhaps a better term is young growth) to accelerate commercial wood production. The calculated allowable sale quantity in the current Forest Plan permits harvest levels today that are somewhat higher than would be permitted if regenerated stands received no intermediate treatments. This is based on modeling forest production with precommercial thinning. Hence, precommercial thinning is important to reaching the proposed annual harvest (USDA Forest Service 1997).

In addition to accelerated fiber production, there is interest in promoting accelerated "value production." Second-growth management opportunities exist for multiple thinnings and pruning to promote the growth of high-value sawlogs. With a worldwide reduction in the supply of high-quality sawlogs typically associated with old-growth forests, the value of these products should continue to grow at a rate above that of wood products as a whole.

Key Questions:

How extensive is second growth within the Analysis Area? How much thinning has occurred? What potential do these second-growth resources have for future timber management?

Wildlife and Fish Issues

Wildlife Habitat. The Analysis Area supports many wildlife species that contribute significantly to the economic, recreational, and subsistence needs of both local residents and visitors. Demands for opportunities to both hunt and watch wildlife are increasing. The old-growth forests of the Analysis Area are valuable for wildlife habitat and as a source of high-quality timber. Balancing these conflicting values of old-growth forests is critical.

Key Questions:

1) Where is the high-value deer habitat and how has it changed since the onset of industrial logging (1956)? How has timber management affected deer-carrying capacity? What are the habitat effects for bear and marten since 1956?

2) How has old-growth forest fragmentation affected wildlife habitat, and what connections should we strive to maintain or restore?

3) What impacts might future timber harvest have on high-value deer winter range?

Fish Habitat. The fisheries of the Tongass National Forest contribute to the economic, recreational, and subsistence needs of the residents of Southeast Alaska and visitors to the region. The riparian habitat within the Analysis Area provides shelter, hiding places, food, and rearing areas for the salmon, trout and char using the streams and lakes. Changes in water quality and riparian habitat can alter a stream's ability to support fish.

In 1994, an Alaska Anadromous Fisheries Habitat Assessment (AFHA) studied the effectiveness of current procedures for protecting anadromous fish habitat on the Tongass National Forest and determined if any additional protection was needed (USDA Forest Service 1995). This assessment concluded that the previous measures were not fully effective for preventing habitat degradation or protecting salmon and steelhead stocks in the long term. The 1997 TLMP took this information into consideration and incorporated all the major tenets of the recommendations from the AFHA report (USDA Forest Service 1997).

Key Questions:

1) What are the past and current conditions of the riparian habitat within the Analysis Area? How will this affect future resource management and human use?

2) What are the key fish-producing habitats within the Analysis Area?

3) What geographic areas within the Analysis Area are particularly sensitive to natural or human disturbance that could adversely affect riparian and aquatic habitat?

Human Use Issues

People have been living on or using this portion of Chichagof Island for thousands of years. In this section we identify patterns of prehistoric and historic human use, subsistence use, recreation use, and commodity production in the Analysis Area. We also discuss, where possible, the social values of the physical and visual environment.

Key Questions:

1) What patterns of prehistoric, historic, and current use can be identified within the Analysis Area? Have prehistoric and historic residents and users of the landscape had any effect on the landscape?

2) What are the subsistence resources within the Analysis Area? Who are the subsistence users of the Analysis Area and what portions of the area do they use? Based on the available data, what is the degree of overlap between the most used areas and the highest quality winter deer habitat?

3) What has been the past recreation use of the area? What is it currently and what will it be in the future?

4) How has management since 1956 affected visuals? Are there areas that exceed the maximum disturbance threshold for visuals? Which areas have the greatest capacity to be managed and still be visually acceptable?

Chapter 4 - Conditions and Trends

Biodiversity

Forest ecosystems are neither discrete nor easily delineated. At any scale, the components of an ecosystem such as the plants, animals, and the abiotic elements (air, water, soil, sunlight, for example) interact both within and beyond that scale. Ecosystems can be thought of as a nested geographic arrangement, with smaller ecosystems within larger ones (Haber 1994, Bailey 1996). A tenet of landscape analysis is to view a particular project or activity from at least one geographic scale larger than the project or activity level, using ecological boundaries to delineate these views. The hierarchy of geographic scales shown in Table 4-1 was used for this landscape analysis. Past analyses focused primarily on the landtype and landtype phase levels, while this analysis focuses on the subsection and landtype association levels.

Table 4-1. National Hierarchy of Ecological Units.

Planning and Analysis Scale	Ecological units	Purpose, Objectives, and General Use	General Size Range	Land Area used in this Project
Ecoregion Global Continental Regional	 Domain Division Province	Broad applicability for modeling and sampling. Strategic planning and assessment. International planning.	1,000,000's to 10,000's of square miles.	Not Applicable
Subregion	Section Subsection	Strategic, multi-forest, statewide and multi-agency analysis and assessment.	1,000's to 10's of square miles	Region 10 wide Tongass wide/ Chatham wide
Landscape	Landtype Association	Forest or area-wide, planning, and watershed analysis.	1,000's to 100's of acres	Southeast Chichagof scale
Land Unit	Landtype Landtype Phase	Project and management area planning and analysis.	100's to less than 10 acres	Project level, i.e., for timber sales (The CLU layer is equivalent to these units)

Source: USDA Forest Service 1993

Biodiversity, an abbreviation of biological diversity, is defined as the variety of life and its processes, including the variety in genes, species, ecosystems, and the ecological processes that connect everything in ecosystems (Jensen and Bourgeron 1994). Biodiversity has become a growing concern, given the species extinction rate we are now experiencing. We need to sustain species diversity at several spatial scales, not just on the earth as a whole, but within our own reach (Klijn 1992).

Biological diversity is discussed from a species (*fine filter*) or ecosystem (*coarse filter*) approach. The species approach works well where the aim is to aid a known species whose survival is threatened. The ecosystem approach works well where we have inadequate knowledge of numbers and kinds of species and the relationships among them in an ecosystem, and where the best approach for conserving them is to ensure that the ecosystem maintains its overall structure and function. In this biodiversity analysis we use both approaches.

Coarse Filter

To preserve ecosystem variety, we need to classify and map the type and extent of ecosystems. This task is difficult, however, since ecosystems are intricate and can be recognized at various scales from the continental to the very specific. Also, not all ecosystems are equally susceptible to human-induced change. For the Analysis Area the following three types of coarse filter diversity types were analyzed:

Landscape diversity. The landscapes or **landtype associations** that make up the watersheds of the Analysis Area vary in patterns of distribution and size. They have been affected differently by natural and human disturbance. We mapped the landtype associations and compared their distribution among watersheds and with past harvest activity. A representative analysis was done to compare landtype associations in VCUs removed from the timber base with landtype associations in VCUs available for timber harvest.

Structural diversity. Disturbances such as wind, disease, and landslides increase diversity in forest canopies and result in many-aged cohorts across the landscape. (Cohort refers to a group of trees regenerating after a single disturbance.) Wind-generated stands were mapped for southeast Chichagof and compared to timber harvest activity. These types of disturbances, as well as timber management, create forest fragmentation, which is a concern for wildlife species. (See disturbance and patch analysis discussions in the forest vegetation section).

Geologic diversity. The distribution, composition, and structure of limestone in our temperate humid environment create **karst**, which may contain cave features (both abiotic and biotic) that are uncommon or rare. The most recent USGS geology map was digitized into GIS to aid in locating potential karst areas within the Analysis Area.

Fine Filter

A species, or fine filter, approach was used for terrestrial animals and fish populations. Other diversity concerns that were not considered for this analysis include vascular and nonvascular plant species, invertebrates, and genetic diversity.

Threatened, endangered or sensitive species. Animal species known to have reduced numbers or limited distribution were considered individually and, when appropriate, surveys of these species were completed.

Salmon stock diversity. Maintenance of individual salmon stocks is a primary concern to insure survival of both stock diversity and sustainable salmon production. Riparian conservation areas were added to GIS using riparian transect data from other locations on Chichagof Island.

Landscape Description

Landscape Processes

A complete characterization of a landscape or landform must involve a description of the feature, the processes involved in its formation, and its development through time (Chorley et al. 1984). There are five primary processes which influence the landscape: tectonism (geological plate movement), glaciation, hill slope processes (land slides and surface erosion), fluvial processes (streamflow and sediment transfer), and wind. Tectonic and glacial processes operate on a geologic time scale. On southeast Chichagof, landforms are generally less than 12,000 years old. Hill slope and fluvial processes have the greatest potential to affect resource condition on a time scale of years to decades. The processes most relevant to management issues are discussed in greater detail in the following section, and generalized landscape and stream descriptions are located in Appendix E. We have attempted to treat the study area holistically and to discuss the development of the landscapes, soils and vegetative types in relation to the major disturbance factors in these watersheds.

Tectonic Processes. Tectonic activity affects the study area on different temporal and spatial scales. On the geologic time scale, the movement of large terranes has resulted in the many different assemblages of bedrock in Southeast Alaska (Brew 1990). Much of the limestone that covers portions of southeast Chichagof and Prince of Wales Island originally formed in the south Pacific Ocean several hundred million years ago (Brew 1990). On a shorter time scale, the geologic fault between Sitkoh Bay and the Kadashan River valley created a weak zone in the rock which glaciers then carved out, resulting in the low and straight connection between them. On a time scale of thousands of years, some movement has probably occurred along this fault.

Glacial Processes. Glaciation has exerted the most profound effect on the soils and plants of the study area. The Wisconsin glaciation, which ended 12,000 to 13,000 years ago (Miller 1973), along with earlier glaciations, resulted in U-shaped valleys and higher elevation cirque basins. The glaciers scoured some areas to bedrock and deposited basal till and ablation till elsewhere.

After Wisconsin deglaciation, sea level was much higher than it is today, allowing marine silts and sands to be deposited in many low-lying valleys of northern Southeast Alaska. Miller (1973) mapped extensive deposits of the Gastineau Channel Formation in the Juneau area, and it is likely that these marine silts and sands now underlie many wetlands in the low-lying areas of the watersheds in southeast Chichagof.

The Little Ice Age was a period of worldwide cooling and glacial advance from the middle of the 13th through the late 19th century (Porter 1986). During this time, glaciers completely covered Glacier Bay. On southeast Chichagof, the upper treeline and forest composition may have been influenced by deeper winter snow pack and more severe avalanching than today.

Hill Slope Processes. Erosion has had a large effect on topography since the Wisconsin glaciation. Many colluvial and alluvial fans (partially formed by debris torrents) were deposited on the valley floors during this time. Recent landslides suggest this process is continuing within the Analysis Area. Initiation of landslides in an undisturbed environment is linked to temporary water table development during high-intensity storms (Swanston 1969). Landslides in timber harvest areas are generally on gentler slopes and significantly smaller than those in an undisturbed environment (Swanston and Marion 1991).

Fluvial Processes. Fluvial, or moving water, processes created the flood plains and alluvial fans in the study area. Based on the volume of both water and sediment, fluvial processes have different effects; however, materials carried by the water are always sorted and deposited according to size and weight. Today, the streams in the study area are not overloaded with material. These streams generally have one channel, with fluvial deposits such as point bars (on the inside of meanders), and levees (fine sands on the upper stream banks) (Davis 1983).

Wind Processes. Southeast Alaska's temperate rainforests are susceptible to wind damage because of the combination of shallow root systems, poorly drained soils, and high winds which often occur during peak rain events (Alaback 1990). Most commonly, single trees or small groups of trees are blown down (Harris 1989); however, southeast Chichagof Island also exhibits stand-scale blowdown. Examination of aerial photographs indicates that approximately 8% of the commercial forest in the Analysis Area is composed of stands which have regenerated after large blowdowns (see Forest Vegetation section below). These stand-replacing disturbances could be mapped as far back as 1680.

Ecological/Geologic Characterization

Subsections of the national ecological hierarchy are delineated by physiography, rock formation, climate, surficial geology, soil types, and natural vegetation. There are 19 ecological subsections on the Chatham Area (Brock et al. in prep.); this Analysis Area is composed primarily of two subsections: Sitkoh Bay and central Chichagof. The Sitkoh Bay subsection makes up the east side of the Analysis Area (Table 4-2) . The central Chichagof subsection contains a preponderance of granitic rocks. Climatically, the Sitkoh Bay subsection is drier and cooler than the west side of the Archipelago.

Of particular interest are the calcareous formations (Kennel Creek Limestone and Paleozoic Marble) which make up 6.3% of the Analysis Area. These formations comprise approximately 20% of the Sitkoh Bay subsection. Less than 1% of the other subsection is calcareous. These formations are important because karst and cave features are formed within carbonate bedrock (Baichtal and Swanston 1996). The 5+ feet of precipitation, acidic water from the peatlands, and the purity of the carbonates in the Analysis Area ensure karst development. Karst lands add a vertical, underground dimension which will be considered during project planning (USDA Forest Service 1997 TLMP).

According to Aley and others (1993), the epikarst and associated shafts and caves are well developed in Southeast Alaska and may be surpassed only by karst in tropical China, Papua New Guinea, and Madagascar. The Kennel Creek Formation appears to have the best developed karst features in the Analysis Area, and the cave system which drains Kook Lake is the largest river cave described in Southeast Alaska (Baichtal 1996). Much of the well-developed karst is in alpine areas, in contrast to Prince of Wales Island, which is primarily at lower elevations. Trap Mountain may contain the deepest cave system in North America. Vertical shafts appear near the top of the mountain (3,700 feet) while streams that probably come from the bottom of the cave system (resurgences), are less than 100 feet in elevation. Therefore, cave systems approaching depths of 3,600 feet may occur here.

Much of the timber on the low elevation karst was harvested between Corner Bay and Peninsular Point in the last 30 years. After the canopy is removed, vertical movement of nutrients and soil takes place where there is well-developed subsurface drainage (Baichtal and Swanston 1996). Timber harvest has impacted the most highly vulnerable karst by blocking cave entrances with logging slash and diverting sediment into karst features. Additionally, rich fens, a relatively rare nonforested wetland type, are located on lowlands below limestone and may be adversely impacted by the increased runoff once the limestone uplands timber has been harvested.

Landtype Associations

Landtype associations (LTAs) are landscapes that repeat across subsections. Bailey et al. (1994) suggested a scale of thousands to hundreds of acres for their delineation, and Table 4-2 shows the relationship between landtype associations and the other ecological units in the hierarchy. Eight landtype associations were defined in the Analysis Area. A detailed description of each LTA, its setting, hydrologic function, and vegetation is presented in Appendix E. These are described in terms of geomorphic processes, soil complexes, stream types, wetlands, and plant associations (ECOMAP 1994). For the Analysis Area the following factors were used: the geomorphology, especially as it relates to marine sediments and glacial till plains (Loney et al. 1975); colluvial and alluvial deposits that have developed since the end of the Wisconsin glaciation; snow accumulation and deposition zones (avalanche tracks); till and bedrock slopes; biotic and climatic factors that contribute to peatland formation; and tree overstory series. Landscapes were delineated where the flow of water, energy, and nutrients is different from surrounding areas as inferred from vegetation, soils, elevation, and relief. The LTAs for southeast Chichagof Island have different hydrologic functions and differing types and frequencies of disturbance (Table 4-3). We combined the existing Integrated Resource Inventory polygons (Common Land Unit layer in GIS) to create these units for southeast Chichagof. The minimum mapping size for these polygons is 40 acres. Before aggregating these polygons, we tested a portion of northeast Chichagof using color infrared photos at 1:62,500 scale. This allowed us to refine our concepts of landtype associations before using the existing GIS information to generate the new layers.

Landscape diversity. Landscape diversity relates to the abundance of different landscape types. In this section we discuss the landtype associations for the Analysis Area then consider some of the differences by watershed. Lastly, a brief section is devoted to Representative Analysis.

Table 4-4 shows the acres of each landtype association (LTA) found in the Analysis Area. The total acreage is greater than the total for the Analysis Area because of the estuaries that are just outside of the boundary. This table shows that the steeper, higher elevation LTAs are abundant, while the flatter, lower elevation LTAs are less common. The most productive forest occurs in four landtype associations, 1) steep forested mountain slopes, 2) moderately steep forested slopes, 3) the colluvial/fluvial and coastal surfaces, and 4) forested hills. Steep and moderately steep forested slopes make up 43% of the Analysis Area, and the forest hills make up about 4%. Due to a variety of factors, including high soil moisture, low soil temperature, and too much snow, the other four LTAs are marginal for trees. These are the lowland wetland-forest complex (12% of the Analysis Area), brushfields (12.5%), alpine/subalpine summits and ridges (21%) and estuaries/beaches (2%). In all, nearly 45% of the Analysis Area consists of LTAs that are primarily nonforest or forested wetlands.

Table 4-2. Ecoregions and Subsections of the Southeast Chichagof Analysis Area.

Ecoregion Hierarchy classes and approx. scale of units (ECOMAP 1994)	Name	Code	Acres and Percent in the Analysis Area
Domain 1,000,000 sq. miles	Humid Temperate	200	
Division 100,000 sq. miles	Marine	240	
Province 10,000 sq. miles	Pacific Gulf Coast Forest	245	
Section 1,000s sq. miles	Alexander Archipelago	M245B	
Subsection 100-10 sq. miles	Sitkoh Bay		73,000 28%
	Central Chichagof		187,000 72%
Landtype Associations 1,000s-100s of acres	See later section on landtype associations		

Table 4-3. Landtype Associations, Hydrologic Function, and the Main Types and Frequencies of Disturbance.

Landtype Association	Hydrologic Function*	Main Disturbance Type	Frequency of Disturbance**
Alpine/Subalpine Summits and Ridges	Donor	Mass movement	100-1,000s
Brushfields	Conveyor/donor	Mass movement	100s
Steep Forested Mountain Slopes	Conveyor	Windstorms	100s
Moderately Steep Forested Slopes	Conveyor	Windstorms	100s
Forested Hills	Conveyor	Windstorms	100s
Colluvial/Fluvial/ Coastal Surfaces	Conveyor	Floods/ Windstorms	10-100s
Lowland Wetland-Forest Complex	Receptor/ donor	Floods/beaver	10s
Estuaries/Beaches	Receptor	Floods/storm tides	10s

*Hydrologic function; i.e., donor, conveyor, or receptor of water (Brinson 1993)
**Approximate number of years between large events.

Table 4-4. Acres of each Landtype Association by VCU for the Analysis Area.

VCU	Alpine/ Subal-pine Summits Ridges	Brush-fields	Steep Forested Mtn. Slopes	Mod. Steep Forested Slopes	Forest-ed Hills	Collu-vial/ Flu-vial/ Coastal surfaces	Lowland Wetland-Forest Complex	Estuaries/ Beaches
230	2680	708	1809	2550	538	245	836	318
231	6845	2837	3811	2069	314	1058	1795	538
232	2878	1683	2109	2973	0	832	713	739
233	2585	1188	2123	1887	0	590	1705	116
234	1398	390	1359	909	0	177	1550	289
235	4906	3672	7899	8526	0	3013	6138	1369
236	1039	1089	3122	2802	60	700	2206	327
237	1355	1130	1600	792	111	747	686	153
238	2124	2112	2075	942	48	1420	1090	176
239	3204	2601	4309	2759	250	2156	1449	101
240	1965	1671	1760	1327	563	732	1203	0
241	1944	1103	2061	1615	30	535	249	18
242	1201	1732	2939	1764	415	1027	2279	302
243	4367	3406	5684	5565	396	2641	5051	626
244	1601	1365	2373	3044	841	850	1714	1
245	4237	2964	1077	2331	422	2275	900	228
246	4255	1807	4742	4434	0	637	1398	209
247	6962	1783	4271	1617	68	1268	394	192
Total	55,546	33,241	64,819	47,906	4056	20,903	31,356	5702

Source: CLU layer in GIS;
Total acres = 263,529. GIS acreage total includes estuaries outside the Analysis Area; hence the total acres are greater than the Analysis Area total.

In addition to these differences in the overall percentage of the Analysis Area, the eight LTAs are not evenly distributed in the watersheds that make up the Analysis Area (Figure 4-1). This distribution is a function of past glaciation, bedrock, and accumulation of sediments. Three examples illustrate this difference: alpine/subalpine summits and ridges make up 42% of VCU 247 but only 9% of VCU 236; colluvial/fluvial/coastal surfaces range from 14% of VCU 238 to 2.5% of VCU 230; and VCU 234 is 25.5% lowland landtype association but only 2.4% of VCU 247 is this type.

Representative Analysis

Concern that conservation areas may not be representative of regional ecological variability led to a technique called representative analysis. Once landtype associations are defined, representative analysis is used to determine if these landtypes are equally represented among management strategies. Assessing representativeness requires the use of basic biophysical data such as geology, vegetation, landform maps, and bioclimatic characterizations. The scale of the area one uses for this type of analysis can have a large impact on the results. For our analysis we used just the Analysis Area. In the future it may be helpful to do this analysis for a larger portion of the island, or for the entire Chichagof Island. We used the Landtype Associations developed from the CLU layer for this analysis. This layer integrates landform, vegetation and soils information (USDA Forest Service 1986) although it is not a direct measure of the ecological variables to which species respond (such as nutrient availability or solar insolation). It does constitute a recognition of the natural landscape units that exist, and hence indirectly stratifies the ecological variables (Bougeron et al. 1994). In the following paragraph we apply these principles to the Analysis Area by contrasting lands that are restricted from timber harvest (LUD II and Old Growth Reserves) with those managed in part for timber production (Scenic Viewshed, Modified Landscape, Timber Production).

Under the 1979 TLMP, about 22% of the Analysis Area occurred within LUD II lands, with the addition of the Old Growth Reserve strategy an additional 15% of the Analysis Area is now within natural setting Land Use Designations. When combined, the forested LTAs (steep forested mountain slopes, moderately steep forested slopes, forested hills, and colluvial/fluvial/coastal surfaces) make up almost the same percentage of the two categories of Land Use Designations (55.5% of the mostly natural LUDs, and 52.6% of the moderate to intensive development LUDs). The nonforested LTAs are also very similar. Alpine/subalpine summits and ridges comprise 21.7% of the moderate to intensive development LUD lands while 20.9% make up the mostly natural LUD lands. The same pattern is true for the lowland wetland-forest complex: 12.2% of the development LUD lands as compared to 11.9% for the mostly natural LUD lands.

The 1999 ROD switched another 20,500 additional acres (8% of the analysis area) from Development LUD to Semi-remote recreation LUD. Without redoing the analysis, we are sure the above results remain basically the same given these changes.

Hence, from a coarse-scale perspective, the mostly natural LUD lands are a good representation of the ecological variability of the lands in the Analysis Area. In addition, karst resources are well represented in both categories of LUDs.

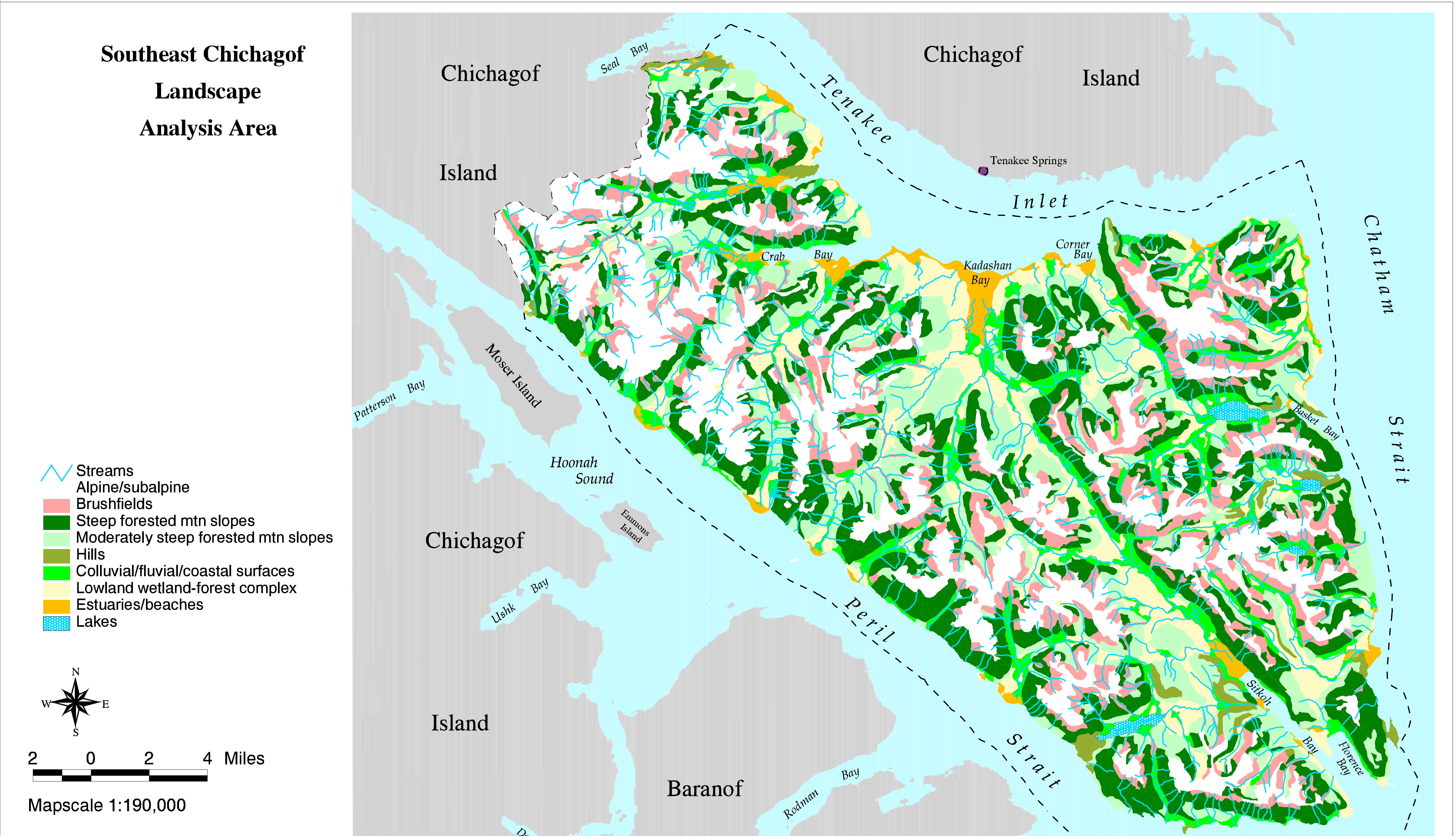


Figure 4-1. Landtype Associations

Forest Vegetation

This section focuses on the old-growth forest, specifically the fragmentation, distribution, and disturbance of this element of the landscape.

Old growth is commonly associated with age, although this may not always be an adequate indicator of old-growth structure. Certain characteristics of old-growth structure are often present in stands that do not meet all the criteria set by the definitions. These stands may be perceived as old growth. This is probably the case in many mixed-age or multi-cohort stands in Southeast Alaska. These stands have never been managed and are perceived to be old growth but may be the results of processes different from the stylized "shifting mosaic, steady state" often associated with old growth.

The Tongass National Forest and the Analysis Area contain extensive old-growth forest. Individual stands are often smaller than in other areas of the continent because of the high degree of natural fragmentation of the forest. In the Analysis Area these stands are also relatively inaccessible because of the lack of road systems. For these reasons, in the Analysis Area and also to some degree in the region, we lack detailed stand information that would allow us to quantify and analyze old growth using the criteria presented in the Ecological Definitions for Old-Growth Forest Types in Southeast Alaska (USDA Forest Service 1992).

To analyze old growth over large planning areas where we lack the inventory detail, we rely on attributes from our timber type mapping. This method requires an average stand age of greater than or equal to 150 years, an average diameter class of greater than or equal to 9.0 inches diameter at breast height (dbh), and stand volume greater than or equal to 8,000 board feet per acre to classify a stand as old growth. This approach oversimplifies much of the analysis and points out the desirability of more detailed stand information.

Connectivity and Fragmentation

The quantity of old growth in southeast Chichagof is one issue; old growth location in relation to openings in the forest is a separate but equally important issue. Because the term "old growth" encompasses more than just the presence of large, or even old, trees, it is crucial to consider the spatial arrangement of unmanaged forested areas relative to roads, harvested areas, beaches, and openings in the forest. At landscape scales, true old growth should be characterized by a high degree of connectivity; that is, we expect to find old-growth conditions in large contiguous blocks rather than small, isolated patches. At smaller scales, however, old-growth conditions are naturally interrupted by the presence of muskegs, alpine areas, rock, and other non-old-growth areas. For example, when compared with other regions in North America, the forest on Chichagof Island tends to be naturally more fragmented due to topographic/hydrographic characteristics.

We use the term "fragmentation" in relation to management activities to mean the reduction in the size of contiguous blocks of old growth as it is broken up into smaller and smaller patches by more numerous openings introduced by road construction and by logging. "Core" or interior old growth refers to those acres that are sufficiently buffered from these openings that conditions such as air temperature, moisture, understory composition, windspeed, and amount of sunlight are unaffected by the conditions in the openings. Core old growth is distinct from "edge" old growth, where the structure of the canopy may be similar to that found in the core, but the nearness to openings alters the understory and micro-climate conditions (Concannon 1995).

Analysis of Old-Growth Distribution

To assess the condition and trend of old-growth distribution and old-growth habitat fragmentation, we used a GIS model developed by Warm and Hawkes (1995). This model tries to mimic the effects of openings on old-growth conditions by buffering old-growth forest areas from clearcuts and other non-old-growth areas. This model uses the old timber type volume classes 4-7 to determine old growth. This is no longer used within the new TLMP but it still is adequate for this analysis (USDA Forest Service 1997). The basic details of the model are as follows:

- The model uses two definitions of old growth. The more inclusive definition (Version A), considers any areas with timber type size Class 4 (diameter at breast height ≥ to 9 inches and age ≥ 150 years) as old growth, regardless of volume. In the more restrictive definition (Version B), only those Class 4 stands with greater than 20 thousand board feet/acre (volume Class 5 and above) are considered to be old growth. Since stand data are derived from photo interpretation, they generally lack individual tree data, which limits our ability to classify old growth (see Chapter 3).

- Buffer specifications differentiate between the amount of edge habitat and the amount of interior habitat within these old-growth stands. The more contrast there is between non-old-growth areas and old growth, the larger the buffer the model uses to separate them. The model buffers roads by 208.71 feet on each side, beaches by 208.71 feet, and clearcuts by 417.42 feet. The precision of these buffer distances is neither completely scientific nor completely capricious: the distances are consistent with the field research documented by Concannon (1995), and they equal the length of a side of a square acre and four square acres, respectively, simplifying the mechanics of our raster (cell-based) GIS analysis. We did not buffer forested muskegs, low-productive forest, young-growth sawtimber stands (greater than 9" DBH but less than 150 years old) or, in Version B, low volume old growth.

- The model calculates a series of descriptive statistics regarding the amount, relative size, shape, isolation, and fragmentation of old growth for 1996 conditions and for 1956 conditions. The 1956 vegetation layer, being essentially free of the effects of large-scale commercial logging, serves as a benchmark for the current conditions.

Results

Table 4-5 shows the total amount of core and edge old growth based on both Version A and Version B definitions for 1956 and 1996. In the intervening 40 years, as 21,569 acres have been clearcut, the number of core old-growth acres declined by between 29% (A) and 41% (B). The number of total old-growth acres declined between 14% (A) and 24% (B). The increase in edge acres (52% A, 68% B) and the decrease in core old-growth habitat results in an accentuated decrease in core-to-edge ratio. This decrease is of

4.28:1.99 or 53% in Version A and 5.50:1.94 or 65% in Version B. These are indications that significant fragmentation of interior old-growth habitat has occurred in southeast Chichagof in the last 40 years.

Table 4-5. Core and Edge Old Growth**:** 1956 vs. 1996.

	Version A		**Version B**	
OG type	**1956 Acres**	**1996 Acres**	**1956 Acres**	**1996 Acres**
Core OG	120,066	85,068	62,527	36,971
Edge OG	28,049	42,738	11,367	19,071
Total OG	148,115	127,806	73,894	56,042
Core/Edge Ratio	4.28	1.99	5.50	1.94

As important as the amount of old-growth habitat is the size of the contiguous patches or blocks in which it occurs. Table 4-6 displays the mean size of core old-growth patches and the distribution of acres by nine size classes. It is clear, from both the increase in number of patches and the decrease in average patch size, that the 40-year trend is toward fragmentation of old growth into increasingly smaller pieces. The size class distribution data reveal this trend even more starkly. This trend represents a considerable reduction of habitat for those wildlife species dependent on contiguous blocks of core old growth larger than certain acre thresholds. (See the Wildlife Habitat section of this chapter.)

Table 4-6. Size of Core Old-growth Patches (Version A).		
	1956	1996
Total Acres in Patches	120,066	85,068
Total Number of Patches	374	688
Mean Patch Size (Acres)	321.03	123.65
Size Class Distribution	Acres	Acres
0-25 acres	2,220	3,362
26-75 acres	1,645	3,497
76-200 acres	428	3,101
201-500 acres	923	6,809
501-1,600 acres	2,002	8,518
1,601-2,500 acres	2,435	6,264
2,501-10,000 acres	3,517	34,443
10,001-50,000 acres	0	19,074
50,001 acres +	106,896	0

The fragmentation model also calculates a patch shape index, based on a ratio of perimeter to area. Simple shapes like circles receive index values near 1; complex, amoeba-like patches have values in the 100s and 1,000s. While there is potential for a patch shape index to reveal trends between managed and unmanaged landscapes, for southeast Chichagof there were no significant differences between average patch shape in 1956 vs. 1996. This is partially because the temperate rain forest exists naturally in amoeba-like patterns since we have so many nonforested alpine and muskeg areas in southeast
Chichagof.

A fourth component of fragmentation is isolation, measured here as the distance between patches of a minimum size and the nearest patch of at least that same size. Table 4-7 compares these distances from 1956 to 1996 for 200-acre-minimum blocks using the Version B definition of old growth. Note that the mean distance between patches has increased 150% since 1956, while the mean patch size has decreased by 50%. These data illustrate the old-growth fragmentation over the past 40 years: there is less old growth now, it is in smaller pieces, and the pieces are farther apart.

Table 4-7. Distance Between Old-growth Patches of a Minimum Size.

Year	**# of Patches**	**Mean Patch Size (ac)**	**Mean Distance to Nearest Patch (ft)**
1956	41	1,524	1,269
1996	38	759	3,182

The final fragmentation measures are designed to "rate" old growth by subjectively assigning different relative values to different kinds of old growth -- values that in part depend on the specific location of old-growth acres. Warm and Hawkes (1995) assigns these relative values as follows:

Core old growth below 800 feet	1.0
Core old growth above 800 feet	0.6
Edge old growth in a patch containing core, below 800 feet	0.5
Edge old growth in a patch containing core, above 800 feet	0.3
Edge old growth in a patch <u>not</u> containing core, below 800 feet	0.3
Edge old growth in a patch <u>not</u> containing core, above 800 feet	0.1
Non old growth	0.0

The 800-foot elevation cutoff is driven by deer winter range. The resulting index is an area-weighted average of the values assigned to every acre in southeast Chichagof. The higher the index, the higher the percentage of high-value old growth. Table 4-8 presents these old-growth value indices by VCU for 1956 and 1996, and the change as a percentage of 1956 values. The VCUs with the greatest decrease in old-growth value correspond with those where the greatest removal of timber volume has occurred since 1956.

Table 4-8. Old Growth Value Index, 1956 vs. 1996, by VCU.

VCU	1956 INDEX	1996 INDEX	Diff from 1956 (real)	Diff from 1956 (%)
230	0.290	0.244	-0.046	-16%
231	0.257	0.239	-0.018	-7%
232	0.281	0.256	-0.025	-9%
233	0.376	0.316	-0.060	-16%
234	0.330	0.224	-0.106	-32%
235	0.421	0.415	-0.007	-2%
236	0.450	0.219	-0.231	-51%
237	0.283	0.281	-0.002	-1%
238	0.352	0.209	-0.144	-41%
239	0.386	0.217	-0.169	-44%
240	0.369	0.369	0.000	0%
241	0.361	0.239	-0.122	-34%
242	0.355	0.208	-0.147	-41%
243	0.400	0.233	-0.167	-42%
244	0.476	0.255	-0.221	-46%
245	0.234	0.133	-0.101	-43%
246	0.276	0.278	+0.001	+1%

247	0.231	0.215	-0.016	-7%

Conclusions

Extensive timber management over the past 40 years has reduced and fragmented old-growth interior habitat in southeast Chichagof. Whether viewed in terms of a decrease in overall old-growth acres, a decrease in core old-growth acres, a decrease in core/edge ratio, a decrease in the average size of individual blocks of old growth, or an increase in the distance between these blocks, fragmentation has reduced the amount of effective habitat for wildlife species dependent on old growth.

Old-Growth Diversity by Landtype Association

The previous section analyzed old-growth forest fragmentation for the whole Analysis Area. Fragmentation also affects landscape diversity; as such we can examine the distribution of past harvest by landtype associations. This is important because not all old growth is the same. Different types of disturbance and hydrologic processes produce different old-growth forests which help to maintain biodiversity across the Analysis Area. (See earlier section on landscape description, Table 4-3, and Martin et al. 1995).

In 1956 most of the acres of old-growth forest (defined for this analysis as Volume Class 4 and above, although with new TLMP we are using volume strata instead) occurred in three landtype associations: steep forested mountain slopes, moderately steep forested mountain slopes, and colluvial/fluvial/coastal surfaces. Management activity has not been equally spread out among the LTAs but has concentrated on the colluvial/alluvial/ coastal surfaces, because they were easiest to get to, flatter, and had a higher rate of disturbance, hence more spruce (44% of the old growth has been harvested). For the forested hills, moderately steep forested slopes, and steep forested slopes, the percent of old growth that has been harvested is 31%, 19%, and 14% respectively. Hence, cutting in the past has been disproportionately concentrated on the colluvial/fluvial/coastal and the forested hills landtype associations (Figure 4-2).

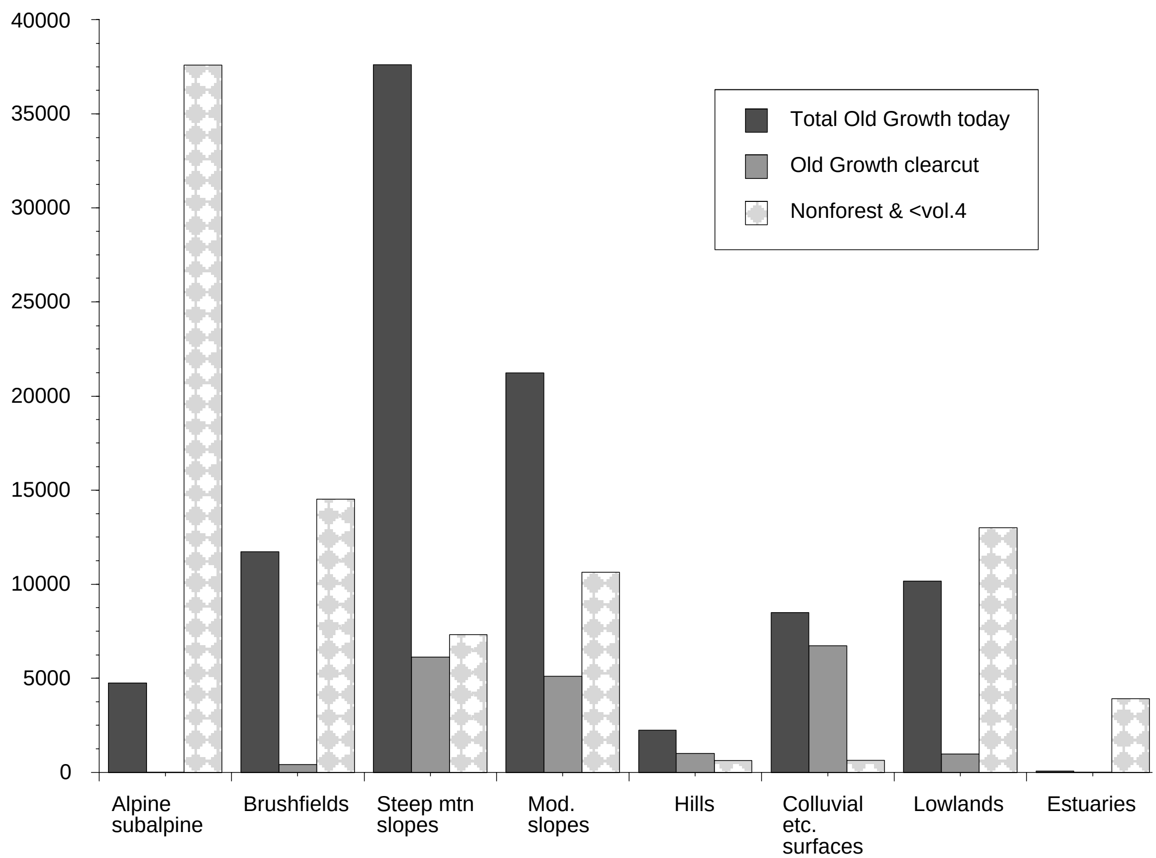


Figure 4-2. Acres of Old Growth Forest, Old Growth Forest that have been harvested, and nonforest and areas with volume class <4 for ALL lands excluding the LUD II areas of the Analysis Area. (Note: numbers would be slightly different if the Old Growth

reserve LUDs and the semi-remote recreation LUDs lands were also excluded from this analysis.)

Natural Disturbance

Natural disturbance processes help maintain forest diversity and function. "Disturbances have a profound effect on forest development since they kill vegetation and thus release growing space, making it available for other species to occupy....In nearly all studies in which the history of a stand was reconstructed, evidence of natural disturbances strongly affecting the species composition and age distribution have been found" (Oliver and Larson 1990). Although old growth is often thought of as undisturbed forest, it is actually a product of disturbances such as wind, landslides, insects, disease and fire, which occur at different locations, rates, and intensities. These processes create structural diversity that influences biological diversity. Better understanding of the frequency and intensity of natural disturbance enables us to better understand the ecosystems and how management can affect the function of the ecosystem by altering these processes.

In this section, we examine wind disturbance in the Analysis Area. We then compare these disturbance processes with harvest activity to try to understand the influence that logging may have on the landscape. This information can then be used to determine if different regeneration methods or patterns of harvest in the future should be considered to better reflect the frequency and intensity of natural disturbance on the landscape. Landsliding, the second most dominant form of disturbance in the forest, is discussed in the Erosion and Sediment Delivery section of this chapter. It is located in that section because landslides are a major concern for fish habitat.

Wind. Wind affects the diversity of tree stands within and across the landscape and the distribution and development of old growth. Wind may snap off stems or branches, which changes the structure within stands, or uproot whole trees. This blowdown is a critical process in renewing the forest. It occurs at different intensities, scales, intervals, and locations.

High-intensity wind disturbances occur throughout most of the Analysis Area but are concentrated in the southeast, east, and northeast. To analyze the effects of wind, we mapped wind disturbances which are identifiable on aerial photographs. These disturbances are mostly high intensity, where the effect is obvious in contrast to the surrounding stands and remnant areas. For example, one wind event, the 1968 Thanksgiving Day storm, resulted in over 25% (3160 acres) of the mappable wind-disturbed stands. However, low-intensity wind disturbance of individual trees and small groups are not captured from photographs. Wind is often not the primary cause of tree mortality at this scale, where windthrow and snapped trees often have infected roots and/or stem rot.

Of the productive forest land in the Analysis Area, 11,844 acres (8%) were identified as disturbed by wind. That compares with 19,918 acres harvested since 1968 (mostly clearcut) and 21,569 acres (14%) harvested since 1910. This harvest is concentrated in the last 30 years, whereas the identified blowdown was distributed over approximately 300 years. To compare wind disturbance with commercial harvest, we examined the location and setting of these events, in particular, the aspect, elevation, slope and site productivity of the disturbed and harvested areas. These comparisons show that both wind disturbance and harvest are concentrated on southerly aspects, lower elevations, and areas of higher productivity.

Aspect The prevailing storm track brings winds from the southeast, especially the southeast end of Peril Strait, the entire shore of Sitkoh Bay, and most of the Chatham Strait shore, which are close to saltwater and exposed to the southeast (Figure 4-3)**.** In the Analysis Area, 5,234 acres (45%), are on aspects between south-southeast and south-west compass points, and this higher occurrence on southerly aspects is probably related to the stronger storm winds from the southeast. Figure 4-4 shows the distribution of these blowdown events and past harvest by aspect.

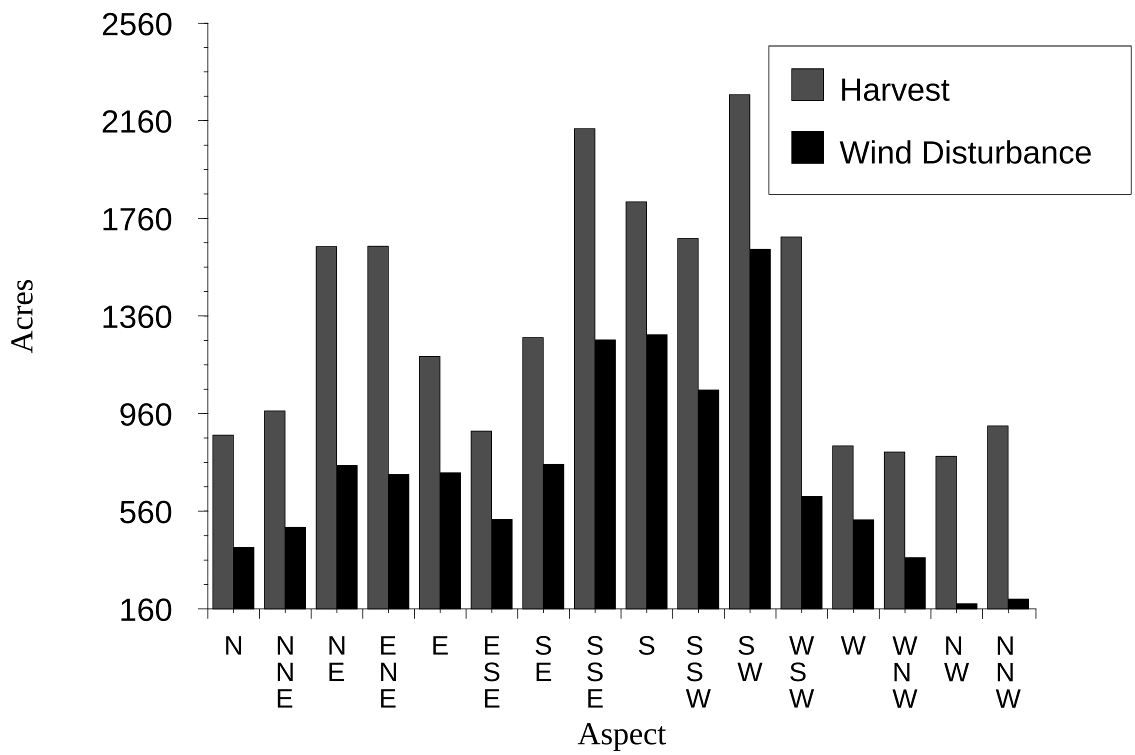


Figure 4-4. Acres of wind and harvest disturbance by aspect.

Elevation and Slope Most wind and harvest disturbance occurred below 500 feet (7,179 acres) (Figure 4-5). A total of 7,639 acres (52%) of wind disturbance and 14,993 (70%) of timber harvest acres occurred on slopes between 20% and 50% (Figure 4-6***)***. Slopes above 50% are often at higher elevations.

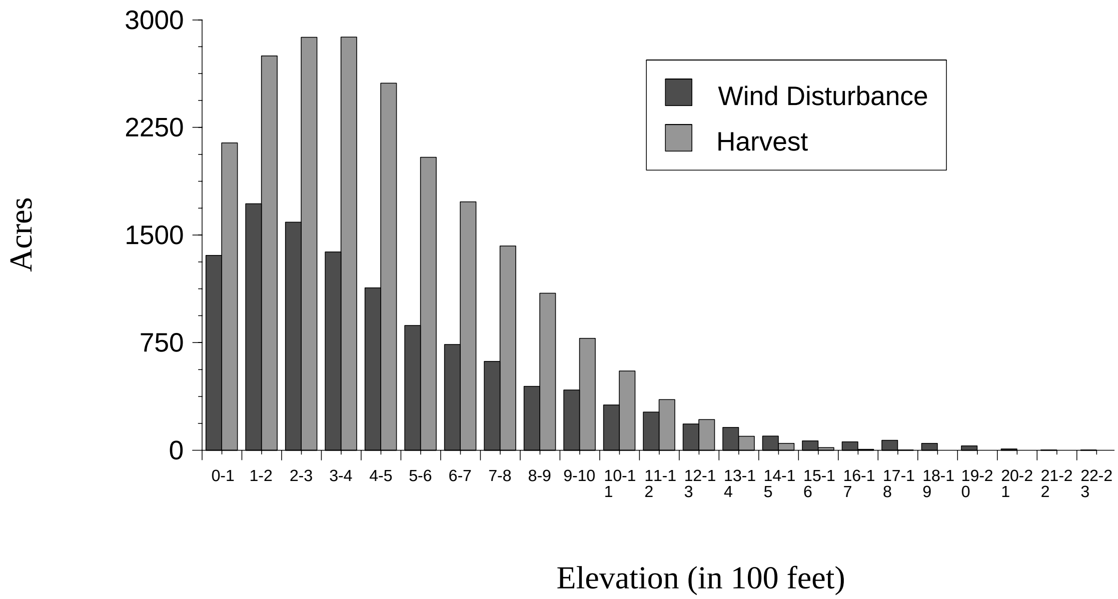


Figure 4-5. Acres of wind and harvest disturbance by elevation.

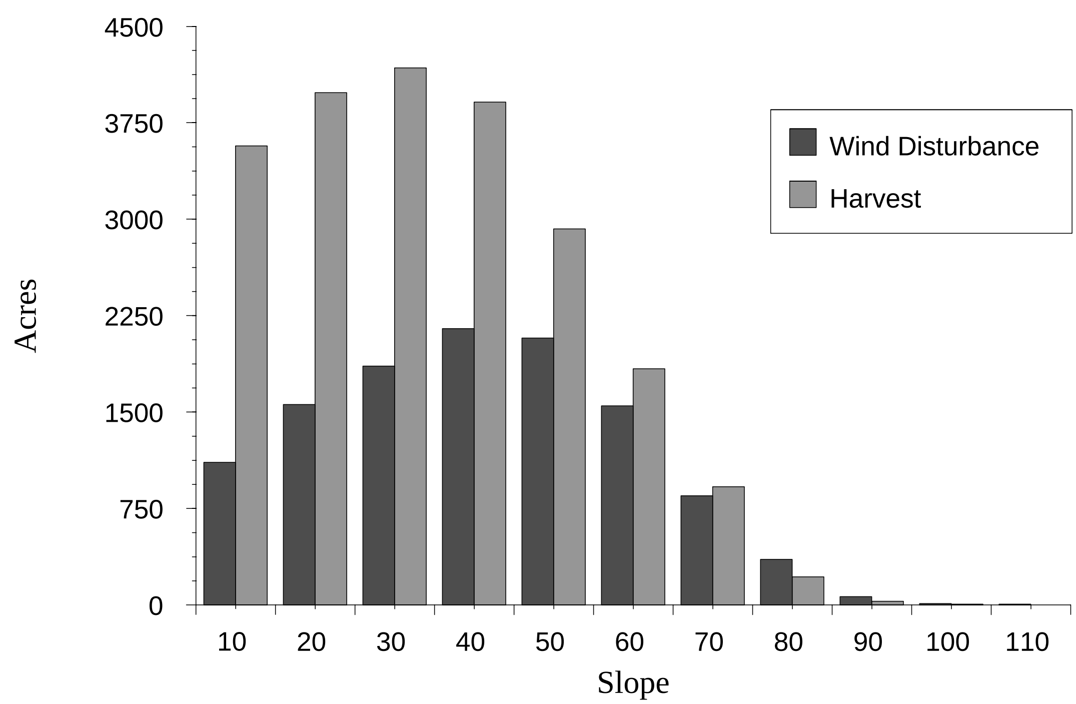


Figure 4-6. Acres of wind and harvest disturbance by slope.

Site Productivity In addition, Figure 4-7 shows that both wind disturbance and commercial harvest are most common in the regions of the forest which are the most productive. We found approximately 60% of the wind disturbance occurred on sites with higher soil productivity (Site Class 80-100) while only 39% of the commercial forest land is within these higher site classes.

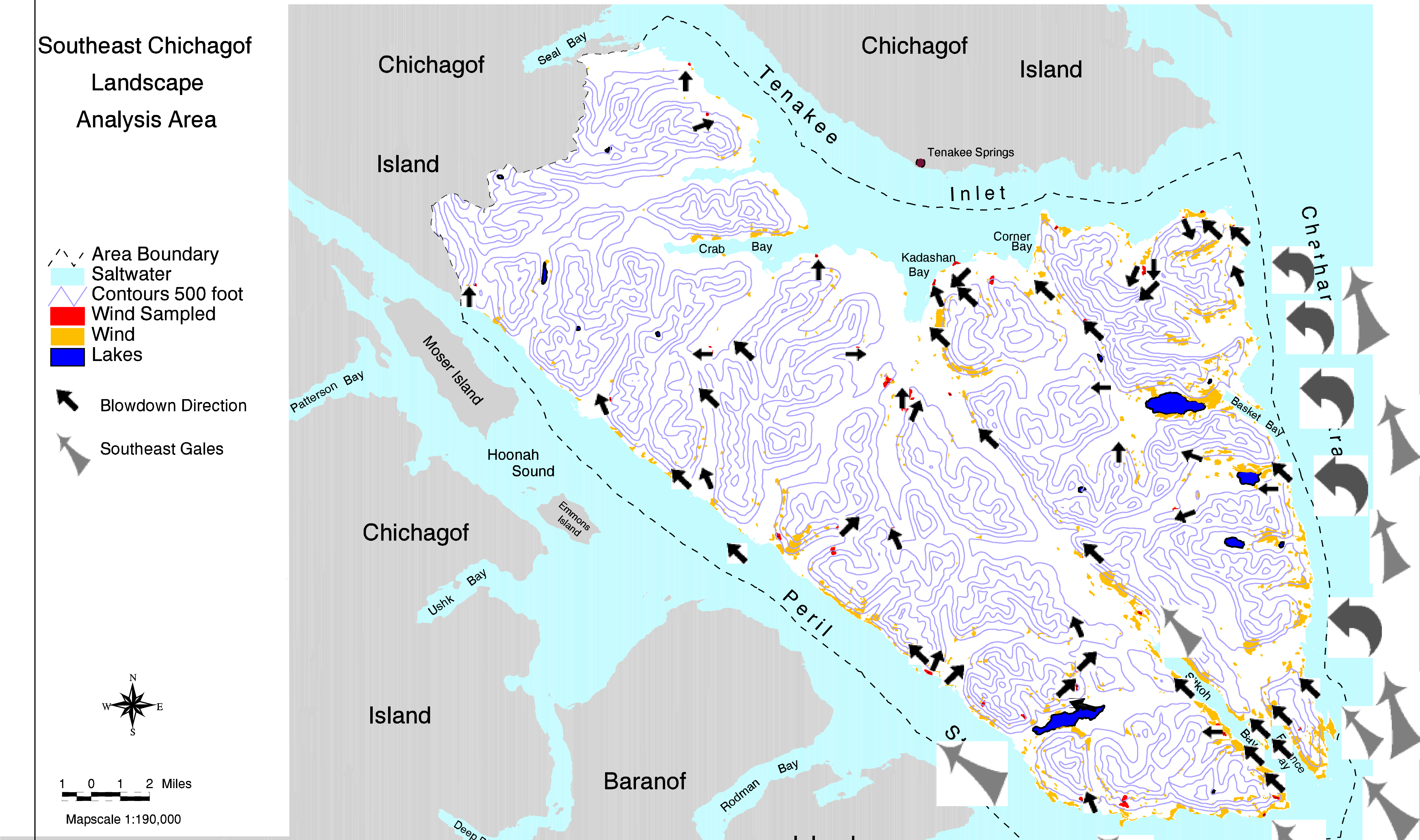


Figure 4-3. Sampled Wind Generated Stands (arrows indicate blowdown direction)

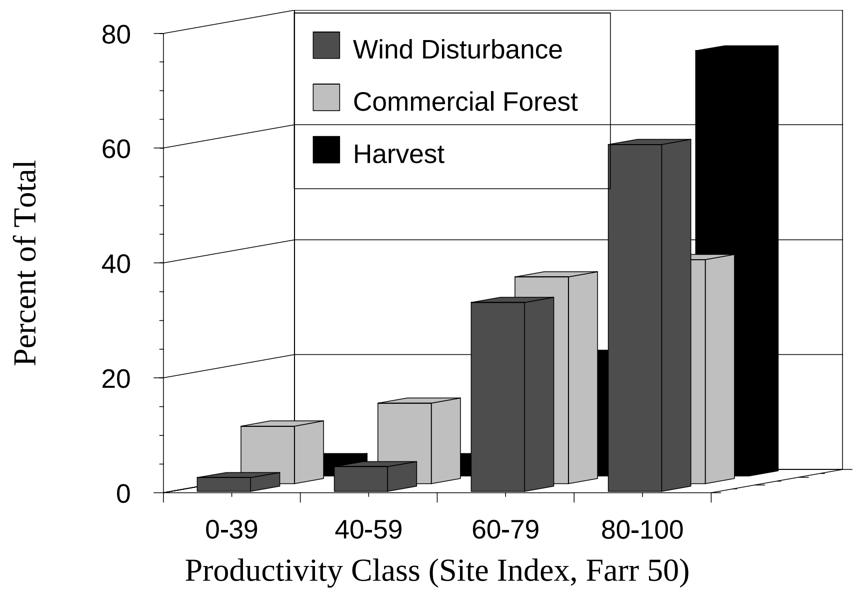


Figure 4-7. Percent of wind and harvest disturbance acres and commercial forest land by site class.

Age By determining the age of the disturbed stands, we can get some idea of the distribution of disturbance through time. Age can tell us if most of the disturbances occur during a few large events or many smaller events. We could determine the age of the wind disturbances only for those stands field sampled (approximately 12% of each stand development stage). We did not feel that we could expand these sample data to the entire population. Therefore, Figure 4-8 displays only the ages of the field-sampled stands.

Assuming this sample is somewhat reflective of the population distribution, more stands are in the younger age groups. Some of this is explained by our decreased ability to map the older events, as they are more difficult to see on aerial photography. In addition, some of the older wind-disturbed stands are in areas where the probability of wind disturbance is high, and therefore they may have received more recent wind disturbance over the same areas. These stands would show up only in the recent disturbance or as mosaics that could not be aged. The peak at 1960-1970 is the result of the 1968 Thanksgiving Day storm that covered approximately 3,165 acres (27% of the population).

The oldest disturbance we were able to map is 318 years old. Assuming all of the disturbance occurred within 318 years, the annual rate of high-intensity, mappable wind disturbance is approximately 37 acres. Figure 4-8 suggests that high-intensity events on southeast Chichagof occurred in pulses about 60-80 years apart over approximately the last 300 years. When evaluating age data, it is important to realize that ages are not exact and that more meaningful interpretation can be made from general shapes and trends in the entire data set.

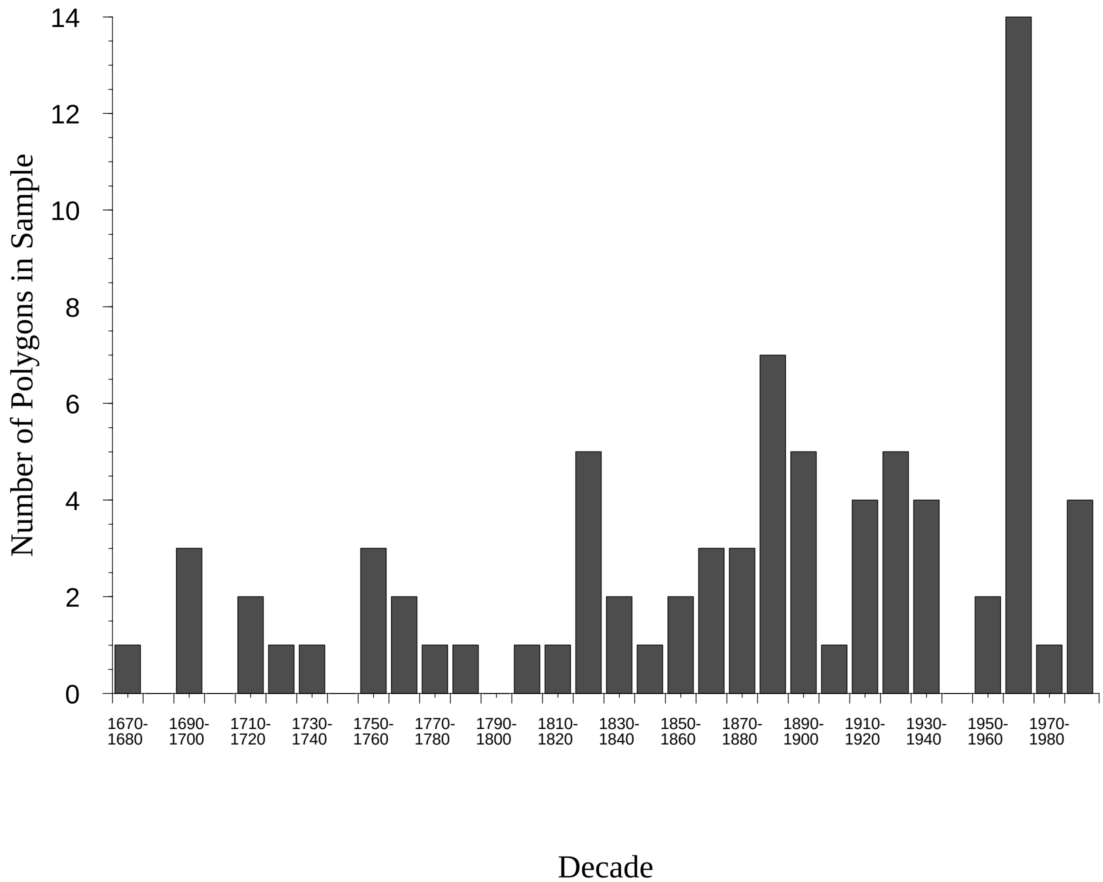


Figure 4-8. Frequency of wind disturbance polygons sampled by decade of occurrence.

As mentioned, 21,569 acres of timber harvest (some over the same areas as wind disturbance) has occurred since 1910. Thus, the mean annual rate of harvest over the entire period is 273 acres, compared to 37 acres of annual wind disturbance. We know, however, that disturbance does not occur at an even rate through time. Because 19,918 acres (92%) were harvested since 1968, it may be more appropriate to compare the rate of harvest to wind disturbance since 1968. The mean annual rate of wind disturbance since 1968 exceeds 115 acres per year. The mean annual rate of timber harvest since 1968 is 639 acres, not including those acres that were windthrow salvage (2,030 acres).

The Thanksgiving Day storm in 1968 caused very widespread windthrow within the Analysis Area but was heaviest in Sitkoh Bay and along Chatham Strait (Figure 4-10). The precise age and extent of the areas disturbed by this storm are known because the Forest Service flew aerial photograph reconnaissance the following year. The difference in scale between this event and the other mapped events illustrates the variability in windthrow events that occur through time. Although we found pulses of large events every 60-80 years, this 1968 storm may be representative of *very* large disturbances that occur at more infrequent intervals. Our mapping suggests the 1968 storm was *very* large and probably as big or bigger than any other occurring in the last 2-300 years (as evidenced on aerial photographs). The 1968 storm is a sample of what level of disturbance this ecological system has sustained along ecological and successional pathways.

It is conceivable, although not probable, that several intense wind events of the 1968 magnitude could occur in a short span of time. This scenario would begin to resemble the rate of harvest of the last 30 years in the Analysis Area. However, it is realistic to assume that further large-scale timber harvest using even-age management has the potential to shift ecosystem conditions (landscape scale) away from this natural range of variability.

<u>Patch size</u>. We mapped a total of 1,118 wind disturbed patches. The mean patch size is 10 acres; the largest patch was 250 acres and the smallest 0.14 acres. Many mapped polygons share common borders and, in the most disturbance prone locations, form large contiguous areas of blowdown (note the area in Sitkoh Bay, Figure 4-10***).*** We analyzed the patch size of the wind-disturbed polygons and found the highest frequency of patch size is < 5 acres and approximately 54% of wind disturbance acres occurred in patches ≤ 25 acres (Figure 4-9). Approximately 90% of the patches are ≤ 25 acres and 51% are ≤ 5 acres (Figure 4-11).

We also analyzed the patch sizes for the harvest units. Where harvest units shared boundaries and the difference in age was less than twenty years, they were considered a single patch. Figure 4-11 shows that only 2% (number of acres) of the harvested patches were <25 acres and that approximately 39% were in patches 25-125 acres in size. Forty-two percent (number of acres) of contiguous cut blocks are from 125-600 acres. Two contiguous cut blocks exceeded 600 acres, representing 17% of the total area (938 and 2809 acres).

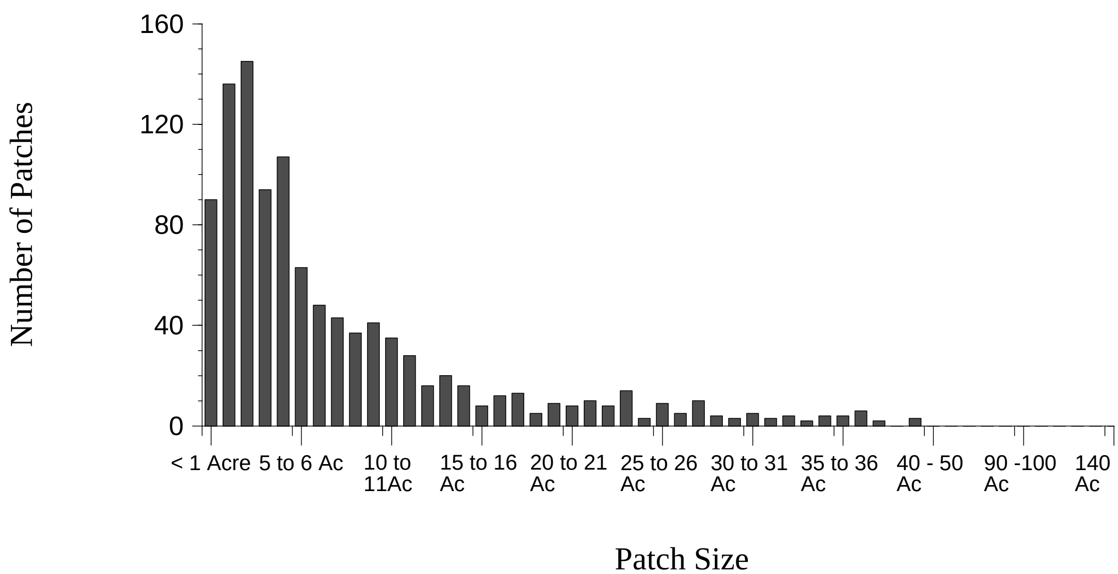


Figure 4-9. Frequency of wind disturbance patches by patch size.

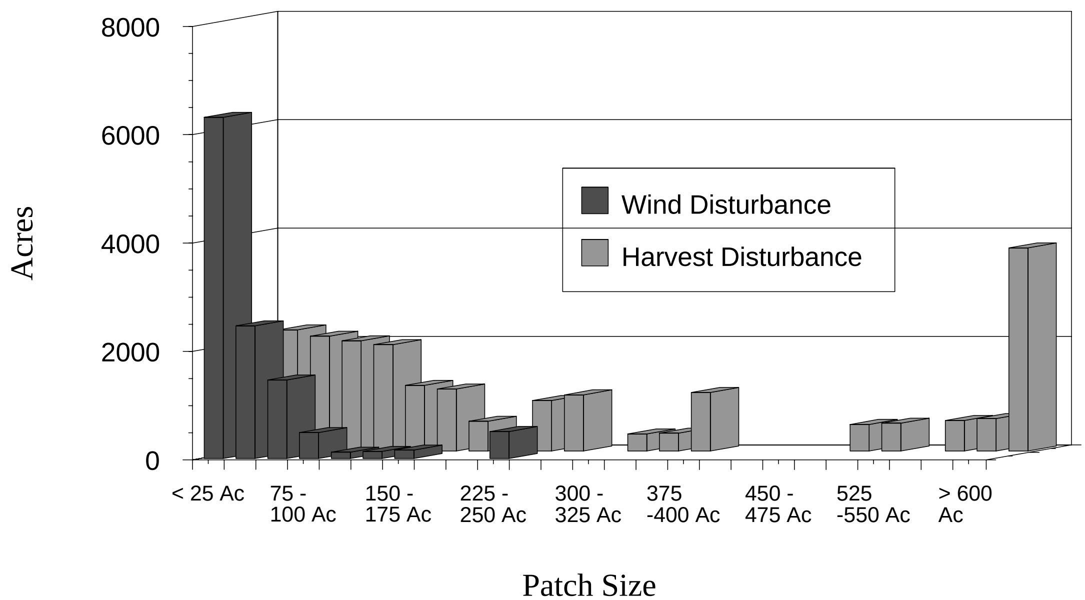


Figure 4-11. Acres of wind and harvest disturbance by patch size.

Patch shape. Stands we field-sampled tended to have an oblong shape oriented to the wind direction. We analyzed the complexity of the patch shape and compared it to the timber harvest units in the area. The results of the comparison in Table 4-9 show that in each size category the wind patches are more complex in shape. This difference tends to increase as the size classes decrease. Natural-disturbance patches are typically smaller in size and more complex in shape and structure than harvest-disturbance patches.

Table 4-9. Shape index comparing variability in wind boundaries to harvest boundaries. (The larger the index value, the more variable.)

	Wind	Harvest
Mean Patch Size (acres)	10.3	67.0
Shape Index (<100 acre patches)	1.42	1.39
Shape Index (<50 acre patches)	1.41	1.35
Shape Index (<25 acre patches)	1.39	1.28
Shape Index (<10 acre patches)	1.36	1.22

Resulting structure. Harris (1989) observed that climax forest vegetation in Southeast Alaska is generally considered to be all-aged and dominated by western hemlock and Sitka spruce. Close observation shows that, rather than being all-aged, however, most old-growth stands are composed of groups of more or less even-aged trees arranged in complex patterns. There is a large continuum of conditions created by wind disturbance. Not only are patch size and shape variables in this diversity, but the amount of residual standing vegetation greatly affects resulting structure. The juxtaposition of this diverse population of wind-disturbed patches changes over time, which adds further landscape diversity. It is important to remember that in this analysis we are looking only at the

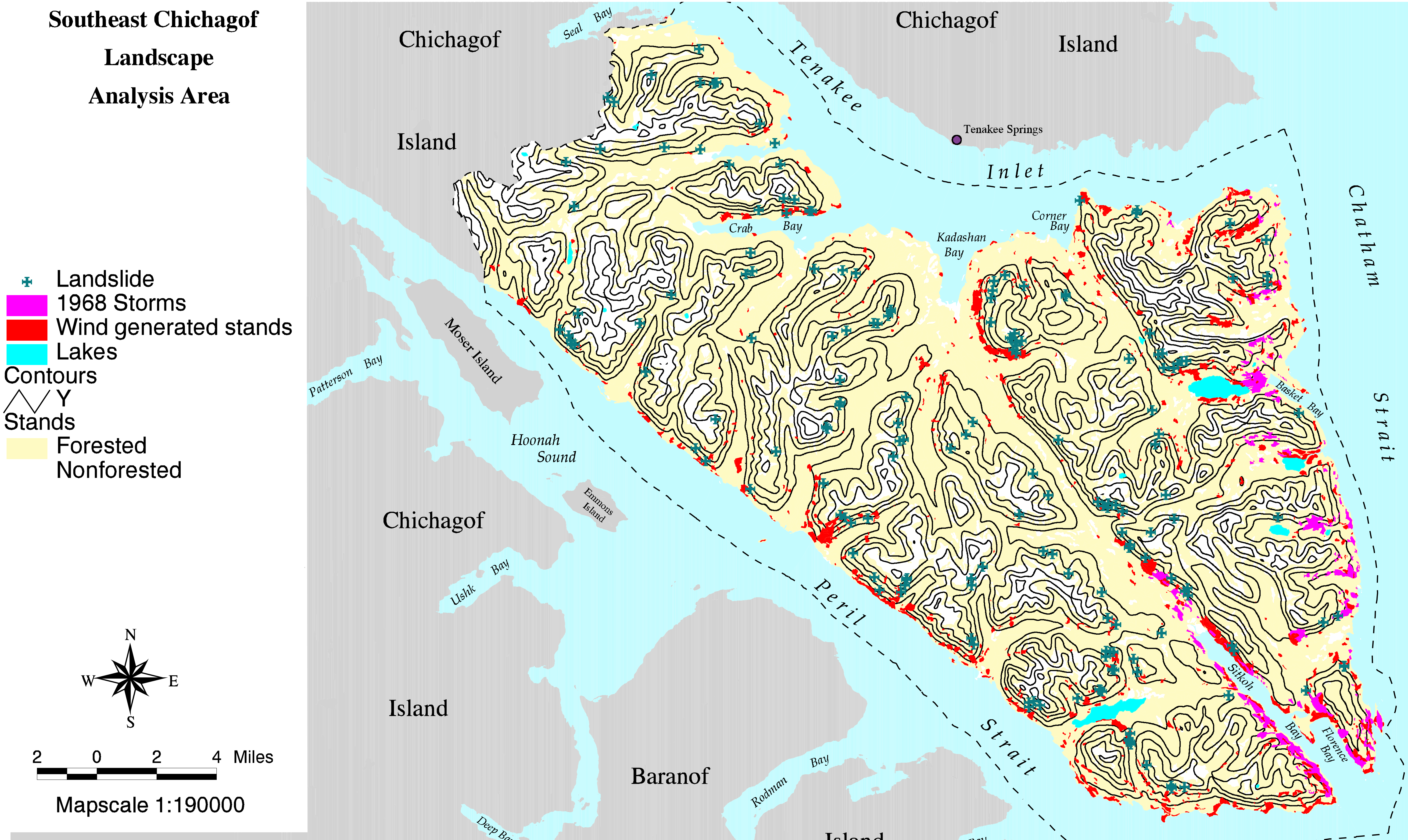


Figure 4-10. Mapped Landslides and Wind Generated Stands (The 1968 storm is highlighted in pink)

most obvious wind disturbance and to recognize that the total effect of wind disturbance on the landscape is even more complex than what we have mapped.

As we mapped areas on photographs, we assigned the following attributes: a) stand development, b) stand structure, and c) percent remnant. We then field-verified a sample of the mapped area and collected additional information.

a) Stand development - We estimated the stage of stand development on the even-aged and two-storied stands. In most cases, portions of the stand did not blow over. This stand development attribute applies only to the regenerated cohort. (Cohort refers to a group of trees regenerating after a single disturbance.) Of the almost 12,000 acres of mapped blowdown, approximately 9,600 acres resulted in a single cohort or two-storied structure. This mapping captures only a small portion of multi-cohort stands that have been repeatedly shaped by moderate intensity wind events. "These multi-cohort forests are often hard to distinguish on aerial photos from old-growth forests, but technically they differ by having age structures comprised of recruitment pulses distinctly linked to periodic exogenous disturbance rather than to chronic, small scale, endogenous disturbance" (Oliver and Larson 1990). This class of wind disturbance and the associated forest structure may be very significant in the Analysis Area and across the region. Ecosystem function in many of these multi-cohort stands is also very much affected by wind disturbance but, because of the difficulty in mapping them, they are generally not included in the results reported here. Analysis of the probability of windthrow using criteria such as site productivity, exposure to damaging winds, aspect, slope, and elevation might prove useful in estimating this mostly unmapped multi-cohort component. (An analysis is underway on the Stikine Area of the Tongass National Forest.)

A summary of the stand development attributes is shown in Figure 4-12. The abundance and distribution of these stages are important to landscape diversity and ecosystem function. Different stages provide different habitat for various flora and fauna. Stand initiation occurs directly following the disturbance but usually lasts only about 25 years, while stem exclusion can last for 150 years or more. For this reason, we separated stem exclusion into early and late to give us a better picture of those stands that are likely to remain in this stage for a long time (early) and those that will be moving into understory reinitiation sooner (late). The mixed category was used for stands that have experienced multiple disturbance events through time. These stands are multi-generational and do not follow the same patterns of development as even-aged forests. They are characterized by a patchy and/or variable structure (refer to the Structure section below).

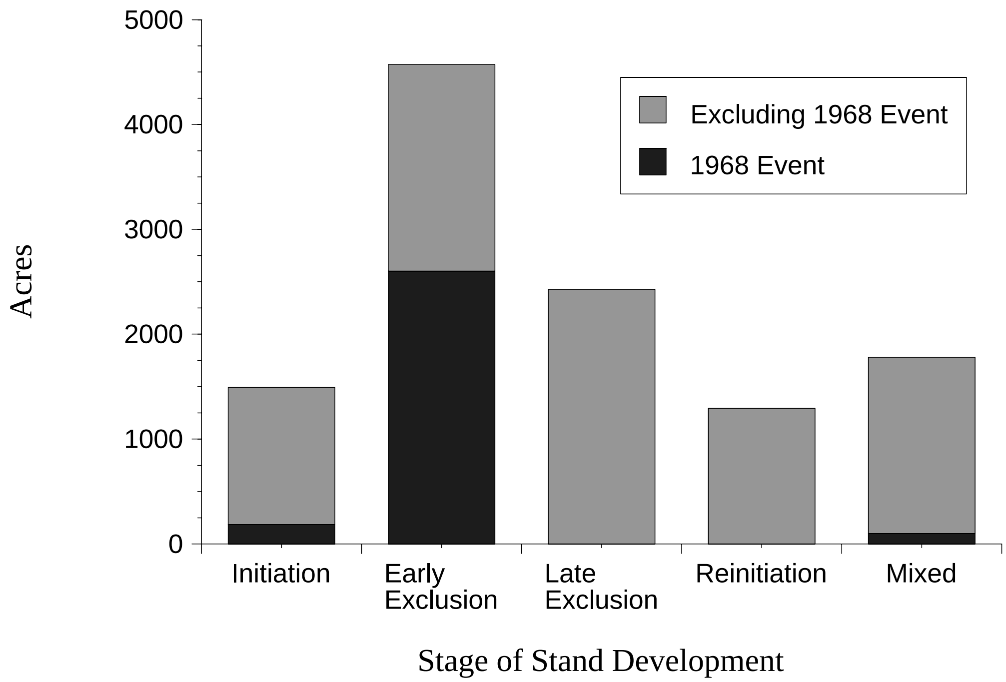


Figure 4-12. Acres of wind disturbance by stage of stand development. The 1968 event resulted from a single storm.

The total amount of large-scale timber harvest in the area is 21,569 acres. The majority of this was harvested in the last 30 years and is currently in the stand initiation or early stem exclusion stages of development. Therefore, when comparing timber harvest to wind disturbance in terms of stand development, it is more meaningful to compare the acres of harvest to the acres of wind disturbance in stand initiation and in early stem exclusion. We found approximately 6,345 acres of total wind disturbance in these two stages. It is also important to note that at least 2,030 of the harvest acres were salvage of large-scale windthrow.

b) Structure - Structure is used to describe not only the intensity of a wind-disturbance event in terms of how much is left standing, but also the spatial distribution of trees within the stand following the event. We used four categories. Their distribution is shown in Figure 4-13**.**

Single cohort stands make up 8,018 acres (69%) of the Analysis Area. For our mapping purposes, the single cohort stands could maintain up to 25% of the original canopy and still be classed as single cohort. The stands have single, relatively uniform, regenerated canopies.

Multi-cohort stands make up the remaining 31% and are broken down as storied, patchy mosaic, or shredded mosaic. Storied stands have two relatively even canopy layers with >25% residual canopy. We mapped approximately 1,332 acres (11%) as storied stands. Understory and overtopped trees are common. The last two categories are mosaics (patchy and shredded). Each of these categories contain approximately 1,100 acres or ten percent of the mapped area. They are represented by at least two distinct size classes of trees that are not uniformly distributed but instead occur in groups (patches) throughout the stand. The shredded mosaics are the most difficult to identify as different from gap-phase processes in some old-growth forest patches. Structure is more variable than in the patchy mosaics. These shredded mosaics are caused by multiple events that blow over groups of trees and individual trees yet leave intact areas with no windthrow, in a heterogeneous pattern within a forest patch.

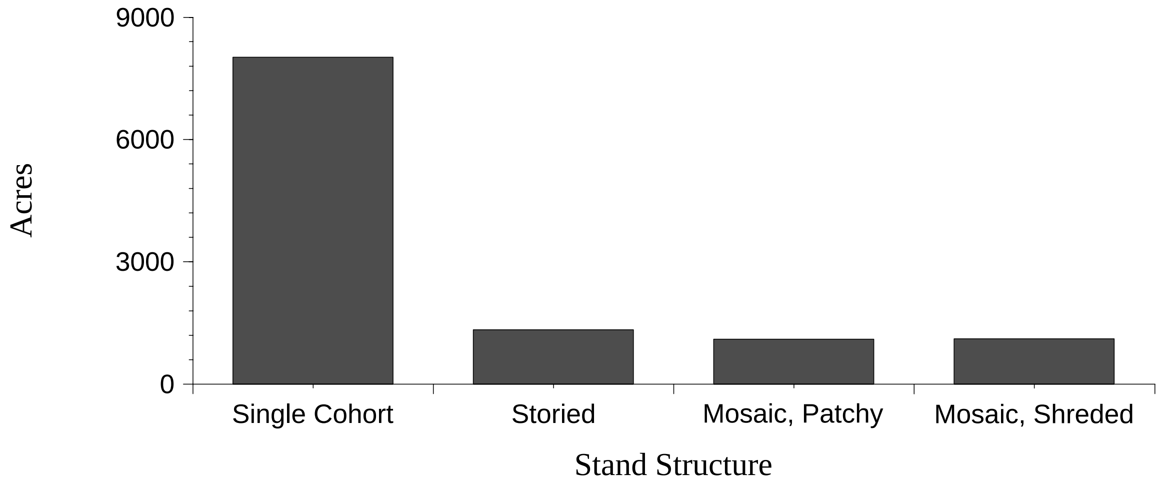


Figure 4-13. Acres of wind disturbance by stand structure.

c) Percent remnant - This is the percentage of the original canopy remaining following a wind disturbance event. Figure 4-14 displays the acreage in the different categories. Acreage in the Undetermined category represents the mapped multi-cohort mosaics which are too variable to classify in other categories [1,725 acres (15%)]. One reason the multi-cohort stands are difficult to map is the small contrast between regenerated cohorts and what might be remnant from an "original" stand or a stand that developed from previous events. It is important to note that the higher the percent remnant, the more difficult the mapping. The mapping may therefore disproportionately capture the lower remnant categories.

A contrast that has not been covered is the difference in the extent of soil disturbance between natural versus harvest disturbance. Blowdowns vary in the percentages of trees that are root-thrown as opposed to stem snap. In general, however, it can be said that wind disturbance is associated with significantly higher soil disturbance than harvest. The relationship between soil disturbance and long-term soil productivity is somewhat controversial. Some researchers believe soil churning associated with blowdown is important to maintaining soil productivity through soil mixing and the breakup of impermeable soil horizons; however, the presence of these soils and the extent that roots penetrate them (resulting in disturbance from root-throw) is not well understood.

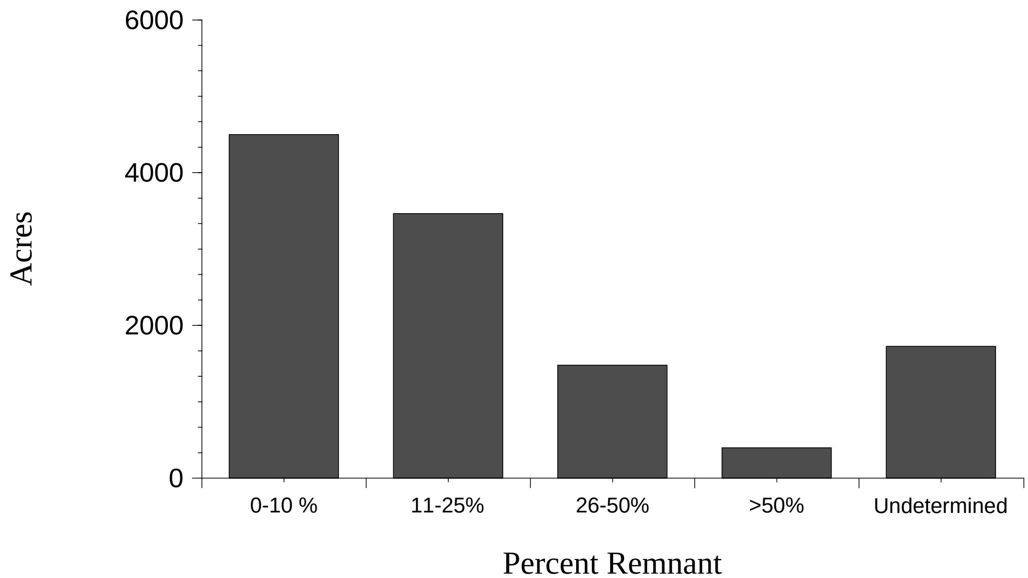


Figure 4-14. Acres of wind disturbance by percent of remnant canopy left following the disturbance. Undetermined represents the mapped multi-cohort mosaics which are too variable to classify.

Human Disturbance

People have affected the landscape of southeast Chichagof for thousands of years, and our uses shaped the current landscape. These include hunting, fishing, tree harvest, land clearing, and construction of roads, trails, canneries, and homes. The most significant human disturbances affecting the current landscape condition are timber harvest and road construction.

Recent Harvest. Timber harvest has been done at different scales within the Analysis Area. Prior to 1956, when the long-term contract with Alaska Lumber and Pulp Company took effect, only 615 acres had been clearcut harvested (Table 4-10). Since 1956 at least 21,569 acres have been harvested within the Analysis Area. The dominant harvest method has been clearcutting (19,129 acres), while salvage of blowdown (2,030 acres), and selective harvest (410 acres) make up the remaining acres. The majority of this harvest has occurred since 1968 (19,918 acres). These areas are now considered second (young) growth (Figure 4-15).

Table 4-10. Acres harvested by time period within the Analysis Area.

Time Period	Acres Harvested
1910 - 1956	615
1957 - 1967	1,036
1968 - 1978	14,335
1979 - 1995	5,583
1996*	34

*Acres of windthrow salvage not yet in the GIS database and are in addition to the 21,569 acres reported in this analysis.

Harvest along Peril Strait, near False Island, and Sitkoh Lake was completed between 1967 and 1979. Harvest areas were designed with residual timber strips left between units. Some of these residual stands have since blown down. This creates very different patterns on the landscape. From aerial photographs, we mapped approximately 425 acres of windthrow that occurred prior to 1990 and was directly influenced by adjacent logging. Much of the harvest that occurred in the False Island and Corner Bay road systems prior to 1980 incorporated stands within riparian corridors. These were typically low-elevation, high-volume stands along fish-bearing streams. More recent logging was prohibited in riparian areas within 100 feet of these streams (Class I and Class II).

All harvest prior to 1990 was accomplished using several types of cable yarding systems. Cable yarding systems range from complete to no suspension but generally cause less ground disturbance than ground-based skidding. Therefore, shovel yarding was implemented only on gentle (≤35%) slopes that did not show reason for soil damage concerns. Most recent harvest used the Grabinski cable system (a modified running skyline system) that varied from no suspension to partial (one end) suspension of the logs. Many cable yarded units that had no suspension show signs of soil disturbance.

Skid paths from units that were logged as early as 1968 are still visible. Most of these paths regenerated adequately. For example, disturbed soils actually aid the regeneration of Sitka spruce, which need a mineral soil bed for seed germination; however, these areas may experience reduced growth rates. In addition, forest composition is altered as regenerated red alder (in more heavily disturbed areas) compete with spruce and hemlock.

Some of the most recent logging required full suspension of the logs over sensitive areas (erosive soils and riparian areas). In addition, an entire sale in Corner Bay was yarded with helicopters (full suspension) from 1990-1995. Helicopters minimize ground disturbance during logging, but the amount of residual slash is usually higher. This slash may not affect regeneration but may impede wildlife mobility in the initial years following harvest.

Second Growth. Thousands of seedlings typically respond to take advantage of the increased light after a clearcut harvest. Management of second (young) growth is an important element of overall timber and land management. The most common treatment of second growth has been precommercial thinning, although release from other competing vegetation and pruning has been implemented on a trial basis. Precommercial thinning enhances the economic return of a stand by improving the quality of logs, decreasing the time necessary to grow trees to merchantable size, and changing the species mix to favor more profitable species. Thinning in the Analysis Area favors Sitka spruce for retention in the thinned stand. In addition, thinning can delay complete canopy closure, maintain greater species diversity, and have increase wildlife forage. Thinning treatments can alter tree arrangement and spacing to improve thermal cover and/or snow interception and to promote ease of wildlife (typically deer) movement through second-growth stands.

Most precommercial thinning has been conducted in productive timber sites. Recent thinning prescriptions, however, have emphasized the value of deer winter range as well as timber production. This habitat is generally near shore, under 500 feet in elevation, and has southerly aspect. Approximately 5,743 acres of the harvest areas have been thinned, mostly near False Island, Corner Bay, and Sitkoh Lake (Figure 4-15). Of these acres, 45% were thinned for wildlife as well as timber objectives. Another 6,651 acres are scheduled for future precommercial thinning.

Historic Logging. Maps of historic logging were done by the Forest Service; these were based on unverified Alaska Department of Fish and Game records. Transfer of these hand-drawn maps into the Forest Service GIS database indicates that 1,667 acres were harvested prior to 1956. These harvest areas are shown in Figure 4-15 and presented in Table 4-11. Heritage resource surveys suggest that additional small-scale, selective logging has occurred along the shoreline of Chichagof Island.

Table 4-11. Estimated acres of pre-1956 timber harvest.

Time Period	Acres Harvested
1900-1920	811
1920-1940	198
1940-1956	165
Unknown	493

Most of the historic harvest was selectively cut and occurred along the shoreline or within several hundred feet of salt water. However, some occurred along main stream channels where logs were skidded down the streams (see Aquatic Habitat section of this chapter). Sitka spruce was targeted in most of these cuts. The stand structures of these areas are generally more variable than the clearcut harvest areas. Removal of the trees improved conditions for residual trees in the vicinity, which resulted in large- and/or medium-sized trees. Similarly, the understory vegetation is more variable and dense (due to the canopy

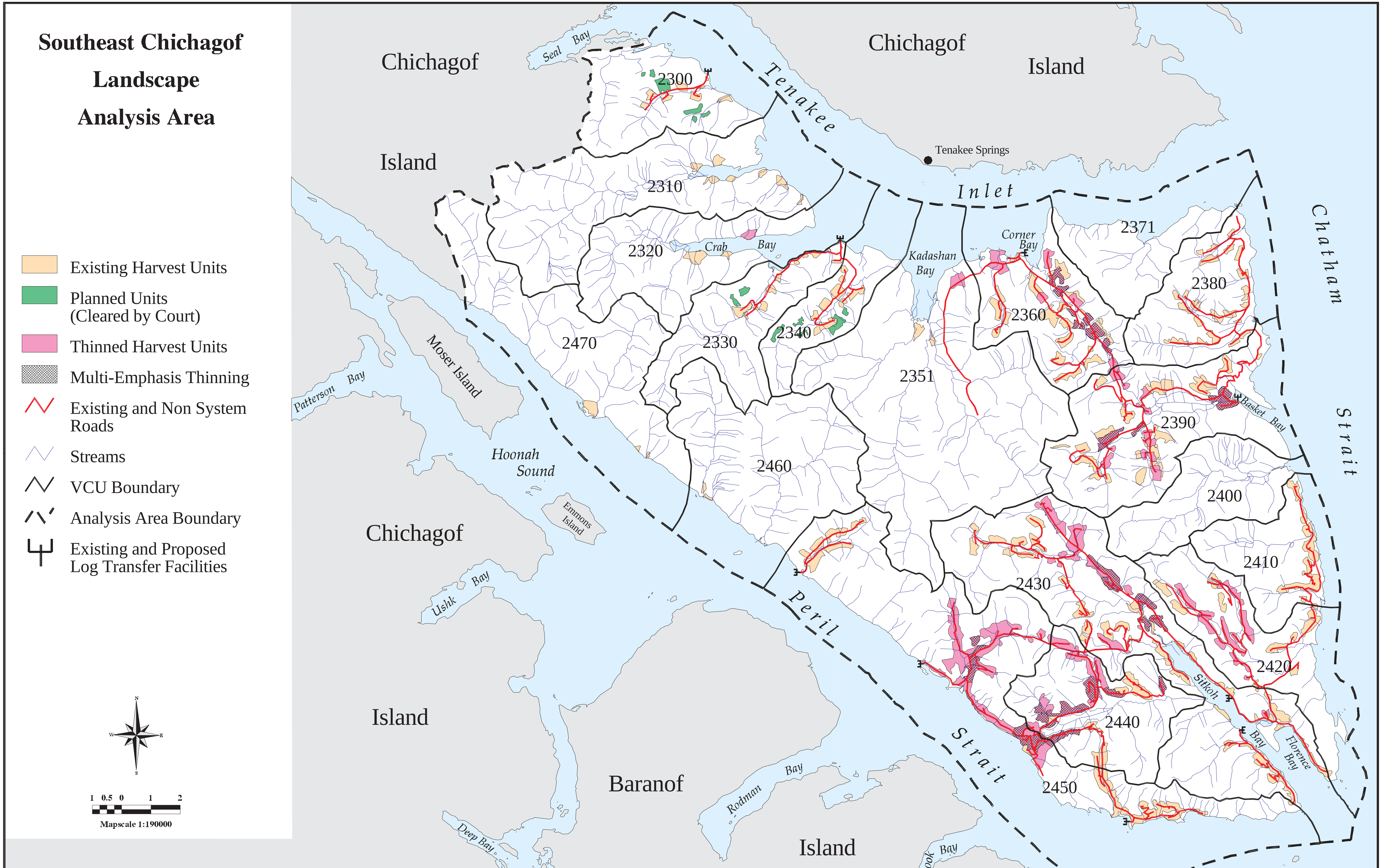


Figure 4-15. Southeast Chichagof Landscape Analysis Area Timber Harvest Units and Second Growth Treatments.

openings created by logging) while little understory vegetation exists in the denser unlogged areas.

Much of this historic harvest was accomplished with A-frames to drag the logs into saltwater. Little suspension is possible with this method and therefore evidence of these skid paths still remains. Often the conifer regeneration in these areas is less abundant and red alder may be predominant. In other cases, however, they promoted the regeneration of Sitka spruce over western hemlock. These skid paths also changed drainage patterns and rerouted small streams.

Future Timber Sales. The Record of Decision (ROD) for the Southeast Chichagof Final Environmental Impact Statement (FEIS) had planned for several more timber sales in the areas of Crab Bay, Saltery Bay, Inbetween Creek, Broad Creek and Broad Finger Creek. Legal challenges, following cancellation of the APC timber sale contract, postponed most of these sales until completion of further National Environmental Policy Act (NEPA) analysis. However, approximately 261 acres at Inbetween Creek and 314 acres in Crab Bay were not successfully challenged and may be offered in 1997 (Figure 4-15). We anticipate a mixture of large sales and small single-unit sales. Harvest methods for these sales will likely include clearcut, possibly group selection, and/or alternative methods. Both cable and helicopter yarding systems will likely be used. Due to the announced closure of the Ketchikan Pulp Company pulp mill, all future sales will probably be offered to independent operators.

<u>LTFs/Roads/Logging camps</u>. Land-based logging camps were established at Oly Creek, False Island, Crab Bay and Corner Bay, while floating camps were used occasionally. The Forest Service has established permanent work sites at False Island and Corner Bay.

Log Transfer Facilities (LTFs) were constructed at False Island, Lindenberg Head, Sitkoh Bay, Basket Bay, Corner Bay, Crab Bay, Inbetween Creek and Oly Creek (Figure 4-15). These locations meet several criteria: water deep enough to float logs, protection for log storage, nearby rock sources and good camp locations, and access to the sale area. Although logging has occurred at other sites in the Analysis Area, no road systems were established there.

An extensive road system connects the camps and LTFs to the harvest areas. Prior to the introduction of logging in the Analysis Area, inland access was limited to game trails. However, roads built to harvest timber provide increased access to inland areas. There are 250.8 miles of road in the Analysis Area; approximately 96.2 miles are open to vehicle travel. An additional 24.6 miles of road were constructed and subsequently obliterated. These roads were built of rock from borrow sites, which were typically established at approximately two-mile intervals along the mainline roads. Rock was also used to construct the LTFs, camps, and sortyards. In Corner Bay, where rock is unavailable near the shore, beach gravel was used to construct the beginning portions of the road. Road construction typically required clearing vegetation to mineral soil along a 50-foot-wide corridor. Approximately 30 inches of rock was placed on this surface to construct a road surface 14 feet wide. Maintained roads remain void of vegetation, while those not regularly maintained typically regenerate to thick red alder stands.

Wildlife Habitat

The value of old growth to wildlife depends on a diversity of forest types, some of which have been generated by disturbances such as windthrow. Windthrow and large scale logging have changed the distribution and values of interior old-growth habitats in this area. Although other wildlife habitats exist in this area, such as alpine or wetlands, the vast majority of recent, human-induced, change has occurred in old-growth forests; therefore, we focused on this habitat type. Most wildlife species in this area are associated with old-growth forest habitats. Changes in wildlife populations are often linked to changes in habitat condition. By evaluating changes in old-growth habitat, we can get a sense of what is happening to the associated wildlife species. For most old-growth associated species, reductions in old growth habitat result in negative impacts.

We conducted more detailed analysis for species which were considered as an issue to a particular user group. These species include Sitka black-tailed deer (*Odocoileus hemionus sitkensis*), which are an important resource to rural and urban hunters; brown bear (*Ursus arctos*), which are an important resource to rural and urban hunters and commercial hunting guides; and marten (*Martes americana*), which are important to trappers and for viability concerns. There have also been concerns about the viability of marbled murrelets (*Brachyramphus brevirostris*) and northern/Queen Charlotte goshawks (*Accipiter gentilis laingi*), which are sensitive species within the Alaska Region. Due to concerns about their viability, yearly surveys have been conducted to collect habitat data.

Forest Fragmentation

Timber harvest and road construction can fragment large patches of contiguous (connected) forest into smaller patches. This action increases the amount of edge habitat while decreasing the amount of interior old-growth habitat (Saunders et al. 1991). The consequences of fragmentation include a loss of interior old-growth habitat, which can limit the success of interior old-growth-dependant species. Interior forest dwellers are faced with reduced habitat and increased competition with edge species. Species which thrive on edge habitats, such as crows, ravens and jays, will have a competitive advantage. For example, when nests of interior nesting birds, such as the northern goshawk or marbled murrelet, are forced to nest closer to an edge, they may fall victim to edge dwelling species such as crows and ravens. Research by Hejl (1992, 1994) in the Rocky Mountains indicates a population decline of conifer forest dwelling birds due to human induced fragmentation. Loss of interior old growth wildlife corridors can result in reduced dispersal and migration of animals.

A description of the fragmentation analysis is included in the Forest Vegetation section. Results of the fragmentation analysis show a 29% loss of interior old-growth habitat, from 120,066 acres in 1956 to 85,068 acres in 1996 (Table 4-6). This reflects the amount of interior old-growth habitat transformed to young growth, edge habitats, or roads. Of the total interior habitat in 1956, 89% (106,896 of 120,066 acres) was contiguous. By 1997, this large patch had been fragmented into smaller patches (the largest being less than 20,000 acres). Figures 4-16 and 4-17 display the location of interior old-growth patches. This fragmentation has resulted in reduced interior old-growth connections

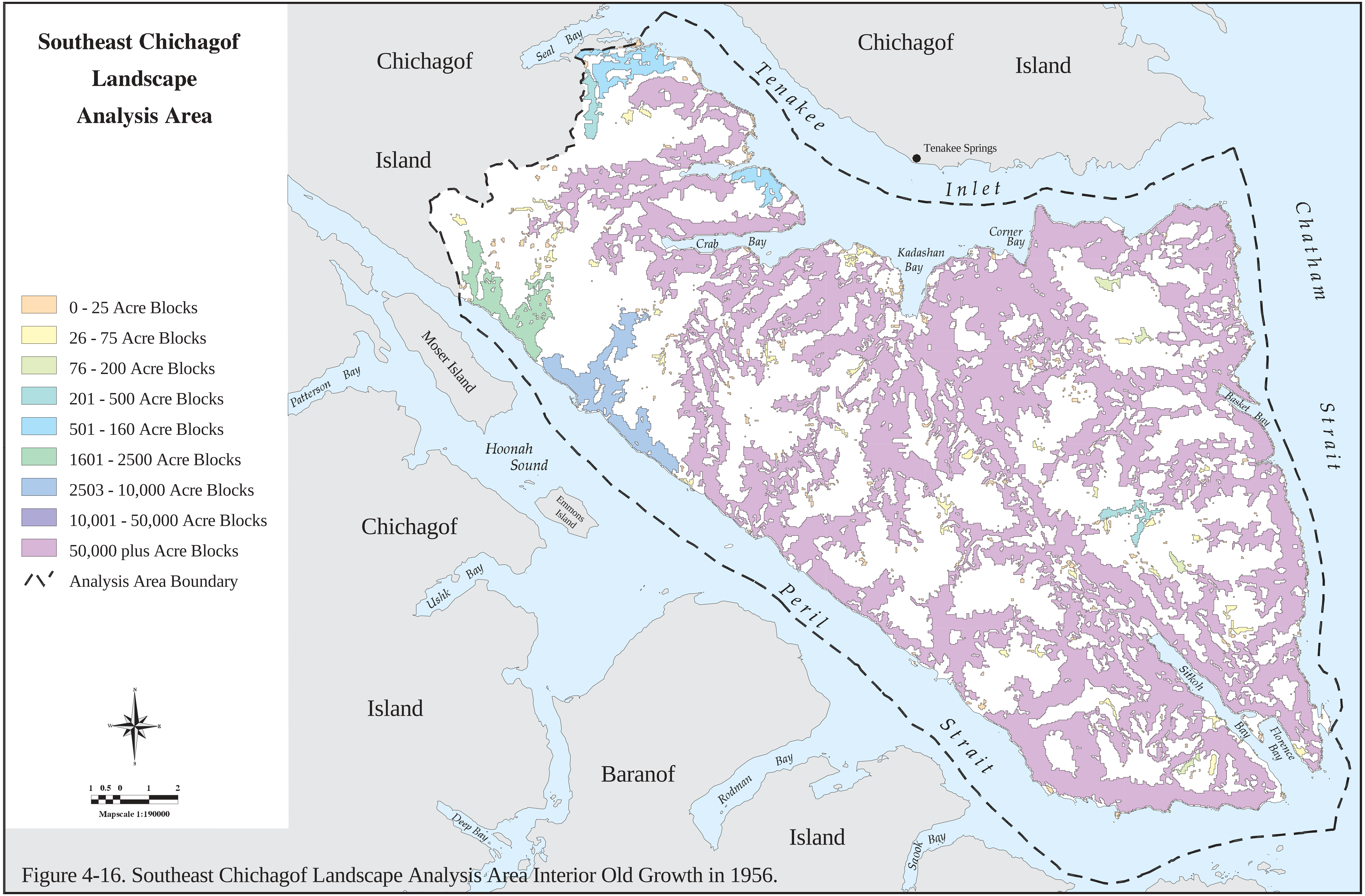


Figure 4-16. Southeast Chichagof Landscape Analysis Area Interior Old Growth in 1956.

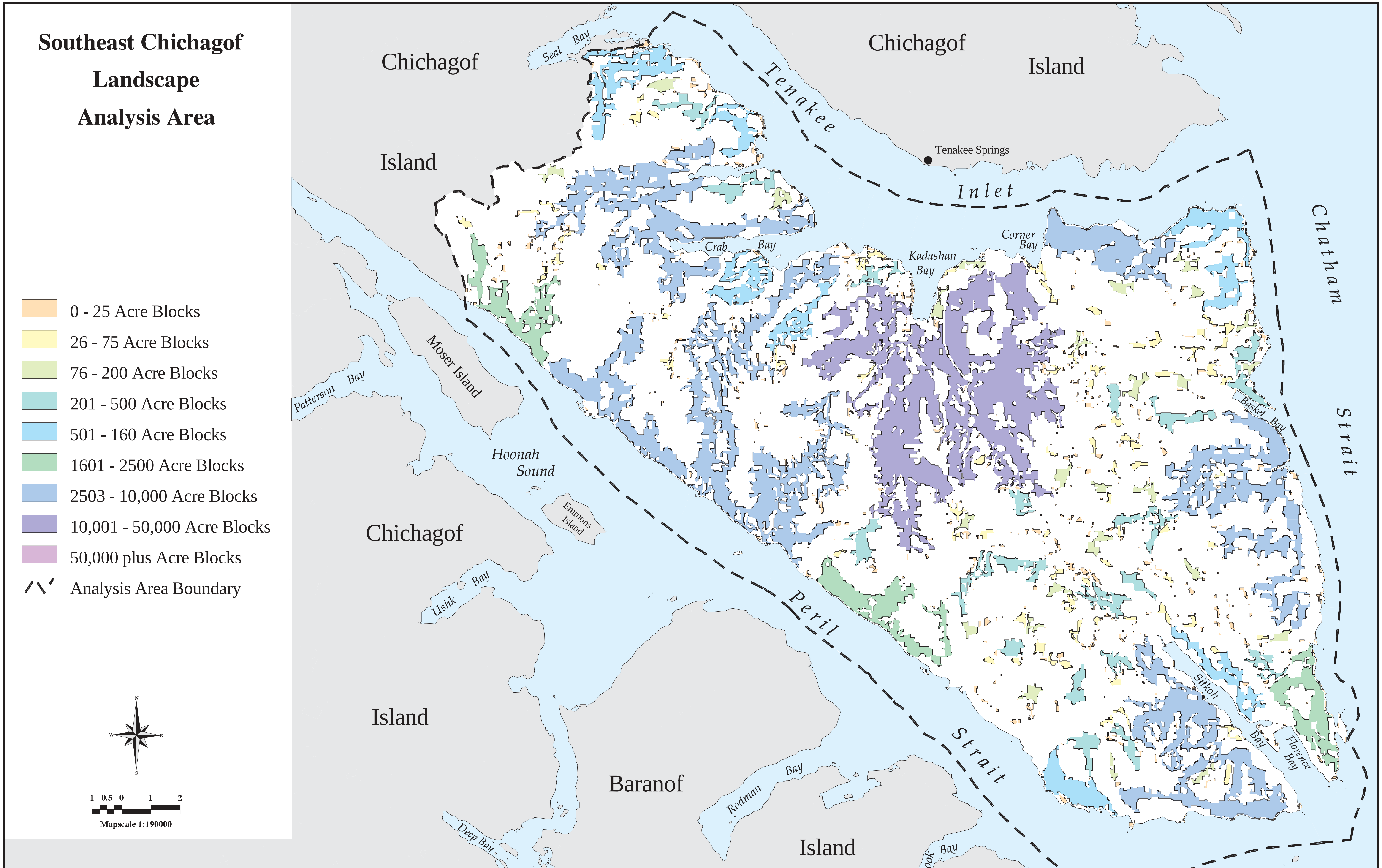


Figure 4-17. Southeast Chichagof Landscape Analysis Area Interior Old Growth in 1997.

between major drainages of Tenakee Inlet, Chatham Strait and Peril Strait (both inland and along the beach).

A Tongass-wide system of old-growth reserves (areas of non-development) was implemented by the signing of the 1997 TLMP, in an effort to protect wildlife viability and the integrity of old-growth forest. The location of these reserves on the Analysis Area are displayed in Figure 1-2. Additionally, a 1,000-foot beach and estuary buffer was established along with an extensive system of riparian buffers. Where timber harvest is planned in areas of high-value marten habitat certain stand structural features must be retained (TLMP Standards and Guidelines for marten) to provide a matrix of forest structure between non-development reserves. Additionally, with the signing of the new Record of Decision (1999), a 200-year rotation was added to the east side of the Analysis Area and 20,500 acres were removed from development LUDs.

An important habitat corridor was identified between the Broad Finger drainage and Crab Bay during our analysis of interior old-growth forest habitat. The maintenance of this connection would have required protection measures during project planning in addition to those prescribed in the 1997 TLMP. The 1999 ROD, however, took both drainages out of development. Chapter 5 also describes connections which have been broken and could benefit from rehabilitation.

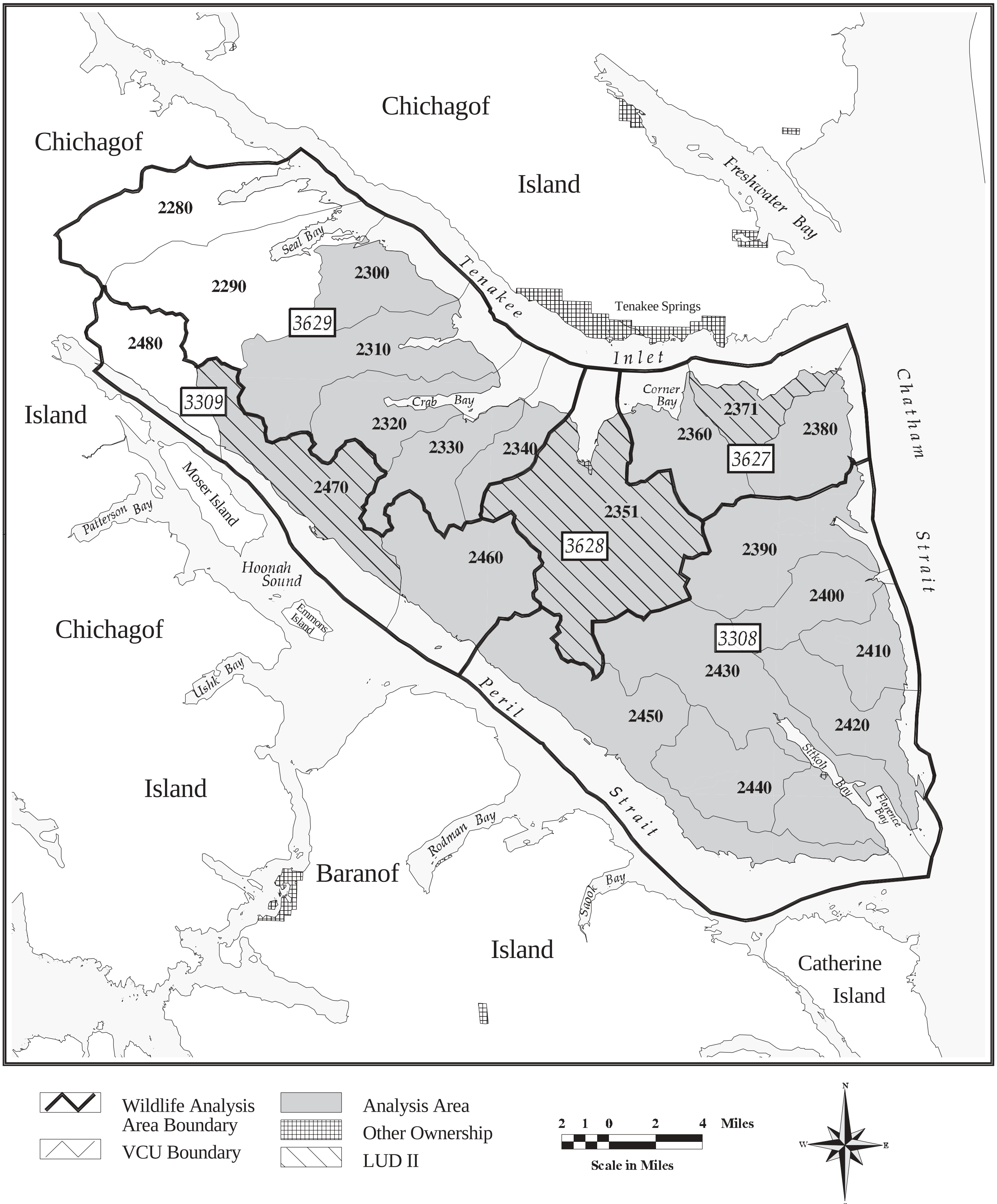
Species-Specific Analysis

We used a GIS database and the latest versions of the deer, marten and brown bear models (which are modifications of the habitat capability models developed by Suring et al. 1993, based on recommendations by TLMP panelists) to estimate the amount and quality of habitat available to these species in 1956 and compared it to the amount available in 1997. The models utilize the availability of critical habitat features to rate an area's ability to provide habitat for animals. These models estimate habitat (carrying capacity), not actual animal populations. They indicate the amount of habitat available, not the number of animals actually using it. Actual populations are often above or below the habitat capability of an area due to a variety of environmental factors such as food production or weather.

Habitat Capability Indices (HCI) were calculated for an area larger than the Analysis Area since two of the Wildlife Analysis Areas (WAAs) extend beyond the Area boundary. A WAA is a geographical area used by the Alaska Department of Fish and Game (ADF&G) to manage game populations (Figure 4-18). It was necessary to include the entire WAA since harvest and demand data are collected on a WAA basis. This facilitates comparison of habitat capability model outputs and ADF&G game harvest records in the Subsistence section.

Deer. Sitka black-tailed deer are the most sought-after big game species for sport hunting and subsistence use of any old-growth associated species in Southeast Alaska. The quantity and quality of winter habitat is considered the most limiting factor for Sitka black-tailed deer (USDA Forest Service 1997 TLMP). The deer winter habitat capability model takes into account snow depths, the value of lower elevations and the more southerly aspects, and forest successional

Figure 4-18. Location of Wildlife Analysis Area's (WAA's) in Relation to Southeast Chichagof Landscape Analysis Area.



stages. High volume old-growth forests have the highest habitat value because they intercept snow and provide understory forage plants. Lack of snow interception in the early successional stages, and lack of forage in middle successional stages, reduce the value of these forest stages as habitat (USDA Forest Service 1997 TLMP).

Table 4-12 presents the habitat capability for deer in winter in the Analysis Area. Review of this table indicates that 83% of the habitat capability remains in 1997 (17% reduction since 1956). These changes are due to timber harvest activities converting old-growth habitat to second growth and roads. Twenty to 28% of the habitat capability has been lost in WAA numbers 3308 (from Oly Creek to Basket Bay) and 3627 (Corner Bay to Buckhorn Creek). All WAAs presently supply adequate numbers of deer to meet or exceed hunter harvest and demand while providing a quality hunt for hunters (refer to Subsistence section). However, the habitat capability of certain VCUs within these WAAs has been reduced disproportionately. These VCUs include 2390 (Kook Lake), 2430 (Sitkoh Bay), 2440 (Sitkoh Lake), 2450 (from Oly Creek to Sitkoh Bay) and 2360 (Corner Bay to Buckhorn Creek). An uneven distribution of deer habitats may be a concern for the long-term viability of localized deer groups.

Table 4-12. Habitat Capability for Deer in the Analysis Area.

WAA	VCU	1956 HCI	1997 HCI	% OF CAPABILITY REMAINING IN 1997
3308	2390	817.7	592.3	72
3308	2400	380.2	379.9	100
3308	2410	404.0	343.4	85
3308	2420	644.7	502.6	78
3308	2430	1,311.3	952.8	73
3308	2440	677.9	430.7	64
3308	2450	1,549.8	991.5	64
TOTAL		**5,785.7**	**4,193.2**	**72**
3309	2460	511.0	512.1	100
3309	2470	576.8	556.3	96
3309	2480	217.7	217.7	100
TOTAL		**1,305.5**	**1,286.1**	**99**
3627	2360	591.2	405.1	69
3627	2371	291.8	293.8	101
3627	2380	435.2	357.1	82
TOTAL		**1,318.2**	**1,056.0**	**80**
3628	2351	1,346.4	1,320.2	98
TOTAL		**1,346.4**	**1,320.2**	**98**
3629	2280	317.8	317.8	100
3629	2290	444.0	417.6	94
3629	2300	258.3	244.9	95
3629	2310	504.3	480.2	95
3629	2320	415.8	381.8	92
3629	2330	272.6	244.1	90
3629	2340	196.3	159.3	81
TOTAL		**2,409.1**	**2,245.7**	**93**
GRAND TOTAL		**12,164.9**	**10,101.3**	**83**

Hunting access from the beach should be fairly well maintained by the 1,000-foot beach and estuary buffers and the system of old-growth reserves. Traditional hunting areas, which are accessed from the road system, may be reduced by additional timber harvest at low elevations. These areas should be identified and retained as much as possible.

Planning of timber harvest within these VCUs should proceed carefully to protect the remaining habitat capability. Effects on habitat capability can be reduced by utilizing silvicultural harvest methods other than clearcutting, deferring timber harvest below 800-foot elevation, or deferring harvest completely.

To visualize the location of deer habitat on the landscape, we produced the maps displayed in Figures 4-19 and 4-20. From 1956 to 1997, 15,672 acres (30%) of the high value deer habitat, within this area, has been converted to a lower habitat value. The 1997 TLMP Standard and Guidelines for Sitka black-tailed deer require consideration of high value deer habitat during timber sale planning. Additionally, the 1999 Record of Decision mandated a 200-year rotation in WAAs 3308 and 3627 to further protect subsistence use of deer.

Marten. Marten were introduced to the Analysis Area from the mainland. Marten use lower elevation old-growth forests because there is less snow accumulation. Beach fringe and riparian areas have the highest value, followed by upland habitats below 1500 feet elevation. Of the successional stages, old-growth forests have the highest value because they intercept snow, provide cover and denning sites, and provide habitat for prey species used by marten. Optimum habitat use occurs when patches of preferred habitat are greater than 180 acres. Conifer corridors facilitate movement and dispersal (USDA Forest Service 1997 TLMP).

Table 4-13 displays the HCI for marten in the Analysis Area. The model evaluates habitat based on vegetation, elevation and riparian areas. The 11% reduction by 1997 was due to timber harvest and road construction. Under the 1997 TLMP (American Martin Standards and Guidelines) any additional harvest in the Analysis Area would have to retain forest stand structures important to marten within those portions of the unit that are within high value marten habitat. The road effects can be limited by administrative regulations, such as closing the road system to motorized vehicles in the taking of marten or closing roads to vehicles.

To visualize the location of marten habitat on the landscape, we produced the maps displayed in Figures 4-21 and 4-22. From 1956 to 1997, 17,076 acres (26%) of the high value marten habitat, within this area, have been converted to a lower habitat value. This is largely due to the amount of timber harvest that has occurred in the higher value wildlife habitats such as riparian and beach fringe. The new reserve system in the 1997 TLMP should protect the majority of this type of habitat. The matrix strategy should help protect the upland high value marten habitats.

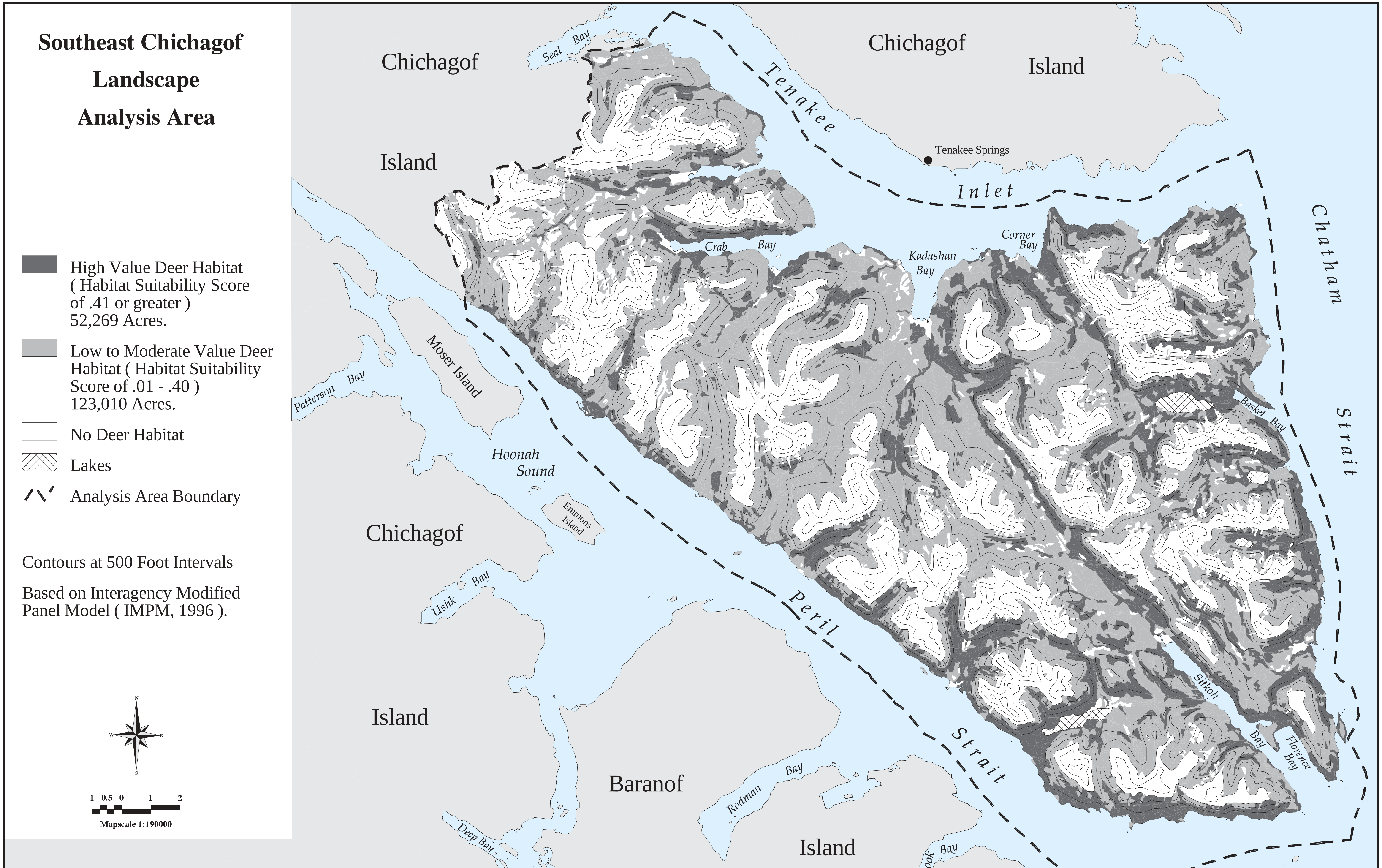


Figure 4-19. Southeast Chichagof Landscape Analysis Area Estimated Deer Winter Habitat in 1956.

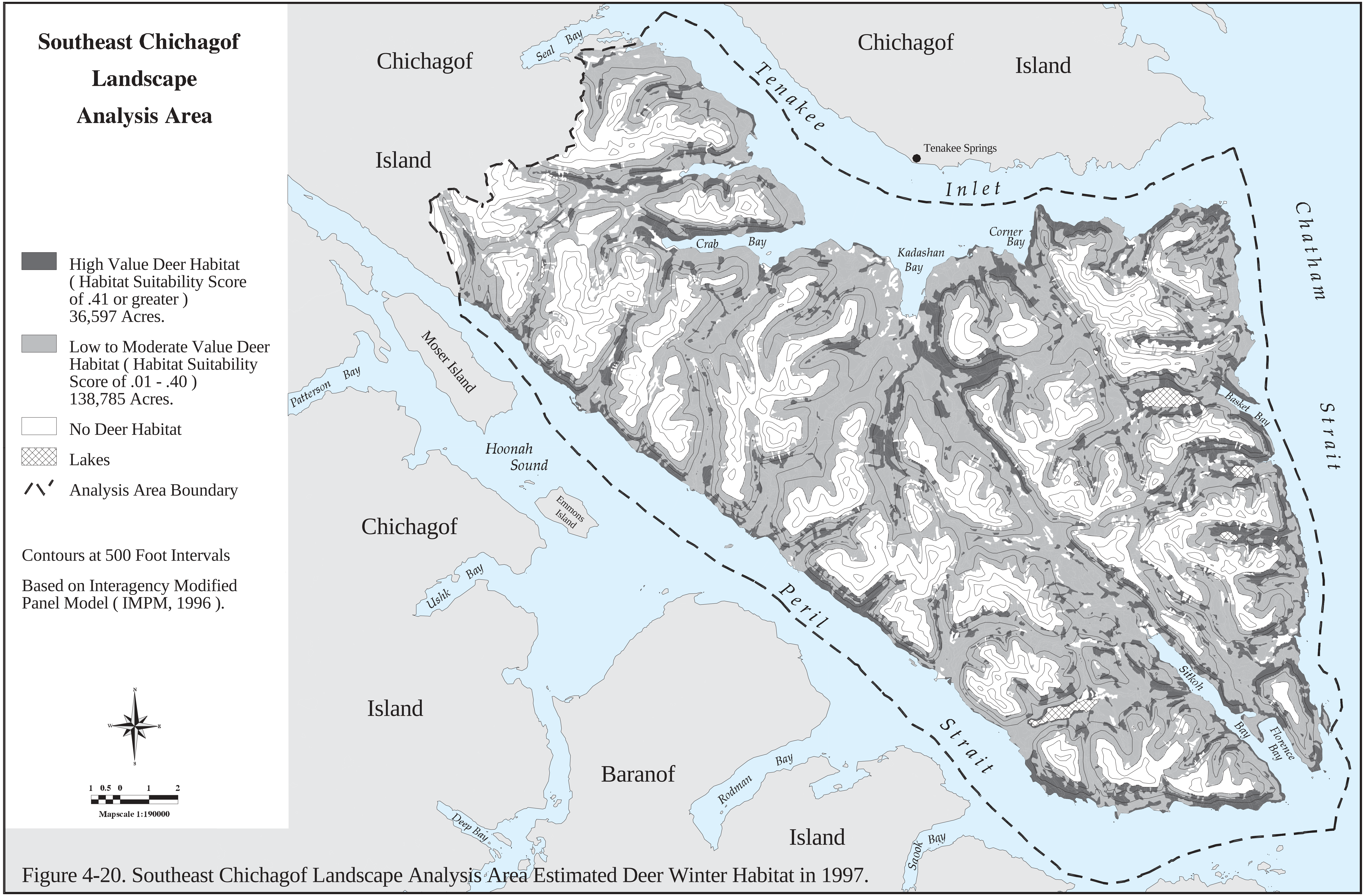


Figure 4-20. Southeast Chichagof Landscape Analysis Area Estimated Deer Winter Habitat in 1997.

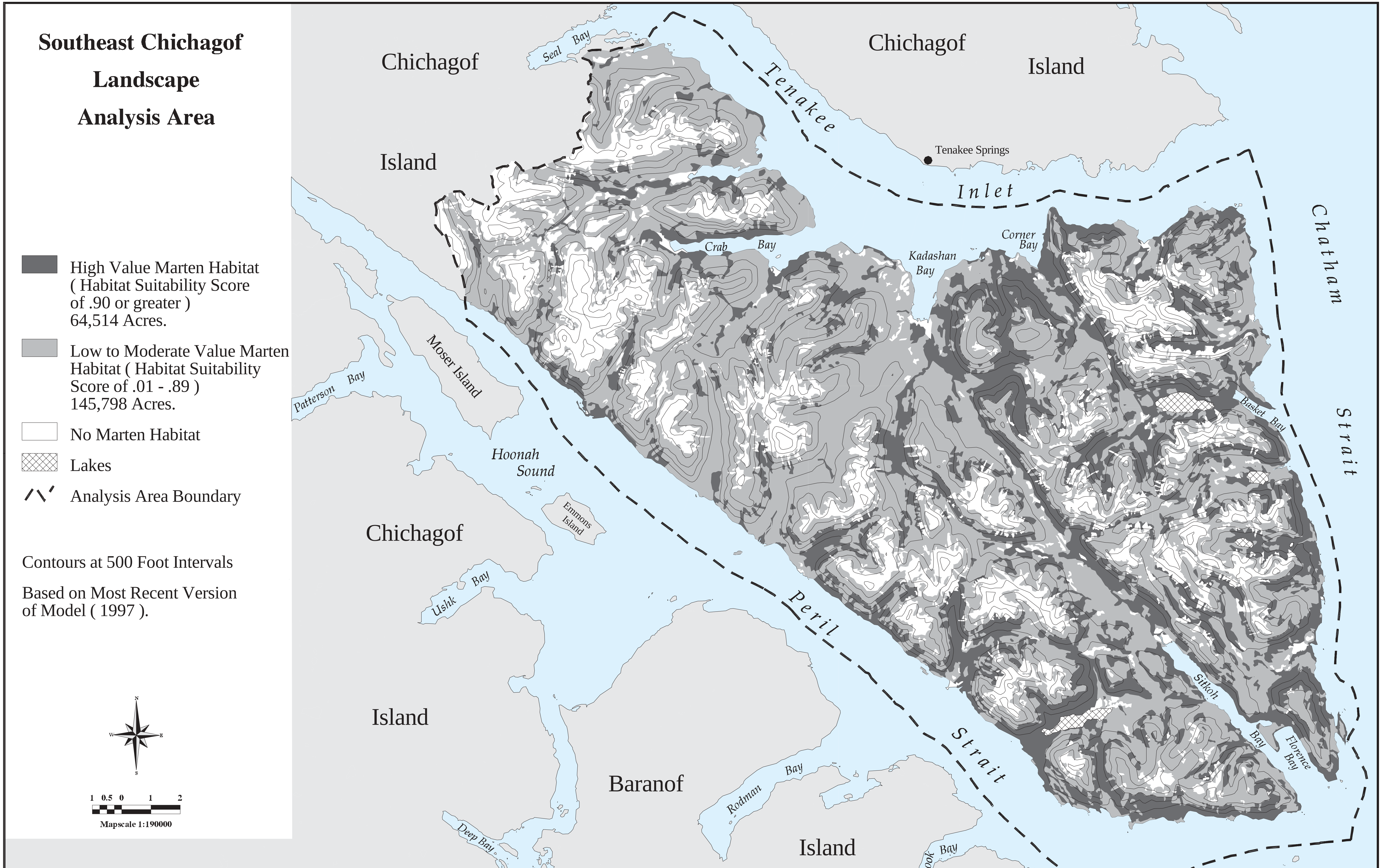


Figure 4-21. Southeast Chichagof Landscape Analysis Area Marten Habitat in 1956.

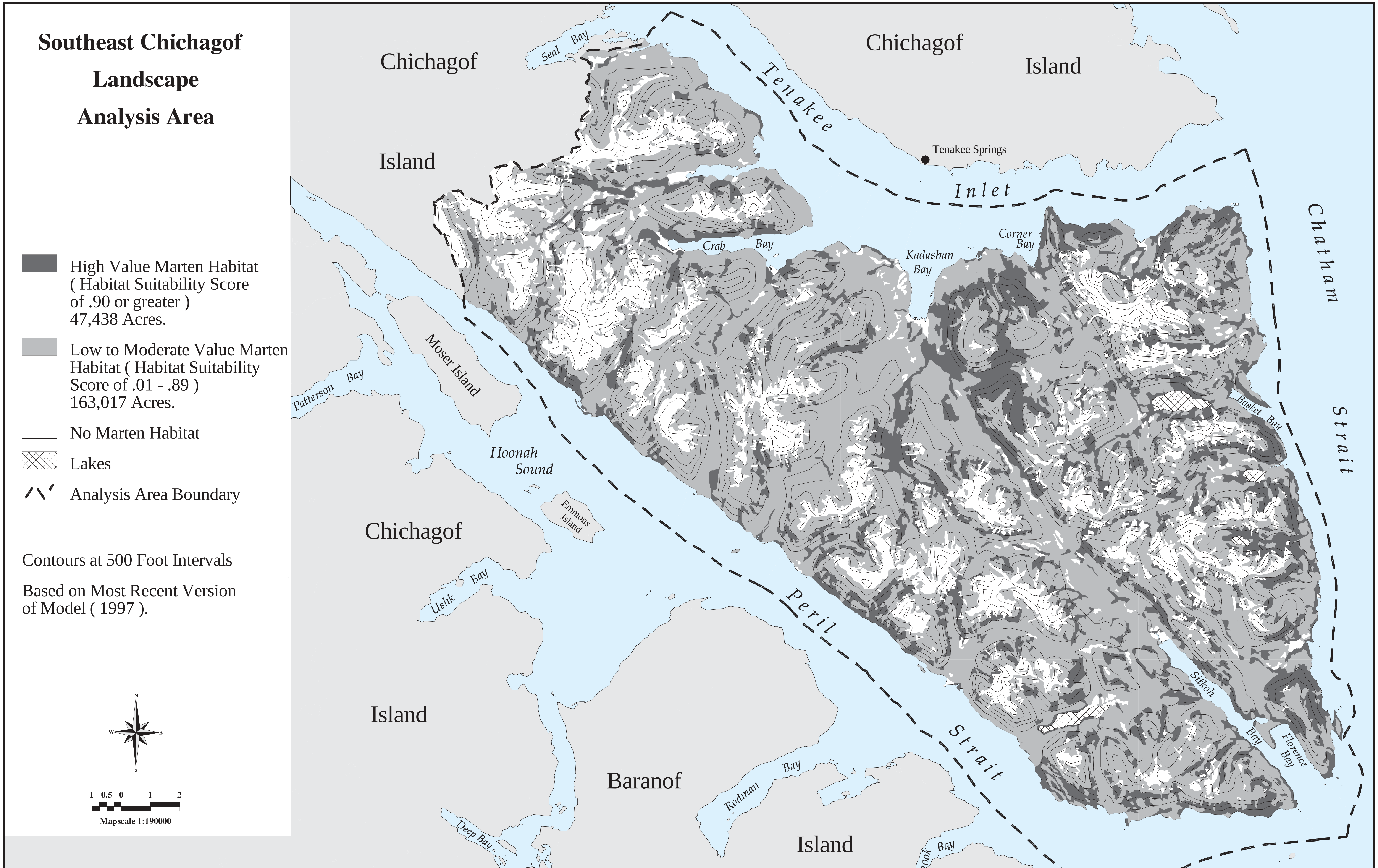


Figure 4-22. Southeast Chichagof Landscape Analysis Area Marten Habitat in 1997.

Table 4-13. Habitat capability analysis for marten in the Analysis Area.

WAA	VCU	1956 HCI	1997 HCI	% OF CAPABILITY REMAINING IN 1997
3308	2390	37.4	29.6	79
3308	2400	17.7	17.7	100
3308	2410	17.0	14.8	87
3308	2420	27.0	22.3	83
3308	2430	59.9	48.3	81
3308	2440	27.4	20.1	73
3308	2450	55.0	40.6	74
TOTAL		**241.4**	**193.5**	**80**
3309	2460	27.9	27.9	100
3309	2470	26.4	25.9	98
3309	2480	10.9	10.9	100
TOTAL		**65.2**	**64.7**	**99**
3627	2360	28.5	21.4	75
3627	2371	15.0	15.1	101
3627	2380	20.2	17.4	86
TOTAL		**63.7**	**53.8**	**84**
3628	2351	72.3	71.5	99
TOTAL		**72.3**	**71.5**	**99**
3629	2280	25.1	25.1	100
3629	2290	32.8	31.8	97
3629	2300	15.5	14.7	95
3629	2310	29.3	28.6	98
3629	2320	20.4	19.2	94
3629	2330	18.4	17.4	96
3629	2340	11.7	10.3	88
TOTAL		**153.3**	**147.1**	**96**
GRAND TOTAL		**595.8**	**530.6**	**89**

Brown Bear. Brown bear range from sea level to the alpine, and require large expanses of habitat and protection from human disturbance. The late summer season has been identified as the most critical or limiting period for brown bear. During this season, bears concentrate along low elevation valley bottoms and salmon streams. These are often the same areas of high human use and the most intense resource development activities. During this season, brown bears use a variety of habitats, with estuaries and riparian areas having the highest habitat values. Streams and rivers that produce anadromous fish have a higher value for brown bears than those without salmon (TLMP 1997). Increases in human activity in an area may result in more bears being killed by humans. Bear losses can result from increased legal hunting, illegal kills, wounding losses, and from defense of life and property.

Table 4-14 displays the Base Habitat Capability for bear on the Analysis Area for 1956 and 1996 by VCU and WAA. An additional analysis estimated the amount of impact that settlements and roads have on brown bear habitat capability. The 3% area-wide reduction which occurred in 1956 was due to the operation of the Todd and Chatham Canneries. The 21% reduction in 1996 was due to timber harvest, road construction and operation of Corner Bay and False Island camps. Approximately 6% of the decrease from 1956 is due to the actual harvest of timber. The remaining reduction from 1956 is due to road and camp development. These effects can be limited by administrative regulations, such as closing the road to motorized vehicles in the taking of brown bear.

To check the validity of the model results, we compared the results to the estimated density of brown bears for all of Chichagof Island. In 1992 the bear density of Chichagof Island was estimated at 0.77 brown bears per square mile. This was based on studies by the Alaska Department of Fish and Game (Titus and Beier 1993). Multiplying the number of square miles in the Analysis Area (489) by the number of bears per square mile (.77), produces an estimate of 377 bears in the Analysis Area. This is fairly close to the 359 bears predicted by the model.

Table 4-14. Habitat capability analysis for brown bear in the Analysis Area.

WAA	VCU	1956 HCI	1956 WITH URBAN IMPACTS	1997 HCI	1997 WITH ROAD & URBAN IMPACTS	% of CAPABILITY REMAINING 1997 (ALL IMPACTS)
3308	2390	26.8	26.8	23.6	15.2	57
3308	2400	13.2	13.2	13.2	11.7	88
3308	2410	10.8	10.2	10.2	8.2	75
3308	2420	16.8	13.5	14.9	10.2	61
3308	2430	42.0	36.8	37.1	26.4	63
3308	2440	17.7	14.3	15.3	11.0	62
3308	2450	35.7	33.1	30.6	23.0	64
TOTAL		**163.0**	**147.8**	**144.9**	**105.7**	**65**
3309	2460	25.8	25.8	25.8	25.3	98
3309	2470	23.2	23.2	22.9	22.9	99
3309	2480	9.9	9.9	9.9	9.9	100
TOTAL		**59.0**	**59.0**	**58.6**	**58.1**	**99**
3627	2360	17.5	17.5	14.5	8.6	49
3627	2371	10.2	10.2	10.2	8.0	78
3627	2380	14.0	14.0	12.9	7.8	56
TOTAL		**41.7**	**41.7**	**37.6**	**24.3**	**58**
3628	2351	55.3	55.3	54.9	43.6	79
TOTAL		**55.3**	**55.3**	**54.9**	**43.6**	**79**
3629	2280	21.5	21.5	21.5	21.5	100
3629	2290	30.8	30.8	30.2	30.2	98
3629	2300	13.7	13.7	13.4	12.0	88
3629	2310	28.5	28.5	27.9	27.9	98
3629	2320	16.1	16.1	15.6	15.5	96
3629	2330	14.8	14.8	14.4	12.9	87
3629	2340	9.1	9.1	8.5	7.3	80
TOTAL		**134.6**	**134.6**	**131.6**	**127.3**	**95**
GRAND TOTAL		**453.6**	**438.4**	**427.5**	**359.0**	**79**

Field Surveys of Threatened, Endangered and Sensitive Species

There are no Federally listed Threatened or Endangered terrestrial vertebrate species within the Analysis Area. However, we did conduct field surveys of marbled murrelets

(*Brachyramphus brevirostris*) and northern/Queen Charlotte goshawk (*Accipiter gentilis laingi*), which are Forest Service sensitive species, to help determine if listing as a threatened or endangered species was necessary. The U.S. Fish and Wildlife Service has determined that listing is not warranted.

Northern Goshawk. The northern goshawk inhabits forests throughout North America, favoring dense stands of conifer or deciduous old growth for nesting habitat. The Queen Charlotte goshawk is recognized as a distinct subspecies and is found only in coastal areas of British Columbia and in Southeast Alaska. Within Southeast Alaska, the goshawk appears to be non-migratory, although it may occupy different, or overlapping, winter and breeding territories. Goshawks are medium-sized hawks which prey primarily on other birds [Steller's jay (*Cyanocitta stelleri*) and varied thrush (*Ixoreus naevius*) are common prey species]. A viability concern exists for the northern goshawk in Southeast Alaska due to association with old-growth forests and the decline in these habitats from timber harvest (USDA Forest Service 1997).

Preliminary surveys were accomplished in 1993-95. Surveys in the Analysis Area in 1996 were conducted along routes based on the probability of nesting habitat, previous goshawk observations, and lack of previous surveys. Probability of nesting habitat was based on attributes of known nest sites in Southeast Alaska. Attributes included areas below 1,000 feet elevation, timber volume of greater than 8,000 board feet per acre, broken mountain or hill slopes with less than 75% gradient, hills, footslopes or valley bottoms. These surveys were conducted in the Broad Creek, Broadfinger Creek, Finger Creek, Trap Bay, Saltery Bay, Inbetween, Kook Creek, Kook Lake, Basket Bay, Little Basket Bay, and Sitkoh Bay drainages.

A goshawk nest in Sitkoh Bay reported by the Forestry Sciences Lab in Juneau was verified. We collected nest tree and stand data for this nest. The nest was active, with two adults and two nestlings. Both adults and one juvenile goshawks were radio-tagged (in cooperation with the ADF&G and USFWS) to allow monitoring of the birds use of the area. No other goshawks were observed in the Analysis Area.

Marbled Murrelet. The marbled murrelet is a robin-sized seabird that feeds below the water's surface on small fish and invertebrates and is usually found within five miles of shore. Murrelet populations seem to be stable in Southeast Alaska, but elsewhere there have been serious declines. The species is listed as threatened by the States of California, Oregon and Washington. Marbled murrelets nest in large, mature coniferous trees within stands of structurally complex, old-growth forests. Except while molting, marbled murrelets fly to the forest throughout the year. Nesting habitat relationships are poorly understood in Southeast Alaska, but elsewhere data indicate the importance of high volume stands that are close to the coast (USDA Forest Service 1997 TLMP).

With assistance from the USFWS, we conducted marbled murrelet point counts in the Analysis Area in 1996. Counts were conducted in Crab, Basket and Sitkoh Bays. No nesting surveys were conducted as the nests are extremely difficult to locate. There are no identified nest locations in the Analysis Area, although the area is used quite heavily by marbled murrelets (based on point count observations).

Riparian and Aquatic Habitat

In order to assess the vulnerability of fish populations, the streams habitats and the fish were examined. This examination includes stream hydrology and water quality, riparian vegetation, wetlands, erosion and sedimentation, and fish populations in the Analysis Area. Riparian areas referred to in this chapter encompass the zone of interaction between the aquatic and terrestrial ecosystems and include riparian streamsides, lakes and floodplains with distinctive resource values and characteristics.

Hydrology

All significant stream segments in the Analysis Area were mapped and classified using the Alaska Region Channel Type Classification System (Forest Service 1992). This system is used on the Tongass National Forest to classify stream channels by size, location in the watershed, adjacent landforms, gradient, hydraulic control, and riparian vegetation. For the Analysis Area, 26 key watersheds were identified. In particular, stream channel type (a measure of sediment transport) and stream class (a measure of fish habitat) are examined. Table 4-17 displays the miles of each stream class and process group for these watersheds and Figure 4-23 shows their locations. Stream process groups are stream channels which share similar formative processes. They reflect the long-term interaction of geology, landform, climate, and riparian vegetation. The TLMP Revision (1997) provides more in-depth descriptions of process groups and channel types. A breakdown of streams by channel type for each watershed is listed in Appendix F.

Channel Type. In the Analysis Area 806 miles of significant streams were analyzed: 549 miles (68%) are transport channels, 103 miles (13%) are transitional channels, and 154 miles (19%) are depositional channels. Transport channels have low sediment retention and include high-gradient contained (HC), moderate-gradient contained (MC), and low-gradient contained (LC) channels. HC channels are on steep headwater slopes and are the primary sediment conduit to the low-gradient valley bottom and footslope streams. Transitional channels have moderate sediment retention and include moderate-gradient mixed control (MM), estuarine (ES3), glacial (GO5), and some alluvial fan (AF2) channels. Depositional channels have high sediment retention and include the valley bottom flood plain (FP), palustrine (PA), estuarine (ES2 and ES4), and some alluvial fan (AF1) channels. Valley bottom flood plain and palustrine streams generally have the most anadromous (Class I) fish spawning and rearing habitat. Generally, the larger U-shaped watersheds contain a higher percentage of depositional, valley bottom channels. The large U-shaped watersheds, including Saltery, Crab, Kadashan, Kook and Sitkoh River, have between 24 and 33% of their stream miles in depositional channel types (Table 4-17).

Stream Class. As noted in Chapter 2, three stream designations are used in this analysis: Class I streams and lakes have anadromous or adfluvial fish habitat, or habitat upstream of barriers that can be enhanced; Class II streams and lakes have only resident fish populations with limited sport fishery value; and Class III streams have no fish populations but have potential water quality influence on downstream aquatic habitat (USDA Forest Service 1986 Aquatic Handbook). The TLMP Revision (1997) also describes Class IV streams: other intermittent and small perennial channels with insufficient flow or

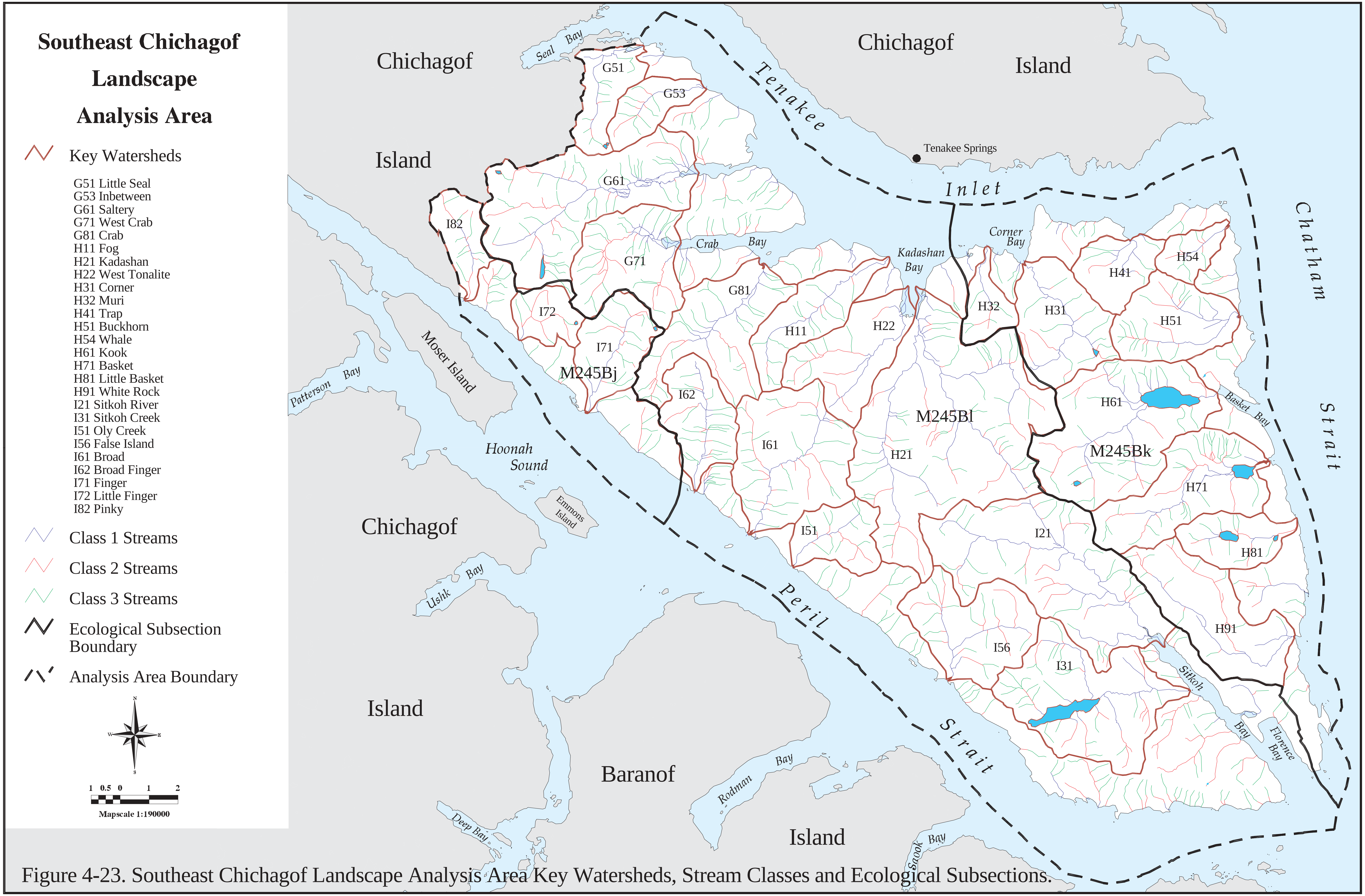


Figure 4-23. Southeast Chichagof Landscape Analysis Area Key Watersheds, Stream Classes and Ecological Subsections.

transport capabilities to have an immediate influence on downstream water quality or fish habitat. Due to their small size and need to field identify, Class IV channels are not included in this analysis but will be assessed in more detailed project-level planning and implementation. In the Analysis Area there are 249 miles (31%) of Class I streams, 210 miles (26%) of Class II streams, and 349 miles (43%) of Class III streams. Table 4-17 and Figure 4-23 show the stream class distribution for the Analysis Area.

Stream Density. Stream density, measured as miles of stream per square mile, is fairly equal across the Analysis Area, and averages 2.0 mi/mi^2, and generally ranges from 1.6 mi/mi^2 to 2.5 mi/mi^2 (Table 4-17). Only West Crab Creek and Broad Finger Creek, with 2.9 mi/mi2, are slightly outside this range. These numbers do not include miles of lakes. Several watersheds appear to have lower than normal percentage of Class III and transport-type channel length, including White Rock Creek and Trap Bay Creek. These may not have had all the smaller Class III channels identified and mapped onto GIS, and/or this could be the result of karst topography.

Table 4-17. Stream miles by class and process group, and drainage density for watersheds in the Analysis Area.

Watershed	Area (mi^2)	Stream Miles by Class: Class I	Class II	Class III	Drainage Density* (mi/mi^2)	Stream Miles by Process Group: Transport	Transitional	Depositional
Little Seal	5.7	5.6	0.7	4.3	1.9	5.6	2.2	2.8
Inbetween	4.6	3.2	2.5	4.6	2.2	6.5	2.8	1.0
Saltery	22.6	20.6	10.8	24.8	2.5	36.1	5.2	14.9
West Crab	11.8	7.2	10.3	16.4	2.9	23.2	3.8	6.9
Crab	13.9	9.4	8.6	15.0	2.4	22.1	3.0	7.8
Fog	8.1	7.5	1.6	8.8	2.2	14.0	1.2	2.8
Kadashan	40.3	34.4	19.5	27.1	2.0	50.1	10.1	20.8
W. Kadashan	10.8	8.1	7.2	4.3	1.8	12.7	1.7	5.2
Corner	11.2	9.7	3.7	7.3	1.8	12.6	1.3	6.7
Muri	3.5	2.4	1.4	2.8	1.9	4.2	1.7	0.7
Trap	5.6	4.8	1.2	3.7	1.7	4.7	0.7	4.3
Buckhorn	9.7	8.4	5.1	9.2	2.3	13.6	2.8	6.2
Whale	3.1	2.1	1.6	2.9	2.1	3.9	2.4	0.2
Kook	22.2	14.0	10.9	18.1	1.9	24.8	7.9	10.4
Basket	14.4	8.5	9.1	16.3	2.4	23.4	2.2	8.5
Little Basket	5.9	2.3	3.6	4.4	1.8	7.4	1.6	1.3
White Rock	14.1	9.8	8.8	4.0	1.6	9.1	3.8	9.6
Sitkoh River	26.6	25.0	10.8	16.6	2.0	30.5	4.4	17.5
Sitkoh Creek	19.3	12.3	10.8	15.5	2.0	29.5	5.2	3.8
Oly Creek	6.0	3.2	3.5	5.9	2.1	9.9	2.7	0.0
False Island	12.3	6.6	9.1	8.8	2.0	14.9	6.6	2.9
Broad	16.6	8.0	10.5	15.7	2.1	28.0	3.0	3.2
Broad Finger	7.9	7.0	3.3	12.4	2.9	16.5	2.9	3.1
Finger	7.4	4.9	3.5	8.2	2.2	11.3	3.9	1.5
Little Finger	3.9	0.5	5.2	2.2	2.0	6.6	1.3	0.0
Pinky	4.6	2.0	3.5	4.2	2.1	6.9	1.4	1.5
All others	96.0	21.2	42.9	85.2	1.6	121	17.4	10.5
TOTALS	408	249	210	349	2.0	549	103	154

*Drainage density includes Class I, II and III streams mappable from aerial photos.
For process groups: transport channels = LC, MC, and HC channels; transitional channels = MM, ES3, AF2, and GO5 channels; and depositional channels = FP, PA, ES2, ES4, and AF1 channels.

Streamflow. As noted in Chapter 2, streamflow regimes in the Analysis Area are typical of island watersheds in Southeast Alaska. Runoff responds directly to rainfall except for a smaller peak in late spring during snow melt. There are no streamflow records for most stream basins in this area, but streamflow records are available for Kadashan River (1969 to 1992) and nearby Indian River (1976 to 1981) watersheds. During these time periods, mean monthly runoff in October averaged 12 cubic feet per second per square mile (cfs/mi^2) at both Indian River and Kadashan River (US Army Corps of Engineers Pouch

898 NPAEN-PL-P; USGS Water Data Report AK-92-1). In August, mean monthly runoff averaged 2.6 cfs/mi^2 at Indian River and 3.3 cfs/mi^2 at Kadashan River.

The larger (≥ 20 mi^2) watersheds in the Analysis Area are predominantly U-shaped valleys, with broad flat alluvial bottoms, one or more steep V-shaped sub-basins, at least one long main stem with substantial floodplain channels, and substantial wetlands. Transport and transitional channels drain the moderate to higher gradient reaches of the watershed and transport sediment and organic debris downstream to the valley bottom depositional streams. In addition to providing much of the available fish habitat, these flood plain stream channels provide short- and long-term storage for sediment and are sensitive depositional reaches.

The moderate-sized (10 mi^2 to 20 mi^2) watersheds have characteristics similar to the larger watersheds, except the moderate-sized watersheds tend to be more variable in watershed shape and have shorter and smaller valley bottom main stem channels.

The smaller (≤ 10 mi^2) watersheds tend to have steep V-shaped valley profiles, short main stem channels, quick response to storm runoff, and are efficient in routing runoff to the main stem channel and out of the watershed.

Karst. Corner, Trap, Whale, Buckhorn, Kook, Basket, Little Basket, and White Rock Creeks are all influenced by karst geology, which runs roughly east of a line from White Rock Creek to Corner Creek (Figure 2-1). Karst effects flow routing from alpine head-water catchments through runoff storage. Nearly the entire Kook Lake watershed drains out through several underground stream segments, creating a very unusual cave outlet for a large anadromous fish system.

Management Effects on Streamflow. In large basins where timber harvest activities are dispersed in space and over time, relatively small changes in streamflow can be expected (Duncan 1986). Studies in Oregon showed increased magnitude of small and moderate peak flows associated with logging (Harr 1986). Salmon have adapted to average flow regimes for all stages of their freshwater life history. Seasonal low flows and peak flows can affect migration, channel conditions, water quality and egg survival (Hicks et al. 1991).

Reduced low flows in watersheds that have been converted from old-growth forest to second-growth forest is a relatively new issue. This reduction in summer and winter flows is from increased canopy interception of precipitation and increased evapo-transpiration rates. Myren and Ellis (1984) speculated that converting old-growth watersheds to second-growth forests may significantly reduce summer low flows in Southeast Alaska streams and impair summer rearing and spawning for salmonids. This decrease would be evident in the intermediate stages of forest succession. However, streamflow analysis for Staney Creek, a large watershed on Prince of Wales Island near Ketchikan, indicated an increase in summer low flows after 35% of the watershed was harvested. Low flow changes are most likely to occur where a significant portion of the stream riparian area has been harvested (Hicks et al. 1991).

Peak flow increases from timber harvesting in rain-dominated runoff regimes will be minor, assuming minimal soil compaction and low road density in a watershed. However, clearcut harvest practices have the potential to increase the magnitude of peak flows under a rain-on-snow runoff regime (Harr 1986, MacDonald and Hoffman 1995).

The sustained baseflow and thermal cover found in palustrine fen channel types are important to winter survival of juvenile fish. Low streamflow during extreme cold weather may freeze gravel riffles and incubating eggs. Low flows in the summer and winter can adversely affect adult spawners, rearing juveniles, and egg incubation. Low summer flows may shrink and occasionally dry up rearing pools used by juveniles; this most often affects young-of-the-year coho, steelhead, cutthroat and Dolly Varden and occurs in the smaller tributaries and side channels of the main stem stream.

Changes in the magnitude and duration of winter peak flow can adversely effect rearing salmonids and the integrity of spawning beds. Flooding reshapes and redistributes gravel bars and large woody debris, causing eggs to be washed away, buried, or crushed. Annual peak streamflows and rain-on-snow storm flows consistently occur during egg incubation. Debris flows, landslides, alluvial fan and flood plain channel migration and stream crossing failures usually occur during peak streamflows. All of these processes have the potential to dramatically affect egg survival and alter habitat features.

Lack of stream gauging information for most of the Analysis Area streams precluded us from doing a quantitative analysis of streamflow condition and trends in these watersheds. Streams like False Island Creek, Kook Creek, Sitkoh Creek, Sitkoh River and Corner Creek, with substantial overall watershed harvest (17 to 25%) and extensive riparian area harvest (17 to 50%), would be most likely to show changes in streamflow trends. Kadashan River is the only drainage in the Analysis Area with adequate stream gauging information to track annual flow levels. However, little timber harvest has occurred and it is essentially an unmanaged watershed. Eight years of stream gauging data were collected for the upper Indian River (Tenakee). For the Indian River Watershed Analysis (IRWA), these two sets of data were compared to evaluate trends over time and possible changes to the Indian River hydrology associated with timber harvest practices. The following results can be extrapolated to some degree for Analysis Area watersheds with similar harvest levels (10%).

Peak Flows. As mentioned, rain-on-snow peak flow events are the most susceptible to change as the result of timber harvest in Southeast Alaska watersheds. Areas with shallow winter snowpack and large canopy openings such as clearcut units are the most important source zones for rain-on-snow floods (Harr 1986). For the IRWA, maximum daily flows from November through February for the period prior to and following timber harvest (at Indian River) were compared. An analysis of the two regression lines indicated no significant difference (P=.95) between pre- and post-timber harvest winter peak flows. The IRWA concluded that it was unlikely that 10% harvesting of the transient snow zone resulted in measurable changes in Indian River peak flows.

Low Flows. The month of August is considered to be a critical period for summer low flows in the Analysis Area. August typically has warm temperatures and periods of one to two weeks with no or little precipitation. Alpine snowpack runoff contributions to base stream flow are minimal. Adult salmon are also migrating and spawning during this time. Similar to peak flows, the IRWA team analyzed summer low flow conditions and trends for Indian River. Mean monthly flows and minimum daily flows in August for Upper Kadashan were compared to flows for the Indian River. They concluded there was a consistent relationship between Kadashan and Indian River over most of the period that both stream gauges were operated and they discounted the possibility of measurable changes to low flow levels in Indian River resulting from timber harvest.

Water Quality

Propagation of fish and other aquatic species is the primary beneficial use of water in the Analysis Area. Temperature, dissolved oxygen, pH, turbidity, and total dissolved solids are the main parameters adopted by the State of Alaska as standards for assessing surface water quality. As with streamflow, quantitative water quality data are available primarily for the Kadashan River watershed in the Analysis Area.

Stream Chemistry. Representative values for major chemical constituents for the upper Kadashan River, nearby Indian River (Tenakee), Sitkoh Lake, Kook Lake, and applicable State standards are shown in Table 4-18. These data show that dissolved oxygen, pH, and total dissolved solids concentrations are at optimum levels for fish propagation in both the Upper Kadashan River and Indian River watersheds. Concentrations of other important nutrients (potassium, phosphorus, and sulfur) are also suitable for fish production. Most of these solutes come from geologic weathering (Stednick 1981).

Table 4-18. Water quality standards and measurements for Kadashan, Indian River, Kook Lake and Sitkoh Lake watersheds.

Parameter	Alaska State Standard	Kadashan River	Indian River	Kook Lake	Sitkoh Lake
pH	6.5-9.0	7.04	7.27	6.9	6.6
Dissolved O (mg/l)	7.0 (min)	12.59	12.06		
Dissolved Solids	1500 (max)	32.81	75.00		
Period of Record	---	1967-1979	1981	1995	1992

Principal sources of nitrogen are from precipitation, biological fixation in alder, leaves, and salmon carcasses. Nitrogen is generally a limiting nutrient for fisheries productivity in the waters of Southeast Alaska. The salmon runs in the area watersheds are very important to the riparian and terrestrial wildlife aspects of each watershed’s ecology. The returning adult salmon provide a large nutrient input into the system. Nutrients from the decaying carcasses enrich the streams and stream biota, the adjacent riparian areas, and the estuarine habitat. Many salmon carcasses flush downstream into the estuary and bay, where they provide nutrients for plant and animal species. The returning adult salmon also are consumed by many species of wildlife, including brown bears, which depend heavily upon the returning adult salmon in the late summer and fall.

Management Effects on Chemical Quality. Concentrations of inorganic nutrients in streams can increase following timber harvest for short periods (Fredricksen 1971), but changes to aquatic species are generally minor in forested watersheds due to rapid absorption and uptake of nutrients by soil particles and microbes (Chamberlin et al. 1991). Detrimental changes in dissolved oxygen levels can occur during low flow periods from fine organic and inorganic sediment clogging spawning gravels or from decreased pool volume in aggraded channels (Chamberlin et al. 1991).

Trends. There are no indications of historic or future sources of chemical contamination in the Analysis Area watersheds. Atmospheric sources of chemical pollutants are not a major factor influencing water quality in the region. Water quality sampling in the nearby Kennel Creek watershed in a harvest unit that was broadcast burned showed small changes in water quality parameters before and after disturbance (Stednick et al. 1982). Therefore, it is unlikely that the minor soil disturbance that resulted from logging activities in the Analysis Area watersheds (Paustian 1987) could have resulted in measurable changes in dissolved water quality constituents.

Stream Temperature. Water temperature is a principal factor influencing aquatic organism growth and propagation. State water quality regulations set average high temperature standards of 13°C for spawning areas and 15°C for fish rearing areas. Maximum allowable stream temperature is 20°C. In the past, temperatures were recorded for monitoring studies in the Kadashan River and Indian River watersheds.

Stream temperatures at Indian River were collected on the main valley bottom channels and on a large tributary channel to establish representative daily and seasonal stream temperature patterns. Temperature data for the MM 1 tributary stream were collected for about one year before and one year after clearcut harvest of the riparian timber stand (1978 to 1980). Two monitoring stations were measured: a control station upstream from the harvest unit and a downstream station located within the unit just above the confluence with the main stem of Indian River. Observed temperature difference between the two stations was a maximum of 4°C for short periods of the day during July and August. No discernible change in winter stream temperature was observed during November and December following timber harvest. Maximum observed temperature in the clearcut MM1 stream reach was 14°C, well below the 20° maximum temperature standard for salmonid habitat. Temperatures recorded for the main stem of Indian River in 1988 and 1989 (Killinger 1994) revealed mean daily temperatures of between -0.5°C in winter and early spring to a maximum of 12°C in midsummer. The maximum two-hour summer temperature observed in 1988 and 1989 was 14°C on July 12, 1989. Temperatures recorded for the upper Kadashan River in 1991 and 1992 revealed mean daily temperatures of between 0.0°C in winter and early spring to a maximum of 12.5°C in midsummer. The maximum summer temperature observed was 13.5°C.

Daily water temperatures (usually taken at 0900 hours) from the outlet of Sitkoh Lake when a weir was in operation (June 16 to September 4, 1982), ranged between 10° and

19°C. Existing temperature data indicate that stream temperatures within the Analysis Area likely meet current State water quality temperature standards.

Management Effects on Stream Temperature. Cumulative temperature changes from riparian harvest can affect fish productivity. For example, elevated winter and spring temperatures in coastal watersheds can promote early emigration of salmon parr (Killinger 1994) and may result in increased mortality to juvenile salmon when insufficient food sources are available in estuaries (Hartmann 1988). High summer temperatures, many adult fish, and low water levels can combine to cause lethal depletion of dissolved oxygen (Murphy 1985). Canopy removal along streams in northern latitudes can influence the formation of anchor ice and ice jams that can negatively affect overwinter rearing habitat and scour spawning beds (Hicks et al. 1991).

Opening the riparian canopy also can be beneficial to stream productivity at least in the short term. Increased primary production from more sunlight and warmer water temperatures can boost juvenile salmon production and growth rates (Killinger 1994, Hicks et al. 1991). However, dense alder and second-growth conifer regeneration following clearcutting in riparian areas can greatly diminish the amount of sunlight reaching small forested streams over a period of 20 to 50 years following harvest. Colder stream temperatures and decreased food supplies under this condition can result in slower growth rates for juvenile salmonids.

Stream Temperature Trends. Stream temperature data from Indian River indicate that summer stream temperatures increased from 1° to 4°C in some tributaries and portions of main stem channels where the adjacent riparian timber was clearcut. Changes in winter temperatures are probably minor due to the insulating effect of persistent winter snowpacks in the watersheds. Summer temperature increases observed immediately after streamside harvesting likely had a net beneficial effect on salmonid rearing habitat (Hartmann 1988). Approximately 10 to 20 years after harvest, however, canopy closure by dense second-growth riparian timber will substantially reduce sunlight to the channels, resulting in lower summer temperatures and decreased food sources that may decrease stream productivity.

The proportion of clearcut harvest within 100 feet of streams in the Analysis Area can be used as a relative index of cumulative sunlight and temperature changes associated with second-growth riparian stand development. Miles of clearcut harvest by stream class, process group, and watershed for the Analysis Area are summarized in Tables 4-19 and 4-20. This index of past riparian harvest identifies watersheds most likely to have experienced stream temperature changes and to experience future temperature changes. Generally, the False Island Creek, Kook Creek, Muri Creek, Sitkoh River and Sitkoh Creek valley bottom streams have the greatest chance of cumulative temperature change due to a high percentage of clearcuts within riparian areas and along stream channels. Monitoring of stream temperatures in these watersheds is recommended to determine how past harvest activities may impact stream temperatures.

Erosion and Sediment Delivery

Sediment that reaches streams can harm water quality, fish habitat, channel stability, and channel structure. Increases in fine sediment delivered to streams can reduce viability of eggs and emerging fry in spawning gravels (Hicks et al. 1991). However, it is difficult to show effects of temporary increases in sedimentation on salmonids. While localized effects of road construction on sediment delivery can be quantified, it is difficult to detect changes from low-intensity disturbances in large watersheds (Paustian 1987). The Washington Forest Practices Board (1994) suggests that increases in fine sediment yields of 100% or more are needed before measurable changes in fish habitat conditions become evident. Therefore, much of our assessment of impact from past human disturbance is subjective.

Sediment production, transport, and delivery interact to control sediment levels in streams. Transport of sediment to streams is determined by the type of erosion process and its proximity to a stream. The dense vegetation and organic mat which covers most of the mineral soil in Southeast Alaska prevents surface erosion from occurring over large areas. Therefore, transport of sediment to streams in Southeast Alaska typically comes from landslides and surface erosion from old slides and areas disturbed by human activity (Swanston 1969). Following is a discussion of potential erosion sources based on a landslide inventory, an inventory of high hazard soils, and an assessment of the level of human disturbance from road construction and timber harvesting.

Landslides. Swanston (1969) counted more than 3,800 landslides which occurred in the last 150 years in Southeast Alaska. Most slides occur on steep slopes and when heavy rainfall has saturated the soil. In addition, wind associated with these storms can blow down trees, which may help trigger slope failures. Regrowth of vegetation masks older slides from identification on aerial photos; however, they can be discerned from soil profiles and shallow linear depressions on slopes.

Landslides typically begin on open slopes and are a mixture of rock, soil, and vegetation. Swanston and Marion (1991) observed that only about 3% of all landslides reached fish streams. In most of these cases, only a relatively small amount of fine sediment reaches the stream. However, if this mixture reaches a headwater channel (Class III and IV streams) where enough water has concentrated, it can become a fast-moving debris torrent, which can scour the channel and move a large amount of sediment and woody debris. If this debris torrent reaches a main stream channel, it can create local accumulations of sediment and large woody debris and cause the bedload to shift.

Table 4-19. Stream Riparian Zone influenced by existing roads and harvest units.

Watershed	Total Riparian Zone*	Road acres in Riparian Zone	Harvest unit acres in Riparian Zone	Total Road + Harvest Acres	Percent of Total Riparian Zone
Little Seal	283	0	0	0	0
Inbetween	267	2.4	12	14	5
Saltery	1,540	0	17	17	1
West Crab	859	0	0	0	0
Crab	899	4.3	45	50	6
Fog	492	6.5	48	54	11
Kadashan	2,271	3.7	19	23	1
West Kadashan	516	0	19	19	4
Corner	603	19	82	102	17
Muri	180	6.4	39	46	25
Trap	287	0	0	0	0
Buckhorn	649	7.4	57	64	10
Whale	174	7.1	18	25	14
Kook	1,213	31	241	272	22
Basket	893	0	0	0	0
Little Basket	247	0.4	3	3	1
White Rock	727	23	96	118	16
Sitkoh River	1,602	40	370	410	26
Sitkoh Creek	979	28	196	224	23
Oly Creek	308	10	36	47	15
False Island	643	29	292	321	50
Broad	917	0	0	0	0
Broad Finger	605	0	15	15	2
Finger	428	0	15	15	4
Little Finger	161	0	0	0	0
Pinky	257	0	0	0	0
All others	3,687	37	374	411	11
TOTALS	21,686	255	1,993	2,249	10

*****Stream Riparian Zones include Class I, II, and III channels.

Using aerial photos taken in 1976 and 1977, Swanston and Marion (1991) mapped all slides in Southeast Alaska greater than 77 m^3 (100 m^3) and measured their width, length, initiation elevation, and average depth. They also mapped slides on aerial photos taken 14 years earlier in 1962 and 1963. From these two data sets, they were able to determine the total number of slides and also the number of slides that occurred in the 14 years between the two photo sets. We have a subset of the data for the Analysis Area, with which we can compare landslide occurrence in the Analysis Area to the rest of Southeast Alaska. A total of 180 slides were mapped in the Analysis Area, 98 of which occurred in the 14-year period between 1962 and 1976. Figure 4-26 shows the landslides in the Analysis Area.

Table 4-20. Stream Class and Process Group Stream Miles Adjacent to Harvest Units.

Watershed	Stream miles (by class) adjacent to or within harvest units*			Stream miles (by process group) adjacent to or within harvest units*		
	Class I	Class II	Class III	Transport	Transitional	Deposi-tional
Little Seal	0	0	0	0	0	0
Inbetween	0.2 (6%)	0.4 (16%)	0.4 (9%)	0.7 (11%)	0.1 (4%)	0
Saltery	0.8 (4%)	0	0	0	0.4 (8%)	0.4 (3%)
West Crab	0	0	0	0	0	0
Crab	1.8 (19%)	0	0.6 (4%)	0.6 (3%)	0	1.8 (23%)
Fog	0.7 (9%)	0.2 (13%)	1.5 (17%)	1.6 (11%)	0.4 (33%)	0.5 (18%)
Kadashan	0.8 (2%)	0	0	0	0	0.8 (4%)
W. Kadashan	0.6 (7%)	0	0	0	0	0.6 (12%)
Corner	2.4 (25%)	0.5 (14%)	1.1 (15%)	1.2 (10%)	0.4 (31%)	2.5 (38%)
Muri	1.1 (46%)	0.2 (14%)	0.2 (7%)	0.4 (10%)	0.4 (24%)	0.7 (99%)
Trap	0	0	0	0	0	0
Buckhorn	1.3 (15%)	1.2 (24%)	0.7 (8%)	1.7 (13%)	0.9 (32%)	0.7 (11%)
Whale	0.5 (24%)	0.3 (19%)	0.2 (7%)	0.4 (10%)	0.6 (25%)	0
Kook	6.2 (44%)	3.4 (31%)	2.5 (14%)	4.8 (19%)	3.2 (41%)	4.2 (40%)
Basket	0	0	0	0	0	0
Little Basket	0	0.3 (8%)	0	0.3 (4%)	0	0
White Rock	1.4 (14%)	2.2 (25%)	0.6 (15%)	0.7 (8%)	1.8 (47%)	1.6 (17%)
Sitkoh River	9.0 (36%)	2.2 (20%)	1.7 (10%)	2.6 (9%)	2.4 (55%)	8.1 (46%)
Sitkoh Creek	3.6 (29%)	2.8 (26%)	3.0 (19%)	4.6 (16%)	3.1 (60%)	1.7 (45%)
Oly	1.0 (31%)	0.7 (20%)	0.8 (14%)	1.0 (10%)	1.4 (52%)	0
False Island	5.7 (86%)	4.1 (45%)	1.4 (16%)	3.0 (20%)	5.3 (80%)	2.8 (97%)
Broad	0	0	0	0	0	0
Broad Finger	0.4 (6%)	0	0	0	0	0.4 (13%)
Finger	0.6 (12%)	0	0	0	0	0.6 (40%)
Little Finger	0	0	0	0	0	0
Pinky	0	0	0	0	0	0
All others	6.1 (29%)	7.3 (17%)	4.7 (6%)	6.9 (6%)	7.2 (41%)	4.2 (40%)
TOTALS	44.2 (18%)	25.8 (12%)	19.4 (6%)	30.5 (6%)	27.6 (27%)	31.6 (21%)

***Harvest unit influence = 100 ft. This includes all streams that are within 100 feet of harvest units.

The rate of sediment production from these slides is approximately 4.4 $m^3/km^2/yr$, compared to a rate of 0.9 $m^3/km^2/yr$ for Southeast Alaska as a whole. Steep ground, especially in the western portion of the Analysis Area, probably contributes to the higher rate of natural landslides relative to the rest of Southeast Alaska. Four of the 98 slides reached streams, which is close to the 3% average for all of Southeast Alaska. On managed ground, eleven additional slides occurred, nine in clearcuts and two along roads; the rate of slides in managed ground is 1.8 $m^3/km^2/yr$, compared to 1.7 $m^3/km^2/yr$ for all of Southeast Alaska.

Slope, elevation, and aspect influence the location of landslides:

- Slope, which controls the amount of gravitational force, is the strongest factor influencing slides. Over 90% of all landslides occur on slopes greater than 50% (Figure 4-24).
- Over 75% of the slides occur on south, southeast, and east aspects. These aspects tend to be most exposed to large storms and, therefore, may receive more rainfall and wind than other aspects, which could help to trigger slides (Figure 4-25).
- Ninety percent of the slides occur in the elevation band between 700 and 1,900 feet. The steep mountain and hill slopes tend to occur in this elevation. Much of the lower areas are alluvial fans, flood plains, and footslopes, which are generally stable.

Soil type also influences landslide occurrence. The soils in the Analysis Area are mapped and described in the Chatham Area Integrated Resource Inventory (USDA 1986). In order to describe their relative instability, soils are grouped into mass movement hazard categories: MMHAZ 1 (low), MMHAZ 2 (moderate), MMHAZ 3 (high), and MMHAZ 4 (extreme). The categories are based on a number of factors which influence landslides, including slope, landform, parent material, and drainage. Forty percent of the Analysis Area is rated as either high or extreme. Of the 98 landslides that occurred between 1962 and 1976, 41 percent occurred in MMHAZ 4 areas, 44 percent in MMHAZ 3 areas, and 15 percent in MMHAZ 1 and 2 areas.

In order to assess risk of sediment transport as well as sediment production, we have developed sediment source areas (SSAs). They are a combination of high and extreme mass movement hazard soils and landform types with high drainage densities. These landform types can rapidly transport sediment from a mountain slope where a slide might occur to a stream system where the it could harm water quality and aquatic habitat. The SSAs include nearly all MMHAZ 4 ground and some MMHAZ 3 ground. (For detailed description of their definition see Appendix F.) Seventy-nine percent of the landslides occurred in SSAs. Figure 4-26 shows the distribution of SSAs throughout the Analysis Area. Table 4-21 lists the extent of each key watershed that is a SSA. Kook, False Island, Sitkoh Creek, Little Finger, and Pinky watersheds have the highest percentages of SSAs, reflecting that a relatively large portion of these watersheds has the potential to produce and transport sediment to streams.

Management Disturbances. Road construction and timber harvest are the two most significant human disturbances that have occurred in these watersheds. Eight percent of the Analysis Area has been harvested, and 197 miles of permanent road have been constructed in it. As shown in Tables 4-19 and 4-20, 20 of the 26 key watersheds have had at least some road construction or timber harvest in them. However, only 16 have had a substantial amount of activity. Eleven watersheds have the most disturbance: Fog, Corner, Muri, Buckhorn, Whale, Kook, White Rock, Sitkoh River, Sitkoh Creek, Oly and False Island watersheds. All have more than 10% of their total area harvested, substantial harvest along streams, and road densities greater than 0.6 mi/mi^2.

These activities can increase surface erosion by removing the vegetation cover, disturbing the surface soil layers, and creating new erosional surfaces such as roads and road banks.

Increases in fine sediment delivered to streams from these sources can reduce viability of eggs and emerging fry in spawning gravels (Hicks et al. 1991). However, it is difficult to show effects of temporary increases in sedimentation on salmonids. While localized effects of road construction on sediment delivery can be quantified, it is difficult to detect changes from low intensity disturbances in large watersheds (Paustian 1987).

Logging activities can increase sedimentation to streams by increasing landslide rates and causing accelerated surface erosion. Both roading and and yarding can increase the risk of landslides. Road cuts can destabilize slopes above, while road fill adds weight to the slope below (Furniss et al. 1991). Most of the existing road systems in the Analysis Area are concentrated in the valley bottoms on gentle slopes, where they are unlikely to trigger slides or cause accelerated surface erosion. However, several slides have been triggered by road construction on steep slopes. Yarding trees can tear roots, which reduces their strength and, after timber harvest, tree roots decay and no longer help stabilize the soil (Chamberlin et al. 1991). Five to seven years after harvest, root strength is at its lowest point; roots from the young growth have not made up for the decayed root systems of the harvested trees.

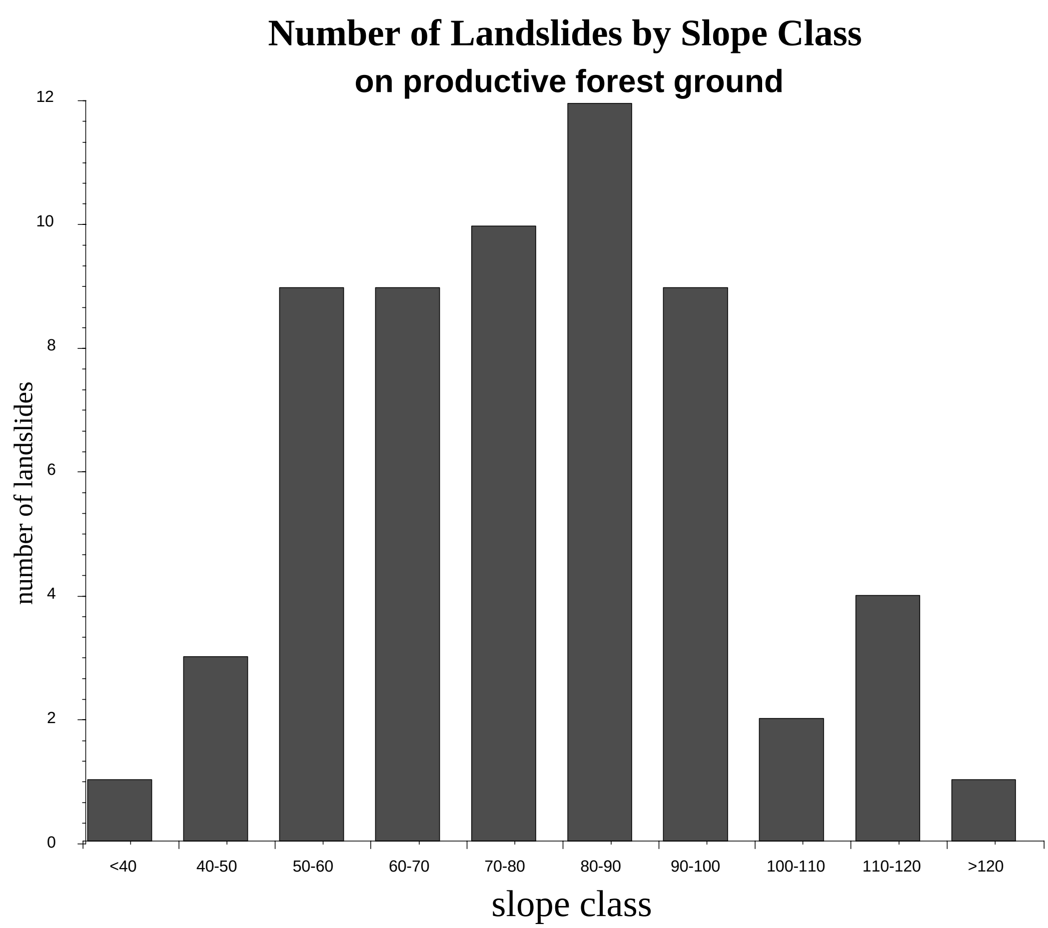


Figure 4-24. Distribution of the initiation point of landslides on productive ground by slope class for the Analysis Area.

The Washington Forest Practices Board (1994) suggests that increases in fine sediment yields of 100% or more are needed before measurable changes in fish habitat conditions become evident.

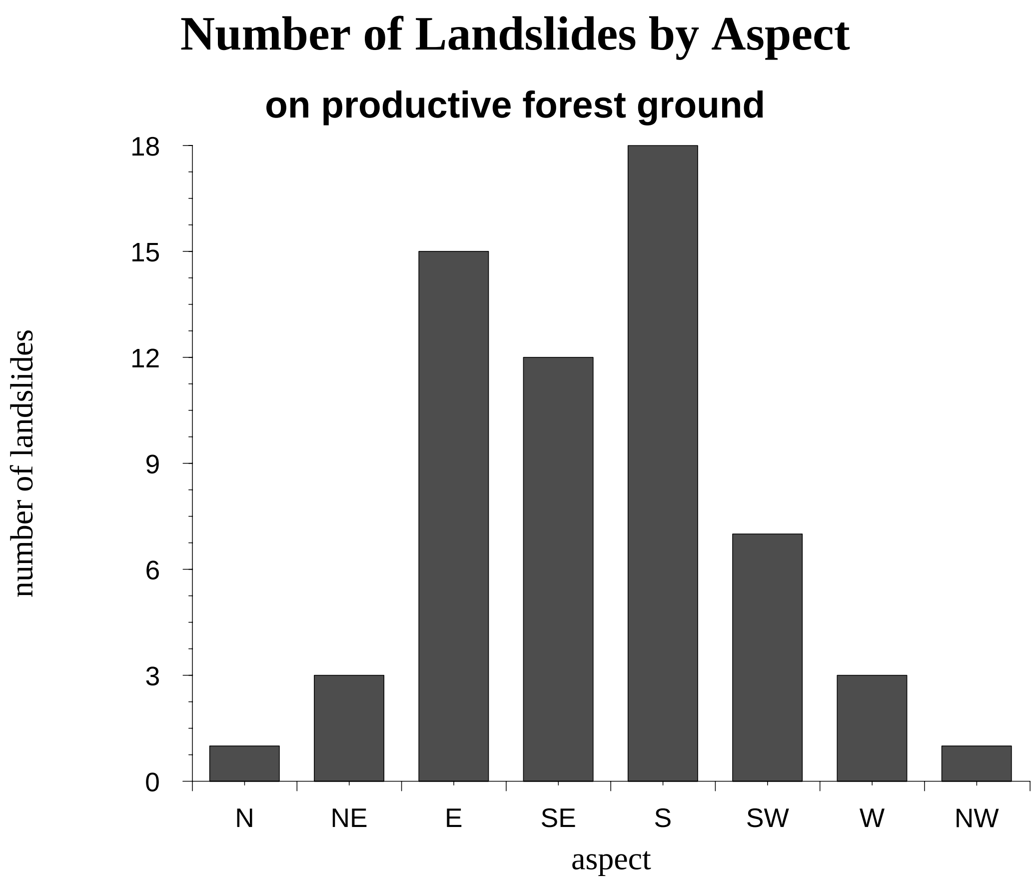


Figure 4-25. The distribution of landslides by aspect on productive forest ground for the Analysis Area.

Table 4-21. Areas and amounts by watershed of high hazard soils (MMHAZ 3 & 4), harvest areas, and natural landslides.

		SSA		Harvest Area		Road	# slides/
Name	Code	Acres	Percent	Acres	Percent	Miles	1000 acres
Little Seal	G51	1,085	30%	0	0%	0.0	0.82
Inbetween	G53	1,185	41%	240	8%	3.8	0.68
Saltery	G61	5,535	38%	54	0%	0.0	0.28
West Crab	G71	2,665	35%	1	0%	0.0	0.00
Crab	G81	3,162	36%	245	3%	2.8	0.45
Fog	H11	1,598	31%	498	10%	5.1	0.39
Kadashan	H21	8,726	34%	74	0%	4.4	0.78
West Tonalite	H22	1,054	15%	71	1%	0.0	1.01
Corner	H31	1,665	23%	1,780	25%	14.6	0.42
Muri	H32	793	36%	373	17%	3.6	0.45
Trap	H41	1,111	31%	0	0%	0.0	0.00
Buckhorn	H51	2,641	42%	670	11%	9.2	0.32
Whale	H54	780	39%	215	11%	3.4	0.50
Kook	H61	7,062	46%	2,481	18%	18.6	0.81
Basket	H71	2,809	31%	0	0%	0.0	0.33
Little Basket	H81	1,696	46%	60	2%	0.5	0.27
White Rock	H91	2,958	33%	1,547	17%	17.7	0.22
Sitkoh River	I21	5,156	30%	2,960	17%	29.4	1.12
Sitkoh Creek	I31	3,723	46%	2,272	19%	19.0	0.17
Oly Creek	I51	1,502	39%	578	15%	4.8	0.78
False Island	I56	4,289	54%	1,705	22%	9.0	0.63
Broad	I61	4,268	40%	0	0%	0.0	0.66
Broad Finger	I62	1,934	38%	29	1%	0.0	0.20
Finger	I71	1,951	41%	43	1%	0.0	0.63
Little Finger	I72	1,164	46%	0	0%	0.0	0.40
Pinky	I82	1,348	46%	0	0%	0.0	0.00
Other Watersheds	n/a	21,508	35%	4,873	8%	51.1	0.81
Total	**n/a**	**103,032**	**40%**	**20,771**	**8%**	**197**	**0.60**

Forest roads are the most significant source of surface erosion caused by human activities. Roads and road building can increase surface erosion by removing the vegetation cover, disturbing the surface soil layers, and creating new erosional surfaces such as roads and road banks. Road drainage structures that have failed or are in poor condition can cause the roads to erode in several ways: (1) plugged culverts can cause water to run over the road, (2) culverts with perched outlets cause fill slope erosion, and (3) the lack of a culvert where one is needed causes water to run over the road. A survey of road drainage structures completed for a portion of Chichagof Island includes the Corner Bay road system, which is in the Analysis Area. Paustian et al. (1995) found that for all culvert sizes, 75% to 90% were in fair or good condition (little or no blockage). About 5% had completely failed, and 22% (18-inch culverts) to 43% (culverts greater than 60 inches) had perched outlets. Over 60% of the 18-inch culverts needed some basin cleaning or debris removal. With their decreased capacity, they are more likely to cause

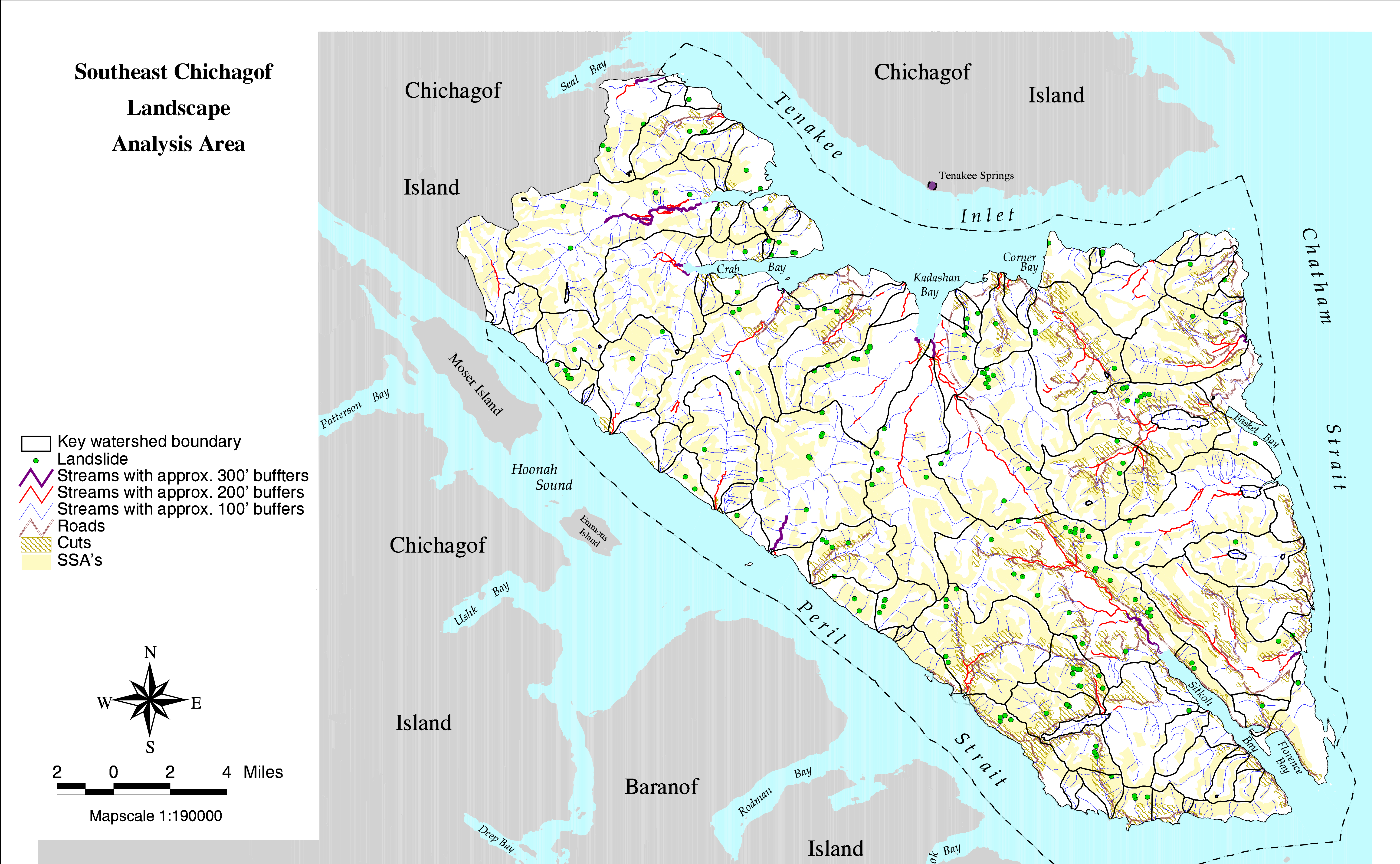


Figure 4-26. Riparian Management Areas

water to cause water to back up and flow over the road. The report concludes that the current condition of drainage structures is generally good. However, proper road maintenance and good road design, as specified in the TLMP revision (USFS, 1997) and current Best Management Practices (USFS, 1996), can reduce road-related drainage problems.

A study of sediment yield at nearby Indian River found that between 1977 and 1981 there was no significant difference between sediment/streamflow relationships from the pre-logging and post-logging periods (Paustian 1987). Timber harvest activities had no measurable effects on turbidity or fine sediment concentrations in Indian River. Observations of erosion sources in some of the Analysis Area watersheds indicate that general turbidity and fine sediment levels have and currently meet State water quality standards. Possible exceptions to this general observation include localized, short-term sedimentation associated with construction of road drainage structures, minor road washouts, and some small-scale landslide events.

Riparian Vegetation

Disturbance patterns and soil moisture adjacent to streams and lakes create unique riparian vegetation types. The streams and vegetation influence each other. During high flows, streams disturb soils and vegetation, creating opportunities for early successional species such as alder to grow and persist. In addition, soil moisture, which ranges from wet to dry, influences species composition and growth rates (Malanson 1993). The vegetation, in turn, contributes to fisheries habitat by stabilizing river banks; partially controlling sediment entry into streams; providing shade, temperature control, and cover; and contributing organic material (woody debris, leaf litter input, insects) to the channel.

As described above, we classify streams into different process groups which reflect the interaction of watershed runoff, landform, geology, climate, and glacial and tidal influences (USFS, 1992). These process groups each interact with the adjacent vegetation in different ways. The process groups in the project area include the following:

- **Contained Channels.** This consists of the high gradient (HC), moderate gradient (MC), and large contained (LC) process groups which are well contained by material from adjacent landforms (e.g. bedrock). Adjacent soils are usually well drained, and disturbance is infrequent and close to the stream. Broken, narrow bands of nonforested riparian vegetation occur along these contained channels. Common species include the following: Sitka alder (*Alnus sinuata),* devil's club (*Oplopanax horridum),* stink currant (*Ribes bracteosum),* and oak fern (*Gymnocarpium dryopteris).* Typically a western hemlock/blueberry plant association occurs farther from the stream and continues to the crest of the steep bank and defines the riparian habitat. The understory vegetation immediately adjacent to streams is probably flooded at least once a year, whereas flooding farther upslope is less frequent. The vegetation helps to stabilize the banks but contributes very little to stream structure.
- **Flood Plain Channels.** This consists of flood plain (FP) process groups, which includes lowland and valley bottom streams that commonly flood the banks, disturbing the adjacent vegetation and saturating the soil. In the most highly disturbed areas, the following riparian species are present: red alder, devil's club, stink currant, oak fern, red alder (*Alnus rubra),* salmonberry (*Rubus spectabilis),* lady fern

(*Athyrium filix-femina),* cow parsnip (*Heracleum lanatum),* and horsetail (*Equisetum arvense*), shrubs, and herbs that can withstand longer periods of inundation and the rigors of scouring and abrasion (Malanson 1993). Sitka spruce plant associations, such as Sitka spruce/devil's club and Sitka spruce/blueberry, occur farther from the river on slightly raised terraces. Large trees within the floodplain help stabilize the stream channel and, as they die, provide large woody debris to the channel, creating structure and helping to store bedload sediment.

- **Alluvial Fan Channels.** The alluvial fan (AF) process group occurs on footslope landforms between mountainslopes and valley floodplains and is strongly influenced by deposition. As the high-energy mountain streams slow down on the footslopes, they deposit gravel, forming alluvial fans. The streams are dynamic, multi-branched channels that periodically change course within the landform. They are poorly contained and meander, disturbing vegetation throughout the fan. The vegetation consists primarily of western hemlock/devil's club and Sitka spruce/devil's club forest types. Large trees within the alluvial fan stabilize the stream channel and, as they die, provide large woody debris to the channel, creating structure and helping to store bedload sediment.
- **Mixed Control Channels.** This process group consists of moderate gradient channels (MM) with banks consisting of large boulder and bedrock, which limit channel migration. Unlike contained channels, however, the stream occasionally floods over the banks, disturbing and saturation the adjacent areas. Western hemlock and Sitka spruce plant associations are dominant. However, red alder persists where flooding occurs. Large trees help stabilize channel banks and, as they die, provide large woody debris to the channel, creating structure and helping to store bedload sediment.
- **Palustrine Channels.** The palustrine (PA) process group consists of very low gradient streams associated with flat wetland landforms. Water movement and sediment transport is slow, and channel banks are typically stable. Adjacent vegetation typically consist of forest vegetation with more extensive areas of wetland vegetation. Some of these channels have forested and nonforested bogs along their margins, while others have calcareous fens or marshes. The marshes have developed from beaver activity.
- **Estuarine Channels.** The estuarine (ES) process group consists of streams influenced by tidal action. Saltwater inundation influences stream flow, channel structure, sediment transport, and water chemistry. Associated vegetation includes saltwater marshes, meadows, mudflats, and gravel deltas.

Riparian conditions and influences gradually decrease away from the stream, making riparian areas difficult to define by a discrete line. We used average widths determined for watershed analyses on nearby northeast Chichagof Island, where the widths of the riparian zones were calibrated from riparian vegetation and slope data collected in 55 field transects on a selection of channel type segments (USDA 1996). The farthest edge of the riparian zone was determined using differences in the plant associations, major slope breaks, and landform. Average widths of the riparian vegetation by channel types common to the Analysis Area are as follows:

	used in this doc.	**TLMP ’97**
• Wide flood plain channels	283 feet	337 feet
• Moderate-width flood plain channels	170 feet	195 feet
• Narrow flood plain channels	155 feet	165 feet
• Palustrine channel	102 feet	107 feet
• Large contained channels	101 feet	128 feet
• Moderate-width mixed control channels	101 feet	143 feet
• Moderate-width contained channels	90 feet	115 feet

Based on these average widths for different channel types, riparian acres encompass 21,686 acres or 8.3% of the Analysis Area. The distribution of the riparian conservation areas in the Analysis Area is shown in Figure 4-26. Buffer widths applied during a project will be based on the TLMP 1997 standards and guidelines (listed above) and information gathered in site specific field reviews; consequently, they will vary from the average widths used in this document.

Natural Disturbance in Riparian Areas. In addition to disturbance caused by flooding, wind also affects riparian areas. Small-scale windthrow is the most important natural disturbance factor in the Tongass (DeMeo et al. 1992). Ott (1995) found that canopy gaps occupy about 9% of old-growth western hemlock/blueberry/shield fern communities. Most of these were less than 540 ft^2 (50 m^2) and formed by three or fewer trees.

Harvest and Roads in Stream Riparian Zones. Of the 21,686 acres of riparian zones, 2,245 acres (1,993 units, 255 roads) have been harvested (Table 4-19). Total harvest acres equal 10% of the stream riparian area in the Analysis Area.

Loss of forested riparian vegetation along streams from timber harvest and roads reduces bank stability, temperature moderation, overhanging bank cover, input of leaf litter and terrestrial insects to the channel, and input of large woody debris (LWD) (Hicks et al. 1991). These changes, along with the possibility of increased sediment inputs, can reduce the amount and quality of fish rearing and spawning habitat. Loss of riparian vegetation associated with blowdown along existing units and roads initially may provide high levels of LWD into streams, but can destabilize banks and eliminate future sources of large wood. Watersheds with extensive wetlands adjacent to streams have fewer forested riparian areas to provide LWD. These watersheds may be especially vulnerable to a reduction of forested riparian vegetation.

Eight of the 26 key watersheds have ≥ 15% of the associated riparian areas harvested, including harvest along main valley bottom channels (Table 4-19). The most extensive streamside harvest and possibly most significant cumulative effects to fish habitat occurred along Class I streams in the False Island, Kook, Muri, Sitkoh River, Oly and Sitkoh Creek watersheds, where harvest occurred along more than 25% of the length of Class I streams (Table 4-19). In addition, there has been harvest along the banks of Class III streams which directly influence downstream Class I and II channels. The loss of these streamside riparian trees will decrease future LWD input into these streams for many years. The condition of streams in these watersheds will decline as instream woody debris and streamside stumps decompose and are washed out of the system. As dense second-growth riparian vegetation matures, it will shade the smaller stream channels, thereby reducing the input of solar radiation and potentially lowering stream temperatures during the summer. This can reduce fish growth rates. All these effects along with increased sediment inputs can reduce both the amount and quality of fish-rearing habitat. This will have the greatest impact on species such as coho salmon and Dolly Varden char, which spend a considerable portion of their life cycles rearing in streams. Future planning should include using available stream survey information or completing additional stream surveys to assess the current condition and trends of key stream habitat within the most impacted watersheds.

Wetlands

Wide areas of forested and nonforested peatlands occur on the marine silt and glacial till deposits on flat to gently sloping areas. Well represented are the shorepine/crowberry poor fens (*Pinus contorta/Empetrum nigrum),* tufted clubrush/peatmoss bogs (*Scirpus caespitosum/Sphagnum),* often called muskegs, and some of the forested wetlands in the mixed conifer series.

Groundwater chemistry helps explain the distribution of wetlands in the Analysis Area. Bogs are wetlands where peat accumulation has separated the bog surface from groundwater (e.g., domed bog). They receive their mineral supply solely from atmospheric precipitation (National Wetlands Working Group 1988). In contrast, rich fens are areas of sedge peat accumulation with slow internal drainage. The soils are primarily organic (Histosols) with three to six feet of sedge peat accumulation The slow-moving water is enriched by nutrients from upslope materials. Thus, fens are more mineral-rich than bogs. The vegetation generally reflects the water quality and quantity, resulting in sedge and grass fens (without trees or shrubs), shrub fens, and treed fens (National Wetlands Working Group 1988). Poor fens are intermediate between bogs and rich fens.

We do not have a complete inventory of the wetlands in the Analysis Area, and National Wetland Inventory Maps (USFWS) are not yet available. We are, however, able to derive approximate wetland maps from our soil and vegetation maps. Bogs and poor fens are distributed throughout the Analysis Area. There are substantial rich fen areas with associated palustrine stream channels in the following watersheds: Little Seal, Saltery, West Crab, Crab, Kadashan, West Kadashan, White Rock, Sitkoh River, Sitkoh Creek, Broad, and Broad Finger. Some bogs and fens have been roaded in the Corner, Kook, White Rock, Sitkoh River, Sitkoh Creek, and False Island watersheds. At the Project level we will map significant or unique wetlands, such as fens.

Interactions between hydrology, water chemistry, and biota make the recharge/discharge function perhaps the most difficult wetland function to evaluate (Siegel 1988). Future management should maintain the runoff storage and contribution function of the Project Area wetlands. As *receptor* wetlands, fens are continuously transporting nutrients and oxygenated groundwater, maintaining higher levels of primary productivity than bogs (Brinson 1993). Fens have a high groundwater discharge from upslope footslope/alluvial fan complexes. During fall peak rainfall, however, wetland soils may not contribute to flood storage, since they typically are saturated (Ford and Bedford 1987).

As *donor* wetlands, fens function as suppliers of water and dilute nutrients to downstream ecosystems (Brinson 1988). High hydraulic conductivity in fens results in greater contribution to stream baseflow relative to bogs. The baseflow contributed by bogs is limited due to fine pore soils with very low lateral hydraulic conductivity (Verry and Boelter 1978).

Fens, especially those formed because of beaver activity, typically contain many small fish-rearing channels. Beaver activity has created ponds, flat terraced sedge-dominated meadows, and generally a more complex mosaic of fish and wildlife habitats along valley bottom main streams. Nesting geese and trumpeter swans *(Olor buccinator)*, and other waterfowl and bird species use the pond areas. The extensive meadow areas also provide habitat for brown bear (*Ursus arctos)* and Sitka black-tailed deer. In the spring, small channels coming out of the bogs are often used by juvenile anadromous fish for thermal cover, as the main channel water is colder due to snowmelt runoff.

Aquatic Species and Habitat

The key watersheds in the Analysis Area contain 249 miles (31%) of Class I streams, 210 miles (26%) of Class II streams, and 349 miles (43%) of Class III streams (Table 4-17). The estuary (ES4), flood plain (FP3, FP4, FP5), and low gradient contained channels (LC1 and LC2), contain most of the critical stream habitat for pink, chum, and coho salmon, steelhead trout, Dolly Varden char and sculpin. Where accessible, these low gradient channels provide much of the available spawning habitat for all fish species present. These channels, along with associated secondary channels and smaller flood-plain channels, provide abundant rearing habitat for juvenile coho salmon, steelhead and cutthroat trout, and Dolly Varden char. The accessible lakes in the Kook Creek, Basket Creek, and Sitkoh Creek watersheds provide rearing habitat for juvenile sockeye salmon.

Very low gradient, palustrine (PA0, PA1, and PA2) channels, sloughs and associated beaver ponds occur within some of the Analysis Area watersheds. Primarily associated with fens, PA channels and beaver pond areas are characterized by organic sediments, abundant deep pool and glide area with cover and spring-fed tributaries. The PA channels and beaver ponds provide high quality rearing and limited spawning habitat for coho salmon, Dolly Varden char and cutthroat.

The highly productive estuary channels (ES) provide high quality spawning habitat for pink and chum salmon and provide important rearing habitat for many salmonids during at least part of their life cycle. In addition, all fish species use the accessible habitat in the moderate gradient channels (MM1, MM2, MC1, MC2, AF1, and AF2). These channels contain low to moderate amounts of spawning and rearing habitat. The stronger swimming coho salmon, cutthroat trout, and char make most use of the habitat in these channels.

For more detail on stream classes, refer to USFS Aquatic Habitat Management Handbook, 1986. Channel types are extensively defined in the Region 10 Channel Type User Guide (April 1992). See Appendix F for more detailed descriptions of habitat capability, escapement trends and conditions, and potential disturbances to fish habitat and populations.

Fish Escapement Condition and Trends. Salmon escapement is the number of adult salmon returning to a stream or lake system during any given year. Weir data are much more reliable than peak, one-day aerial or foot escapement counts, but weir data are available only for a few streams in the Analysis Area. Although they are not good estimates of complete escapement, foot and aerial stream surveys provide a relative index of year-to-year variability in salmon escapement numbers. Allowing for annual fluctuations in adult escapement, available stream escapement surveys indicate most salmon stocks are healthy, with some large returns of pink and chum salmon throughout the Analysis Area in recent years.

An assessment of Southeast Alaska salmon stocks was recently completed by Halupka et al. (1995). They reviewed all available information on the biological characteristics and population status of anadromous salmon in Southeast Alaska. Within the Analysis Area, there were adequate survey data to estimate escapement trends for 21 pink, 13 chum, and one sockeye salmon system. For the stocks with available survey data, eight pink streams showed increasing escapement trends, two chum stocks (Crab Bay and Inbetween) showed declining escapement trends, and Sitkoh Lake sockeye showed a declining escapement trend. Most chum salmon escapement surveys are completed coincidentally during pink salmon surveys, and surveys are usually not completed during the peak timing of the chum run. Therefore, chum data should be interpreted cautiously. Kadashan is the exception, with good data for chum escapement indicating a stable system. Although sockeye escapements at Sitkoh Lake may be depressed from historical levels, the declining trend should be interpreted cautiously since data quality is poor.

Escapement data are not available to track population trends for coho salmon, Dolly Varden char, steelhead and cutthroat trout. These species are most dependent on good-quality stream rearing habitat. Therefore, we used stream habitat condition (based on existing harvest and roading impacts to riparian and sensitive soil areas) within each watershed as an indicator of current and future fish stock health for these species.

Biological Diversity (Fish). The highest natural diversity of salmonid species occurs in the lower stream reaches of the Analysis Area. During at least part of the year, the lower reaches of many of the larger streams contain juvenile or adult pink, chum, coho and sockeye salmon (in a few streams), steelhead trout, cutthroat trout and Dolly Varden char (resident and anadromous), and coastal sculpin. Several salt-tolerant species may use the estuary channels. Genetic diversity within species is also provided by straying adult and juvenile fish from nearby streams and from resident populations upstream.

Key Fish Populations. Summary information for the key fish-producing watersheds is listed in Table 4-22. This includes estimated fish-producing capability for just the indicator species - pink and coho salmon - and identification of any key subsistence or sport fisheries. Along with trout and Dolly Varden char, most of these watersheds also produce chum salmon on a relative but smaller scale than their estimated pink production. Although many of these streams produce substantial numbers of fish, the streams which are the highest producers of pink and coho salmon include Saltery, Crab, Kadashan, Corner, Buckhorn, Kook, Basket, White Rock, Sitkoh River, and Sitkoh Creek.

Table 4-22. Lake area, fish species, habitat capability for pink & coho salmon, peak escapement counts, and important subsistence or sport fisheries in Analysis Area streams.

Watershed	ADF&G Stream Number	Lake Acres	Species Present	Pink Salmon Annual Adult Capability	Pink Salmon Actual Peak Count	Coho Annual Adult Capabil.	Key Subs/ Sport Fish
Little Seal	112-45-360	0	P,Ch,C,D	22,000	25,000	450	
Inbetween	112-45-320	0	P,Ch,C,D	18,000	6,500	380	
Saltery	112-44-100	0	P,Ch,C,D	250,000	80,000	2,200	
West Crab	112-43-100	0	P,Ch,C,D	40,000	23,000	840	
Crab	112-43-020	0	P,Ch,C,D	60,000	22,000	1,300	
Fog	112-42-320	0	P,Ch,C,D	38,000	12,000	880	
Kadashan	112-42-250	0	P,Ch,C,D,Sh	190,000	280,000**w**	4,000	Sh
W. Kadash.	112-42-280	0	P,Ch,C,D	24,000	1,900	660	
Corner	112-42-160	10	P,Ch,C,D,Ct	50,000	50,000	1,100	
Muri	112-42-200	0	P,Ch,C,D	16,000	NA	280	
Trap	112-41-100	0	P,Ch,C,D	24,000	13,000	450	
Buckhorn	112-12-340	0	P,Ch,C,D	64,000	54,000	1,100	
Whale	112-41-360	0	P,Ch,C,D	5,400**B**	NA	120**B**	
Kook	112-12-250	600	P,Ch,C,D,S, Sh, Ct	110,000	31,000	1,900	S,Ct
Basket	112-12-160	180	P,Ch,C,D,S	33,000	3,100	1,300	S
Little Bask.	112-12-120	104	?	6,000**B**	2,500	140**B**	?
White Rock	112-12-050	0	P,Ch,C,D	90,000	54,000	1,800	
Sitkoh R.	113-59-070 113-59-060	0	P,Ch,C,D,Ct	190,000	82,000	3,000	
Sitkoh Ck.	113-59-040	550	P,Ch,C,D,S, Sh, Ct	46,000	79,000**w**	1,100	S,Sh, Ct
Oly	113-51-020	0	P,Ch,C,D	6,400	18,000	170	
False Is.	113-51-040	0	P,Ch,C,D	46,000	32,000	780	
Broad	113-51-010	0	P,Ch,C,D,Ct	74,000**B**	40,000	870**B**	
Broad Fing.	113-55-050	0	P,Ch,C,D,Ct	32,000**B**	26,000	730**B**	
Finger	113-55-010	0	P,Ch,C,D	22,000	25,000	430	
Little Fing.	113-58-110	0	P,Ch,C,D	3,600	4,000	69	
Pinky	113-58-090	0	P,Ch,C,D	22,000**B**	NA	370**B**	
All others	NA	NA	NA	30,000**B**	NA	1,000**B**	
TOTALS	NA	NA	NA	1,510,000		27,400	

Estimated annual production for pink and coho salmon based on stream channel type capabilities (Appendix F), assuming all fish-producing channels are accessible to anadromous fish, but not including lake habitat. Pink salmon calculated by multiplying the number of smolts (based on channel type capability) by 0.024 (average survival rate from smolt to adult). Coho calculated by multiplying the number of smolts (based on channel type capability) by 0.10 (average survival rate from smolt to adult).
"Actual Peak Count" is the highest number counted in the stream/lake during a one-day escapement count in any census year; or the total count through a seasonal weir (if noted with "**w**"). Weir counts are more accurate than one-day peak escapement aerial or foot counts.
P = pink salmon, Ch = chum salmon, C = coho salmon, D = Dolly Varden char, Sh = steelhead, Ct = cutthroat trout, S = sockeye salmon. **B** = Barriers limit anadromous fish access in this watershed.
Many streams may have unverified populations of steelhead and cutthroat trout.

Lakes provide valuable rearing habitat for Dolly Varden char and trout, and those accessible from saltwater provide important rearing and overwintering habitat for sockeye and coho salmon, steelhead, and anadromous Dolly Varden char and trout. At Sitkoh Lake Creek, 48,252 Dolly Varden char and 3,955 cutthroat were counted passing a weir operated in 1996**.**

Modeled Fish Habitat Capability. (See Appendix F for detailed information on how the estimated fish producing capability was derived for the watersheds in Table 4-22.) There are not adequate and accurate enough fish escapement data available to compare potential fish production between all the Analysis Area watersheds. Therefore, to compare watershed productivity on a similar scale, we determined the pink and coho salmon estimated annual production capabilities for each watershed based on stream channel type capabilities.

Subsistence Fisheries. Residents of Tenakee Springs, Angoon, Hoonah and Sitka rely heavily on subsistence fishing, hunting and gathering and are the primary sport and subsistence users of aquatic resources in the area streams and bays. Fish caught for these purposes include coho, pink, chum, sockeye and chinook salmon, steelhead and cutthroat trout, and Dolly Varden char. Many of the Analysis Area watersheds and associated estuaries are key producers of salmon, trout and shellfish crab for subsistence use. The most recent ADF&G subsistence fish survey data for salmon and Dolly Varden char are summarized in Table 4-23. A survey completed in 1984 found that 88% of Tenakee residents used subsistence-caught fish, with an average use of 134 pounds per household or 67 pounds per person (ADF&G Technical Report Number 138). Sockeye salmon accounted for 64% of the fish, with most (32 permits) coming from Kook Lake Creek (Basket Bay). Juneau residents and visitors also utilize fishery resources in the Analysis Area. Juneau residents actually accounted for the highest number (969) of sockeye taken from Kook Lake in 1984.

Table 4-23. Subsistence fisheries data for Angoon, Hoonah, Sitka and Tenakee Springs.

Species	Angoon		Hoonah		Sitka		Tenakee Springs	
	#/capita	Total	#/capita	Total	#/capita	Total	#/capita	Total
coho	2.4	1,386	2.2	1,599	1.0	8,089	1.2	109
pink	2.2	1,243	1.2	892	1.3	10,388	2.9	278
chum	1.1	643	3.2	2,317	0.3	2250	0.3	30
sockeye	2.7	1,518	1.2	842	1.6	12,648	4.3	405
chinook	1.6	892	1.8	1,306	1.3	10,252	1.2	113
DV char	1.2	692	2.3	1,699	2.1	16,760	3.7	355

*Data are from 1987 survey for Sitka, average of 1987 and 1984 survey for Angoon and Tenakee Springs, and average of 1987 and 1985 survey for Hoonah (ADF&G Community Profile Database 1993). Community populations for surveys were as follows: Angoon 1984 = 622 people, 1987 = 521 people; Hoonah 1985 = 758 people, 1987 = 700 people; Sitka 1987 = 8061 people; Tenakee Springs 1984 = 94 people, 1987 = 95 people.

Sockeye salmon from Kook Lake Creek (Basket Bay) and Sitkoh Lake Creek are important local stocks that are heavily used for subsistence fishing. Since 1975, the reported subsistence harvest has been as high as 4,756 sockeye salmon (288 permits) at Sitkoh Lake Creek and 3,056 sockeye salmon (303 permits) at Kook Lake Creek. There is a long history of use in both areas by Tlingit inhabitants, descendants of whom now reside principally in Sitka and Angoon. In addition to ongoing subsistence fishing, Sitkoh was the site of a commercial salmon fishery and cannery in the early to mid 1900s, with as high as 121,667 cases of canned salmon reportedly produced in 1917 (ADF&G Technical Report Number 174).

Both of the Sitkoh Creek and Kook Lake sockeye salmon stocks have been assessed or assumed to be in a declined state within the past decade or longer. It is difficult to pinpoint, but potential causes of lower sockeye escapements at these two watersheds are a combination of overfishing due to heavy and poorly managed subsistence and commercial harvest, and detrimental impacts to returning adult fish and spawning and rearing habitat from past management activities. The subsistence use at Sitkoh Creek has declined since 1984. The trend appears to be the result of declining fish runs. Sockeye salmon fishing at both Kook and Sitkoh Lakes has been closed several times within the past ten years due to low adult returns.

A lake enhancement feasibility study completed in 1992, and a follow-up two-year cooperative (ADF&G and Forest Service) investigation of the Kook Lake system in 1994 and 1995, found that the lake has adequate primary production and available forage for sockeye but lacks recruitment (production of juvenile sockeye) to use the available forage. Total adult sockeye salmon escapements were 1,817 and 5,817 for weirs operated in 1994 and 1995 respectively. The initial indications from this work are that the lake habitat quality (chemistry and primary production) is good, but there are not enough returning adult sockeye to seed the system to capacity. Bioenhancement should be investigated as a potential sockeye salmon rehabilitation method at Kook Lake.

A total escapement of 7,228 sockeye was counted through a weir operated at Sitkoh Creek in 1982. A higher return of 9,465 adult sockeye salmon passed through a counting weir operated in 1996 at Sitkoh Creek. Only an initial lake enhancement feasibility study, including water chemistry and primary production, was completed in 1992 at Sitkoh Lake. A more thorough investigation, similar to the one completed at Kook Lake, should be completed at Sitkoh Lake to help determine what factors may be limiting sockeye salmon numbers.

Sport Fisheries. Most of the larger Analysis Area streams that produce salmon and larger trout or char receive at least light sport fishing use. Much of this sport fishing is concentrated in estuary areas and bays near the stream mouths, or where existing roads provide access to streams and lakes. Some stream systems, however, receive substantially higher sport fishing pressure than most.

The Sitkoh Creek steelhead run also is well known for producing large steelhead and has received substantial sport fishing pressure in recent times. Creel census data for 1976, 1978 and 1982 show that 111, 150 and 119 anglers respectively caught 98, 70 and 348 steelhead (Schmidt 1992). Although there are few good estimates of escapement, foot surveys indicated that the number of returning steelhead declined during the late 1980s and early 1990s, as it did for many streams throughout Southeast Alaska. For this reason, steelhead fishing has been restricted at the stream in recent years, including being completely closed to harvest several years. However, a weir operated in 1996 counted

926 returning adult steelhead, the second highest number ever counted and the most since a weir count of 1,108 in 1937. Other fish counted at the weir in 1996 include totals of 9,465 sockeye salmon, 78,978 pink salmon, 1,100 chum salmon, 48,252 Dolly Varden char and 3,955 cutthroat. These numbers emphasize the importance of this lake system for many fish species. There is also a popular sport fishery for cutthroat trout and Dolly Varden char at Sitkoh Lake.

Kook Creek also is a popular cutthroat trout sport fishery, and there is a recreation cabin located on the lake. Additionally, some of the larger streams, including Kadashan River, provide quality steelhead fishing to area residents and visitors.

Cumulative Impacts on Stream Habitat

Stream Channel Morphology and Fish Habitat. As discussed in the Riparian Vegetation section, effects of timber harvest on streams from landslides, loss of instream woody debris (existing and future supplies), and related impacts can have serious long-term impacts to stream productivity. Previous timber harvest activities were concentrated in riparian areas along the banks of Class I and II streams within the False Island, Sitkoh River, Sitkoh Creek, Kook Creek, Muri Creek and Oly Creek watersheds (see earlier sections).

The scope of this landscape analysis does not allow us to complete in-depth sampling and analysis of specific stream reaches. Instead, we used cumulative information on management activities, including timber harvest activities in stream riparian and high hazard soil areas, fish capabilities and values, and a Watershed Risk Index (WRI) to provide a general summary of condition and vulnerability for each key watershed**.**

Watershed Risk Assessment. We used a prototype model developed by Geier (1996) to identify watersheds with high potential for transporting sediment to sensitive fish habitat. The process ranks watersheds based on fish habitat and geomorphic characteristics. Steep watersheds with sensitive fish habitat would receive a higher ranking than a less steep watershed with little sensitive fish habitat. Sensitive habitat is defined as depositional and mixed channel types (see Table 4-24), since these types retain and can be altered by sediment. Geomorphic characteristics are defined by overall steepness of the watershed and the amount of high and extreme mass movement hazard soils within it. The final watershed risk index is the product of the fish habitat index and geomorphic indices and is scaled to a unitless number between 0 and 10. The watershed with the highest rating is given a value of 10, and all others are scaled to this maximum. Table 4-24 shows the WRI scores for the key watersheds.

Watersheds with a high WRI have a relatively large amount of high and extreme mass movement hazard soils and a substantial amount of channel types susceptible to damage from sediment. Of the 26 key watersheds, 15 have a WRI greater than 7, indicating a relatively high risk of damage from sediment. Six watersheds have the highest risk, with WRI values greater than 8. While many of the steep watersheds have high potential for sediment production, they also have the ability to flush out, rather than accumulate, sediment. For example, Finger Creek has one of the highest sediment delivery indices but has a low fish habitat index. Therefore the combined index, the WRI, is only moderately high at 7.8.

Watershed Condition and Vulnerability. We used the WRI and several other indicators to decide which watersheds are in poor condition or are most vulnerable to future disturbance. By identifying these watersheds, we can adjust our future projects to help protect them and/or plan rehabilitation projects to help reduce conditions which limit fish populations or other aspects of aquatic health. For each key watershed, Table 4-24 lists the WRI, the Fish Habitat Capabilities, whether or not a key subsistence or sport fish population is present, and the level of human disturbance. As discussed previously and shown in Table 4-20, eleven watersheds have a high level of past harvest and/or road construction. Using the information in the first four columns, we assigned an overall level of concern in the final column, with a rating of low, moderate or high (Table 4-24).

The ratings presented in this table simplify the information presented throughout the Riparian and Aquatic Habitat section. The ratings are presented here as a general assessment of the values and concerns for watersheds within the planning area. These are relative ratings based on the other watersheds in this planning area. Generally, our overall concerns are high for watersheds with some combination of moderate to high levels of roading and overall watershed harvest, especially in stream riparian areas and along Class I and II fish streams; moderate to high fish production capability; and presence of major subsistence or sport fisheries. A high watershed risk index rating further increased our overall concerns. We use these ratings in two ways: (1) to make recommendations for future timber harvest and roading activities in watersheds with high ratings, and (2) to make recommendations for current and future watershed rehabilitation activities (see Chapter 6).

Table 4-24. Summary of Condition and Vulnerability for Key Watersheds.

Watershed	Watershed Risk Index	Fish Habitat Capability* Pink	Fish Habitat Capability* Coho	Major Sport or Subsistence Fisheries@	Level of Human Disturbance~	**Overall Concern**
Little Seal	5.5	L	L	N	L	L
Inbetween	6.7	L	L	N	M	L
Saltery	10	H	H	N	L	L/M
West Crab	8.1	M	M	N	L	L
Crab	7.9	M	H	N	M	M
Fog	6.5	M	M	N	M	M
Kadashan	6.8	H	H	Y	L	L/M
West Kadashan	4.7	L	M	N	L	L
Corner	6.5	M	H	N	H	M/H
Muri	7.4	L	L	N	H	M
Trap	6.5	L	L	N	L	L
Buckhorn	9.2	M	H	N	H	M
Whale	7.0	L	L	N	H	L
Kook	7.7	H	H	Y	H	H
Basket	8.1	M	H	Y	L	M
Little Basket	7.2	L	L	N	L	L
White Rock	7.2	H	H	N	H	M
Sitkoh River	9.4	H	H	N	H	H
Sitkoh Creek	6.6	M	H	Y	H	H
Oly Creek	6.7	L	L	N	H	M
False Island	9.1	M	M	N	H	H
Broad	6.8	M	M	N	L	L
Broad Finger	8.0	M	M	N	L	L
Finger	7.8	L	L	N	L	L
Little Finger	7.2	L	L	N	L	L
Pinky	7.5	L	L	N	L	L

***** Fish Habitat Capabilities for pink and coho salmon were given a relative rating (L = low, M = moderate, H = high) based on these estimated stream habitat capabilities for adult fish: Pink salmon: L ≤25,000, M = 25,000 to 75,000, H ≥75,000; Coho salmon: L ≤500, M = 500 to 1,000, H ≥1,000.

@ Many of these watersheds receive some level of targeted sport or subsistence fishing. Ones designated as major sport/subsistence fisheries have a combination of relatively large salmon/steelhead runs or resident trout populations and documented significant subsistence and/or sport use.

~ Level of human disturbance was a relative rating (L = low, M = moderate, H = high) based on: % of total area harvest, amount of roading, % of riparian area harvested, and amount of harvest along streambanks.

Human Use

The disciplines of cultural anthropology, ethnography, archeology and history can shed some light on past human use, especially the nature use and extent of impacts on the landscape. This section expands on the Human Use introduced in Chapter 2 in order to examine how "we" as humans interact with the landscape, how we affect landscape processes and how we relate to the landscape on a social level. It includes discussions of prehistoric/historic use, current use (subsistence and recreation), and the social "values" associated with these current uses and commodity values. Our efforts began with a literature review which consolidates information from many primary and secondary sources, identified areas of research interest, and conducted limited field surveys (Muenster et al. 1996).

Prehistoric and Historic Use

There are 49 archeological sites in the Analysis Area; 21 prehistoric, 22 historic, and 6 prehistoric/historic (Table 4-25). Research during the past two decades has focused on archeological site identification and protection; measures required of a Federal agency by the National Historic Preservation Act. However, more research and detailed archeological excavations are essential to understanding past human use. Due to limited research on southeast Chichagof Island, the human past of the Analysis Area needs to be considered within the larger framework of Southeast Alaska. Human history in Southeast Alaska is delineated into two major periods: the prehistoric (before 1741 A.D.) and the historic (after 1741 A.D.). Our knowledge of the prehistoric inhabitants of comes from Native oral traditions and archeological investigations. Our knowledge of the historic inhabitants of the Analysis Area comes from records kept by early explorers and Anglo settlers, early ethnographical studies, archeological investigations, and agency archives. Using the human use "issues" described in Chapter 2 as guidelines, we researched the topic of prehistoric and historic human use in the Analysis Area.

Prehistoric Chronology and Sites. The human history of Southeast Alaska spans the last 10,000 years. Davis (1990:197-202) proposes a three-part chronological sequence for Southeast Alaska. The first part, the Paleomarine Tradition, began during the Holocene and lasted until about 6,500 years ago and is characterized by a microblade and core technology. The Transitional Stage occurred between 6,500 and 5,000 years ago; during this era the micro lithic technology of the Paleomarine Tradition began to be replaced by the ground stone tool technology characteristic of the third stage, the Developmental Northwest Coast stage. This stage is subdivided into three phases: the Early Phase from 5,000 to 3,000 years before present, the Middle Phase from 3,000 to 1,000 years before present, and the Late Phase from 1,000 years before present to European contact.

During all periods, subsistence and travel focused on nearshore and littoral resources of this biologically rich region (Moss 1994). This conclusion is primarily based on the location of prehistoric sites, their artifact assemblages, and the marine fauna in their refuse. Regionally, populations seem to have expanded by 4,000 years ago based on the frequency of radiocarbon-dated sites.

Sometime before 3,000 years ago, area residents developed techniques for the mass harvest of salmon, enabling long-term storage of large quantities of this important staple food. By 1,000 years ago, populations had increased and signs of intraregional competition, in the form of fort sites, are present.

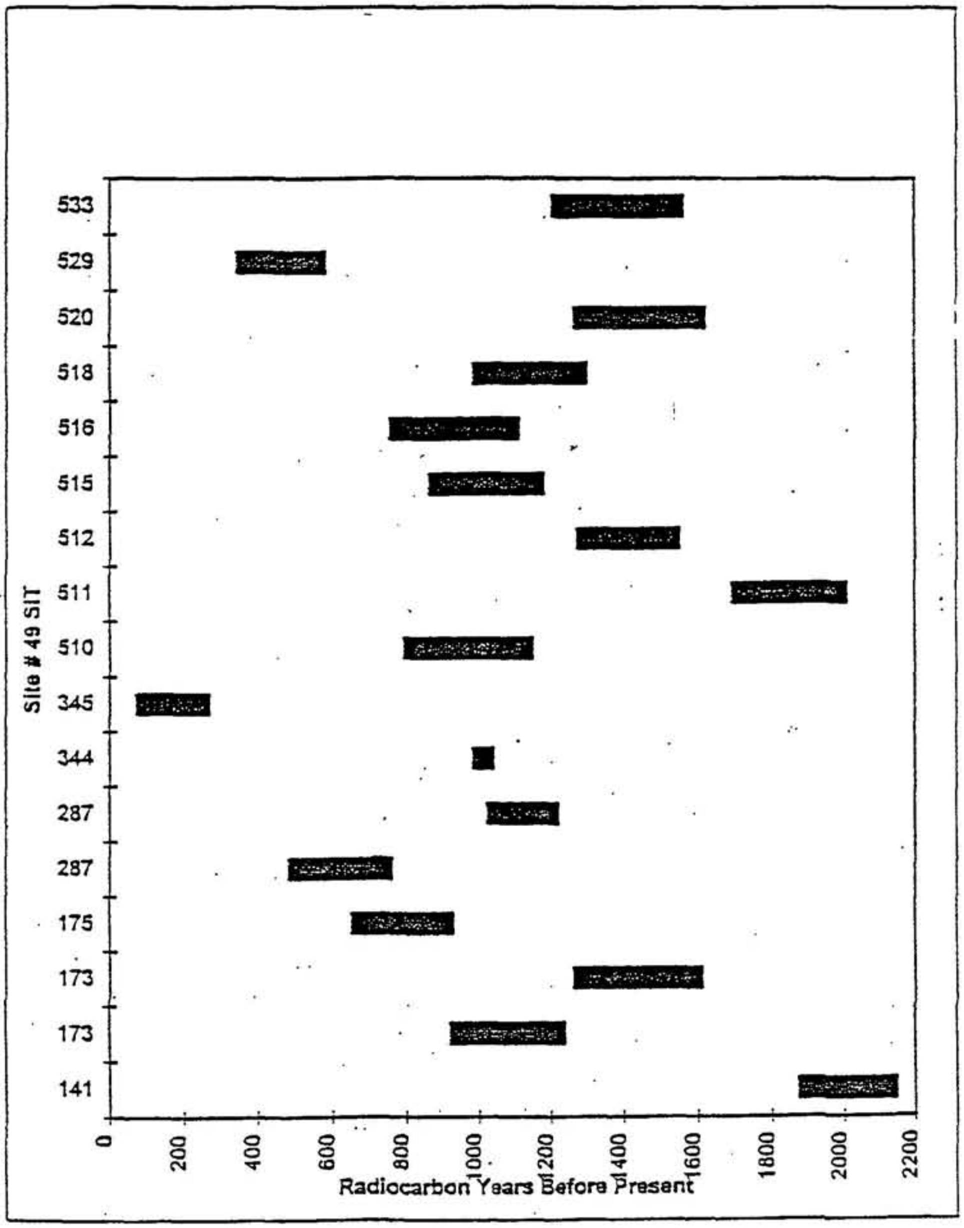
Table 4-25. Known Heritage Sites in the Analysis Area.

VCU	Historic sites	Prehistoric sites	Prehistoric/-Historic sites	Total sites
231	1	0	0	1
232	1	2	0	3
233	0	1	0	1
234	2	1	0	3
235	7	3	0	10
236	2	1	0	3
237	2	0	0	2
238	1	0	0	1
239	0	2	1	3
240	0	0	0	0
241	0	0	0	0
242	1	3	2	6
243	3	4	0	7
244	0	0	1	1
245	2	5	2	9
246	2	0	0	2
total	22	21	6	49

Information on the prehistoric occupation of the Analysis Area is limited. We can draw only limited conclusions on temporal and spatial scales, report the number of *known* prehistoric sites and do limited analysis, based on the results of radiocarbon dating.

There are 28 known prehistoric sites in the Analysis Area (4 villages, 2 forts, 3 petroglyphs, 19 subsistence sites or camps). Of the 19 subsistence sites, 16 are shell middens. Seventeen sites have had radiocarbon samples analyzed and four have had limited archeological testing. The earliest known human occupation in the Analysis Area is near False Island; this occupation, which dates to 5,390 ± years ago (C-13 adjusted radio carbon years - Beta sample #39319), falls within the Transitional Stage in Southeast Alaska prehistory. Radiocarbon samples from the majority of the other prehistoric sites in the Analysis Area fall between 1600 and 1000 years ago, during the Middle phase of the Developmental Northwest Coast stage. Figure 4-27 lists all archeological sites in the Analysis Area for which we have radiocarbon ages. This graph illustrates uncalibrated radiocarbon age at 2 sigma. This basically means that the age of the sample is likely to fall within the range of radiocarbon years indicated on the graph. The term "present" on this graph represents the year 1950. It is interesting to note that the sites for which we do have dates fit in well with the currently accepted cultural chronology for the region. For example, the two "fort" sites (40 SIT 173 and 516) date to less than 1,500 years ago (Beta sample numbers 38955, 38956, 38957 and 97688); a time period during which fortification sites are common.

Figure 4-27. Adjusted Age Ranges for Sites Less Than 2500 Years Old.



Ethnographic Data. Fortunately we also have ethnographic information for the Analysis Area which aids understanding both current and past use of the area. This area falls is near the north end of the Northwest Coast culture area, which extends from the Gulf of Alaska to northern California (Suttles 1991). Historically, Southeast Alaska has been occupied by the Tlingit, Alaskan Haida (Kaigani), Tsetsaut and Eyak. Of the four, the Tlingit have been dominant, controlling at one time or another the entire Southeast from north of Yakutat Bay to Dixon Entrance (Arndt et al. 1987). Both the Haida and the Tsetsaut live at the southern limits of the Tongass National Forest while the Tlingit occupy the islands and the mainland in and near the Analysis Area.

The Tlingit are divided into a series of community areas, each with its own internal integrity and recognized territory. In historic times these communities have consolidated into larger and more complex units. Most of the consolidation has been within the separate tribes of the Tlingit. In 1880 Petrov reported from two to eight separate villages for the Chilkat, Hoonah, Angoon, Kake, Auk, Taku, Stikine, Klawock, Sitka and Yakutat peoples. Despite the consolidations, the separate entities have remained highly constant through time (Goldschmidt and Haas 1946:5). A number of cultural anthropologists and ethnographers have studied Tlingit social structure and documented the early and present territorial claims of the Natives of southeastern Alaska. For example, in 1946 Dr. Walter R. Goldschmidt and Theodore H. Haas compiled a report to the Commissioner of Indian Affairs entitled Possessory Rights of the Native of Southeastern Alaska. Goldschmidt and Haas mapped and described historic and contemporary use areas.

The majority of the Analysis Area falls into the territory traditionally claimed by the Angoon Tlingit. Of the five clans within the Angoon Tlingit, three claim territorial rights in the Analysis Area. The Teokwedi Clan claims all of Peril Strait except for the larger bays north and south of the entrance, and the Decitan Clan claims Basket and Sitkoh Bays (Goldschmidt and Haas 1946:171). According to Goldschmidt and Haas, the Angoon community generally recognize that Tenakee Inlet belonged to the Wuckitan Clan, a group affiliated with the Angoon people but to some extent separate from them. According to a statement by Peter Tom, "Tenakee was formerly the area claimed by the Decitan Clan, but the right was transferred as a settlement for murder" (1946:117-122).[1]

When maps prepared by Goldschmidt and Haas are compared with current subsistence harvest (TRUCS 1987 and ADF&G Subsistence Division), it is apparent that hunting and fishing by Natives in Southeast Alaska is still tied to some extent to historical traditions. Despite the introduction of technological innovations (such as outboard motors) that enable residents of Native communities to travel farther, their use generally conforms to

[1]Frederica de Laguna, a cultural Anthropologist who worked in Southeast Alaska during 1949 and 1950, differs slightly in her interpretation of territorial claims along Chatham Strait and Tenakee Inlet. She states: "Goldschmidt and Haas were probably in error when they reported that False Bay, Freshwater Bay, and Tenakee Inlet on the east shore of Chichagof Island were originally claimed by the Angoon people but that they were later taken over by the Wuckitan, probably from Auke Village near Juneau. Rather, our informants said that this territory belonged to an independent division of the Wuckitan, the Freshwater Bay Branch, and it was the latter who inherited rights at Angoon when the Kootznahoo branch of this sib became extinct" (1960:60).

traditional clan land-use boundaries. The distribution of harvest locations for non-Native communities, on the other hand, is often apt to range over greater areas.

Through the accounts of explorers, the ethnographic records of individuals, such as Goldschmidt and Haas and Tlingit oral histories, we know that the Tlingit were a people of plenty who lived on the bounty of the sea and forests. They "subsisted" and flourished on the abundant shellfish, seaweed, salmon, herring, and animal life of the marine and intertidal environment as well as the greens, berries, hemlock cambium, and mammals of the terrestrial environment (Newton and Moss 1984).

They developed a stratified and complex culture using the spruce, cedar and hemlock forests for both utilitarian and artistic purposes. The Alaskan forests favored the development of woodworking crafts. Tlingit developed methods of using steam and fire to augment their advanced wood splitting and carving skills. Houses were large, rectangular, gable-roofed dwellings built of logs and split boards. Water travel, a necessity in the coastal region, was carried on in canoes shaped by fire and adze. They ranged from ten to twelve feet for river travel to war canoes fifty or sixty feet long. Bows and arrows, fish spears, pikes, and lances were made of wood, bone and stone. Household furnishings were usually carved of wood or woven from cedar bark. Spruce roots were used in basketry, and rain clothes and hats were made from cedar bark (Rakestraw 1994).

Indian artistic and ceremonial life included a sophisticated use of wood. Early collectors and ethnographers described elaborately carved "totem poles," intricately carved rattles, boxes, masks and other objects (Rakestraw 1994).

Historic Chronology and Sites. The historic period in Southeast Alaska began with the Russian discovery of Alaska in 1741. The history of Euro-American exploration and occupation of Southeast Alaska can be broken down into four major periods. These are: 1741-1799 early exploration and the maritime fur trade; 1799-1867 Russian-American Company management; 1867-1884 American military rule; and 1884-1958 development of the modern landscape (Arndt et al. 1987). Each period is briefly described below with the evidence we find of historic sites dating to the described periods within the Analysis Area. Twenty-eight of the archeological sites in the Analysis Area are classified as "historic" (Table 4-26).

Table 4-26. Historic Sites in the Analysis Area.

Site Type	Total
Salteries and Canneries	4
Cannery Storage Grounds	1
Fish Traps and Fish Trap Tender Cabins	2
Historic Logging Camps and Artifacts	3
Possible Finnish Settlement	1
Special Use Permit Cabins for Personal Use	8
Burials	3
Gardens	2
Villages	4

Source Muenster et al. 1997	Total	28

Early Exploration and the Maritime Fur Trade 1741-1799. This period begins with Vitus Bering's second Kamchatka Expedition, the first European voyage to touch Southeast Alaska, in July 1741. The voyage had profound consequences for the history of Southeast Alaska in terms of the maritime fur trade. The high prices paid for sea otter pelts by the Chinese and stories of the abundance of these animals on the newly discovered islands fired the Russian merchant community. Spain, Britain, America and France also conducted voyages of discovery in Southeast Alaska during this time. Their aims, much like the Russians, were to establish possessory rights, search for the fabled Northwest Passage, and assess the potential economic significance of the region. The publication of the narrative of British Capt. James Cook's voyage and several unpublished accounts brought this commercial opportunity to the attention of the merchants of western Europe and America and launched the maritime fur trade.

Occupation at two of the known historic sites within the Analysis Area began during this period. One (49 SIT 147) is known ethnographically to have been a Tlingit village and the other (49 SIT 345) is known only through the archeological record and appears to have been a Native subsistence site.

Russian-American Company Management 1799-1867. During this time, all of Alaska was in the nominal possession of the Russian-American Company, which held an imperially granted monopoly over its trade and resources. In July 1799, the company established a settlement near the present day location of Sitka, called St. Archangel Michael. The Tlingits attacked the settlement in 1802, reducing the post to ashes. The Russians returned in 1804 to retake Sitka from the Tlingits who, after days of being under siege, slipped away and abandoned their fort and adjacent area, leaving it to the Russians. After the Battle of Sitka, the Tlingits went to southern Chichagof Island.

There are three known village sites within the Analysis Area which date initially to this period; the site to which the Tlingit traveled following the Battle of 1804 is one of these.

American Military Rule 1867-1884. After Alaska was transferred to the United States, the American Military ruled the territory: the Army from 1867-1877 and the Navy from 1879-1884. It was during this period that the fishing, mining, timber, and tourism industries were beginning to become established in Southeast Alaska.

There are no known sites within the Analysis Area which clearly date to this period, although occupation at the four village sites established during the former two periods clearly continued during this period.

Development of the Modern Landscape 1884-1955. Throughout this period the economic development of Southeast Alaska continued. Fishing, mining, and the timber industry became the mainstays of the region. Small communities associated with these came and went, and the cultural landscape gradually took on its present character. Physical reminders of these industries, as well as government activity associated with the Forest Service, the Civilian Conservation Corps, and the military, are common throughout Southeast Alaska.

Twenty-three historic sites in the Analysis Area date to this period. The fishing industry is represented in the area by seven sites recorded as salteries, canneries, cannery storage grounds, fish traps, and trap cabins. Natives continued to live on the land during this period, occupying established village sites until as late as the 1950s. Two of the historic sites are recorded as burials. During this period agriculture and homesteading took off once the land was opened by the Forest Service in 1909 for homesteading. Ten historic sites including garden furrows, small clearings, cabin remains and other domestic structures, are reminders of these activities. There is one historic site--a corduroy road and camp--which is attributed to WWII activities. Finally, three of the historic sites our archeologists have documented are clearly attributable to historic timber harvest activity.

Of the four historic periods delineated by Arndt et al. and discussed above, it is the fourth during which humans have had the greatest impact upon the landscape. The commercial fishing industry had a clear impact upon the distribution of finfish resources within the Analysis Area. Unfortunately, we weren't able to explore these affects in any detail. Humans also have clearly had an impact on the landscape through timber harvest activities, which have intensified through time. The early logging era is represented in the Analysis Area by evidence of logging camps and artifacts as well as harvested areas. Comparing the distribution of historic sites to the distribution of known historic harvest units (harvested before 1956) shows a clear spatial relationship between the known historic sites in the Analysis Area and harvest units recorded by ADF&G (Figure 4-28). These relationships are seen clearly at Lindenberg Harbor, the site of a large cannery for 43 years (1913-1966), and at Chatham Cannery in Sitkoh Bay, reportedly in operation from 1901 to 1974.

The lives of the prehistoric and historic inhabitants of the area were tied to the marine and terrestrial resources of the region. Humans have been in the Analysis Area for at least 5,300 years; however, it has been only since the beginning of the 20th century that humans have had a measurable impact on the landscape.

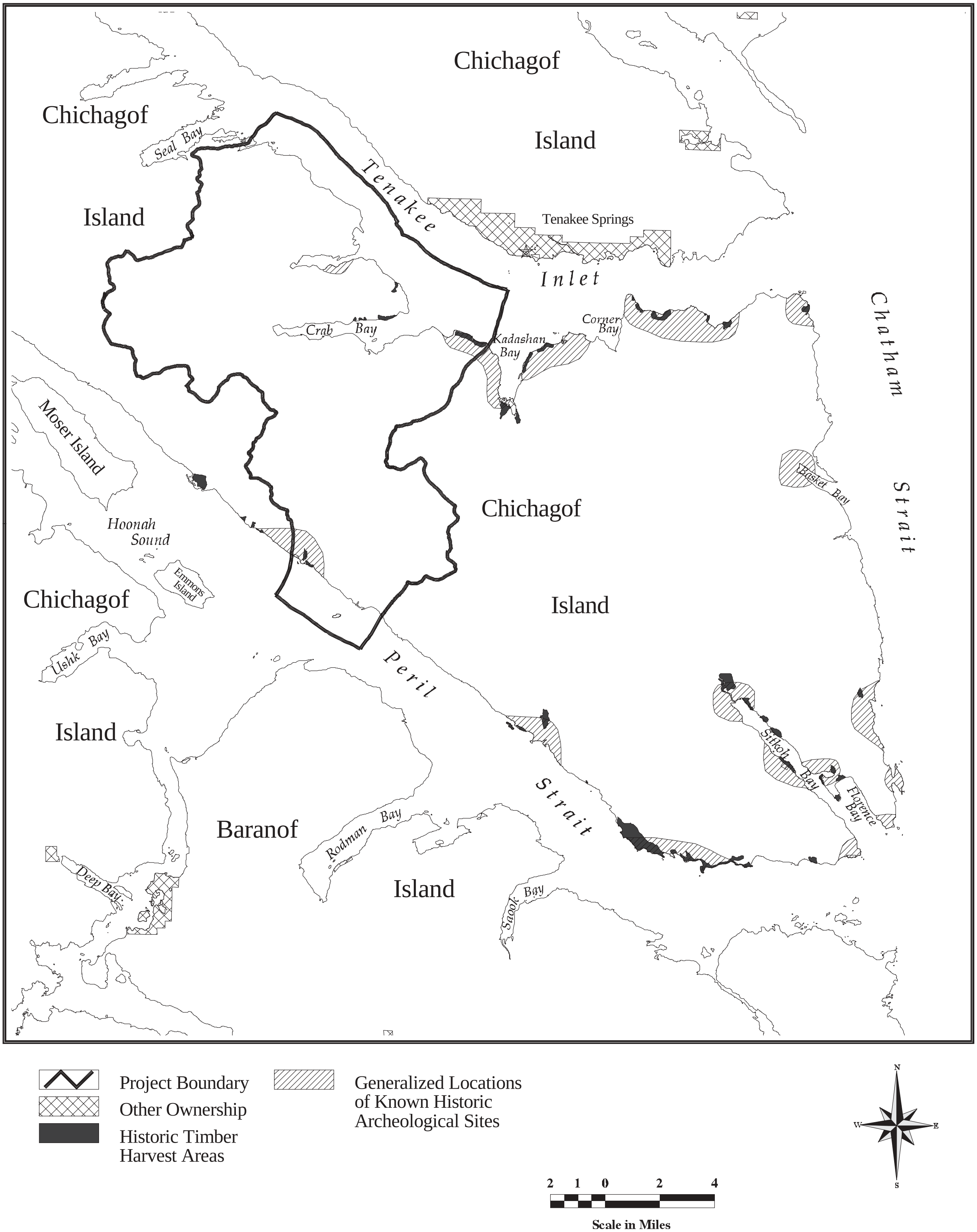
Current Use

Currently the Analysis Area is primarily utilized in three ways: subsistence, recreation, and timber extraction. A discussion of each use, the economic benefits, and conflicts is presented below.

Subsistence. Subsistence is a way of life for many rural Alaskans. By definition subsistence is:

> The customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of non-edible by-products of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade. (ANILCA, 16 USC 311)

Figure 4-28. Relationship Between Historic Archeological Sites and Historic Timber Harvest



Many rural residents have given eloquent testimony concerning the social and cultural significance of subsistence at hearings prior to Forest Service planned timber sales. We present the following two statements as examples :

> "The Chichagof and Baranof coastline represent a way of life to all of our Tlingit nation. The animals and berries we collect make me and my family healthy people" (STA 1996)
>
> "Subsistence hunting and fishing are really the very core of my life. I will defend my hunting and my fishing as dearly as I'll defend anything that matters to me in my life. It is the center of my existence. It's why I live here. Food is what connects me to this place. Food is what binds my heart and my soul to this place that's my home" (Nelson 1996).

The act of gathering subsistence resources is an important practice that reflects deeply held attitudes, values and beliefs. Some traditional foods are not available through any means other than subsistence and, often, the occasions for gathering wild foods and edible plants are social events. Historical patterns of movement, such as the annual cycle of dispersal into small family groups at summer fishing camps and then to larger gatherings at protected winter villages, are also linked to the tradition of subsistence gathering. In addition, sharing subsistence resources is important not only within households, but also with extended families and friends (including those households unable to harvest resources), and between communities.

Fish and game are widely preferred sources of food among Southeast Alaska households, regardless of household income. Average per capita income may or may not indicate the importance of subsistence to a community. While individuals of low income may have a greater dependence on subsistence gathering, individuals with a higher income may simply be in a position to have a more comfortable life-styles because they combine their subsistence activities with their ability to purchase goods. Higher income does not deter an individual from gathering resources and sharing those with friends and family (Kruse and Muth 1990).

Subsistence resources include deer, bear, marine mammals, birds, clams, fish and shellfish, marine invertebrates, furbearers, firewood, herring eggs, berries, and edible plants. Subsistence goods may be eaten, traded, given away, or made into an item of use or decoration. For example, the skins from brown bear or fur from the marten or sea otter may be used for regalia costumes used in ceremony and dance (Kruse and Muth 1990).

Table 4-27 summarizes some of the subsistence harvest data for those communities designated rural. Residents of Juneau and Ketchikan also utilize the region for sport hunting.

Table 4-27. Per capita subsistence harvest for rural communities using SELSA resources in 1987.

	Deer Harvest (lbs)	Other Mammals (lbs)	Salmon Harvest (lbs)	Finfish/ Shell fish(lbs)	Other Harvest (lbs)	Total Harvest (lbs)	Mean % Meat & Fish
Angoon	74	34	70	26	7	242	46
Haines	16	12	28	44	5	105	21
Hoonah	94	60	133	104	12	404	50
Myers Chuck	21	37	105	227	24	414	45
Petersburg	45	19	46	80	3	203	31
Sitka	38	2	38	56	5	139	24
Tenakee Springs	135	8	49	140	11	343	42
Wrangell	21	24	30	84	5	164	23

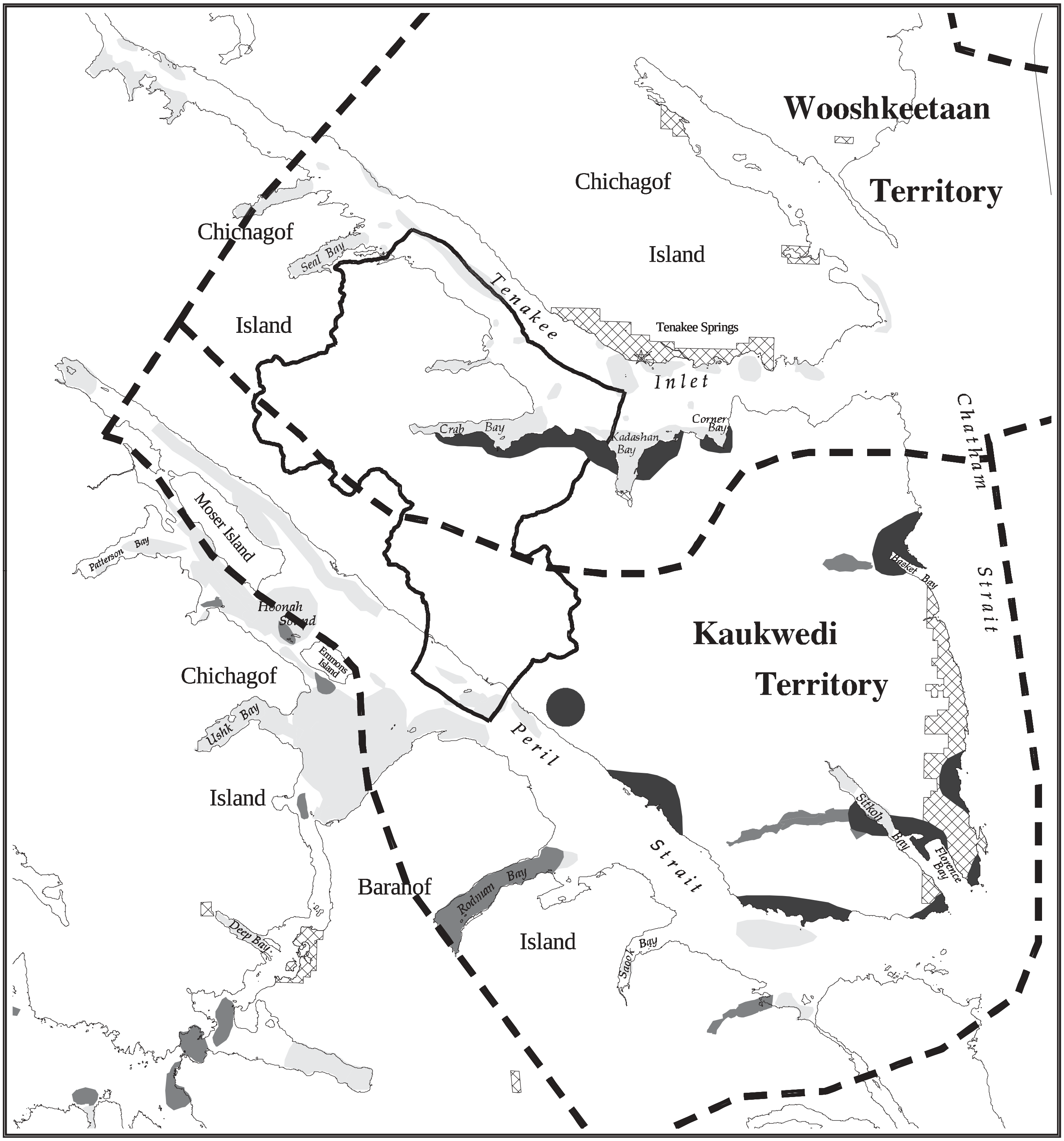
Source**:** ADF&G Division of Subsistence 1992.

In 1988, ADF&G gathered subsistence use data based on interviews with samples of households in 30 southeast communities (Tongass Resource Use Cooperative Surveys or TRUCS, Kruse & Frazier 1988). They mapped subsistence harvest locations by community for deer, marine animals, salmon and marine shellfish. All subsistence resources are important; however, in the following paragraphs we will comment on some observable, interesting patterns of use by all communities of marine shellfish, finfish and deer.

Marine Invertebrates and Finfish. As stated previously, patterns of current subsistence use are rooted in the cultural traditions of the modern Tlingit people. We know humans have used resources within the Analysis Area since as early as 5,300 years before today (see Prehistoric Occupations in Area). There is an observable spatial relationship between the distribution of prehistoric sites and the current marine invertebrate and finfish subsistence use patterns in the Analysis Area. Figure 4-29 shows the geographical extent of subsistence use in the Analysis Area for marine invertebrates and finfish (salmon) for the communities of Haines, Petersburg, Sitka and Tenakee Springs. TRUCS data for Angoon for marine invertebrates and salmon were not available in the Chatham Area Geographic Information System at the time of this analysis. Figure 4-29 illustrates that prehistoric inhabitants of the Analysis Area utilized many of the marine invertebrate and salmon resource areas that current subsistence practitioners use. Because information concerning the exact location of archeological sites is protected by law, we have shown only very generalized locations for single or groups of prehistoric sites on this figure.

Deer. As discussed in the section of this chapter on Wildlife Habitat, Sitka black-tailed deer receive the highest sport hunting and subsistence use of any terrestrial species in Southeast Alaska. Angoon, Haines, Petersburg, Sitka and Tenakee Springs identified important deer hunting areas extending from Long Bay in Tenakee Inlet on down to Sitkoh Bay in Chatham Strait. Long Bay, Seal Bay, Saltery Bay, Crab Bay, Kadashan Bay and Corner Bay have been identified as important deer hunting and shellfish gathering areas. Estuaries in these bays provide important habitat for waterfowl; the tidal flats provide important shellfish habitat; and the bays have salmon runs which contribute to the abundance of wildlife that utilize the estuaries. Basket Bay and Sitkoh Bay were identified as important for both deer hunting and subsistence harvest of sockeye salmon.

Figure 4-29. Relationship Between Prehistoric Archeological Sites, Territorial Boundaries and Subsistence Use



Project Boundary

Traditional Territorial Boundaries *

Other Ownership

Regional Subsistence Marine Invertebrate Harvest Areas **

Regional Subsistence Finfish Harvest Areas **

Generalized Locations of Known Prehistoric Archeological Sites

* Source: Goldschmidt and Hass, 1946

** Source: TRUCS 1988 and Chatham Area GIS

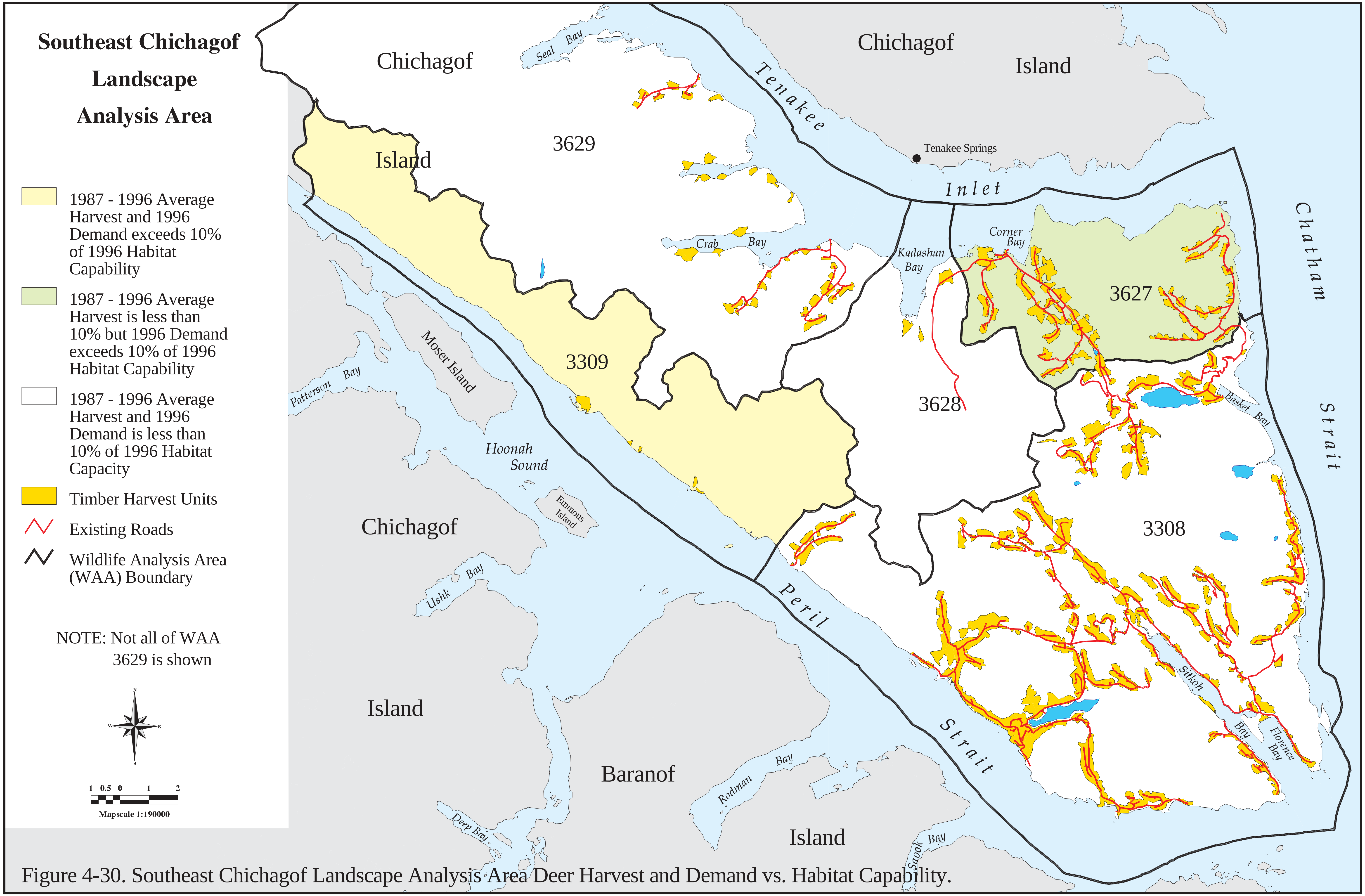


Figure 4-30. Southeast Chichagof Landscape Analysis Area Deer Harvest and Demand vs. Habitat Capability.

It is interesting to compare current deer harvest and demand with deer habitat capability in the Analysis Area. A full discussion of deer habitat capability is provided in the Wildlife Habitat portion of this chapter. ADF&G collects actual deer harvest data by community via annual harvest surveys. These surveys include both subsistence and sport hunting harvest. We calculated the mean actual harvest numbers over a nine-year period for deer and then represented them as a percentage of 1996 Habitat Capability for the Analysis Area (1987-1996 mean divided by 1996 habitat capability). ADF&G also compiles estimates of deer "demand" by community. Demand reflects the number of deer hunters would "like" to harvest in any given area; it is not a measure of hunter success. We have taken the ADF&G demand values for the Analysis Area for 1996 and represented them as a percentage of 1996 Habitat Capability (1996 demand divided by 1996 habitat capability. Table 4-28 illustrates these calculations and Figure 4-30 illustrates the data.

It shows that in Wildlife Analysis Area 3309 the average number of deer harvested during 1987-1996 and 1996 demand exceeds 10% of the 1996 deer habitat capability. ("WAA" -- Wildlife Analysis Area; a division of land used by Alaska Department of Fish and Game for wildlife analyses.) In Wildlife Analysis Area 3627, the average number of deer harvested during 1987-1996 was less than 10% of habitat capability but 1996 demand exceeded 10%. We use 10% as a delineator here because ADF&G has estimated that harvest of over 10% of deer habitat capability per year reduces the quality of the hunting experience. It is thought that harvest of over 20% of deer habitat capability may not be sustainable over time (Suring et al. 1993).

Table 4-28. 1996 Deer Habitat Capability vs. Actual Harvest Trends and 1996 Demand.*

WAA	Habitat Capability* 1997	Mean Deer Harvest (1987-96)	Demand for Deer in 1996	Harvest (87-96)** as a % of Habitat Capability	Demand** as % of Habitat Capability
3308	4,193	188	282	4	7
3309	1,286	155	124	12	10
3627	1,056	76	110	7	10
3628	1,320	33	66	3	5
3629	2,246	146	110	7	5
Total	10,101	599	693	6	7

WAA - Wildlife Analysis Area

*Source: Suring et al. 1993
**Source: ADF&G Deer Hunter Surveys -- 1987-1996

In addition to subsistence use, Table 4-29 is a summary of ADF&G deer harvest data for the Wildlife Analysis Areas (WAAs) which include the Landscape Analysis Area. Note that some of the WAAs extend beyond the boundaries of the Landscape Analysis Area. The greatest number of deer killed in the Analysis Area WAAs, for those years with available records, were during the 1987-88 hunting season. During this season deer harvest numbers were five times as high as the low, 1992-93, season. Hunting success can vary for a number of reasons. The major factor appears to be winter survival. Hard winters with low temperatures and heavy snows can increase winter mortality and reduce the number of deer available for hunters to harvest. Harvest numbers can also fluctuate due to variables such as additional road access, the closing of roads, and bad weather during hunting season, which inhibits hunter access (particularly by boat). Some weather conditions can also concentrate deer, making them easier to hunt.

Table 4-29. Wildlife Analysis Area deer harvest.**

Season	Hunters	Days hunted	Deer killed
95-96	273	926	488
94-95	393	1,769	681
93-94	260	871	389
92-93	160	569	211
91-92	375	1,396	586
90-91	356	1,148	767
89-90	*	1,139	661
88-89	*	1,400	761
87-88	*	2,150	1,055
Total	1,817	11,368	5,599
Average	303	1,263	622

** WAAs extend beyond the Analysis Area boundaries.

Source: derived from ADF&G deer harvest data

Recreation. Both water- and land-based recreation occurs in the Analysis Area; however, saltwater recreation and transportation accounts for the majority. A small number of people use float planes or helicopters to reach the Area. Activities include fishing, crabbing, shrimping, pleasure boating, and watching wildlife. The majority of overnight visitors stay aboard their boats; a few camp on National Forest System lands or stay in Forest Service public recreation cabins. Land-based recreation activities include hiking, hunting, stream and lake fishing, beachcombing, camping, and viewing wildlife. In addition, karst formations and caves are scattered along the eastern side of the Analysis Area. Most cave entrances are located at high elevations and are difficult to reach. Many of the cave shafts are narrow and run vertically, making exploration difficult. Several of the caves in these areas have been nominated as significant for protection under the Federal Cave Resources Protection Act of 1988. In order to protect this unique geologic feature, the Act provides that the location of caves be kept confidential. It is unlikely that recreation use of the caves and karst will increase beyond exploration by serious spelunkers with technical caving skills.

<u>Unguided Recreation Users</u>. The Analysis Area is used by unguided forest recreationists for the variety of outdoor activities mentioned above. Residents of Tenakee Springs (population 94 in 1990) and Angoon (population 638 in 1990) boat to locations in the Analysis Area for the day, returning home in the evening. Tenakee Inlet and its bays are of particular importance to the residents of Tenakee Springs for recreational pursuits. Locals from Juneau and Sitka also frequent Tenakee Inlet. Peril Strait is popular with sport hunters from Angoon and Sitka. Sitkoh Bay is used frequently by residents of

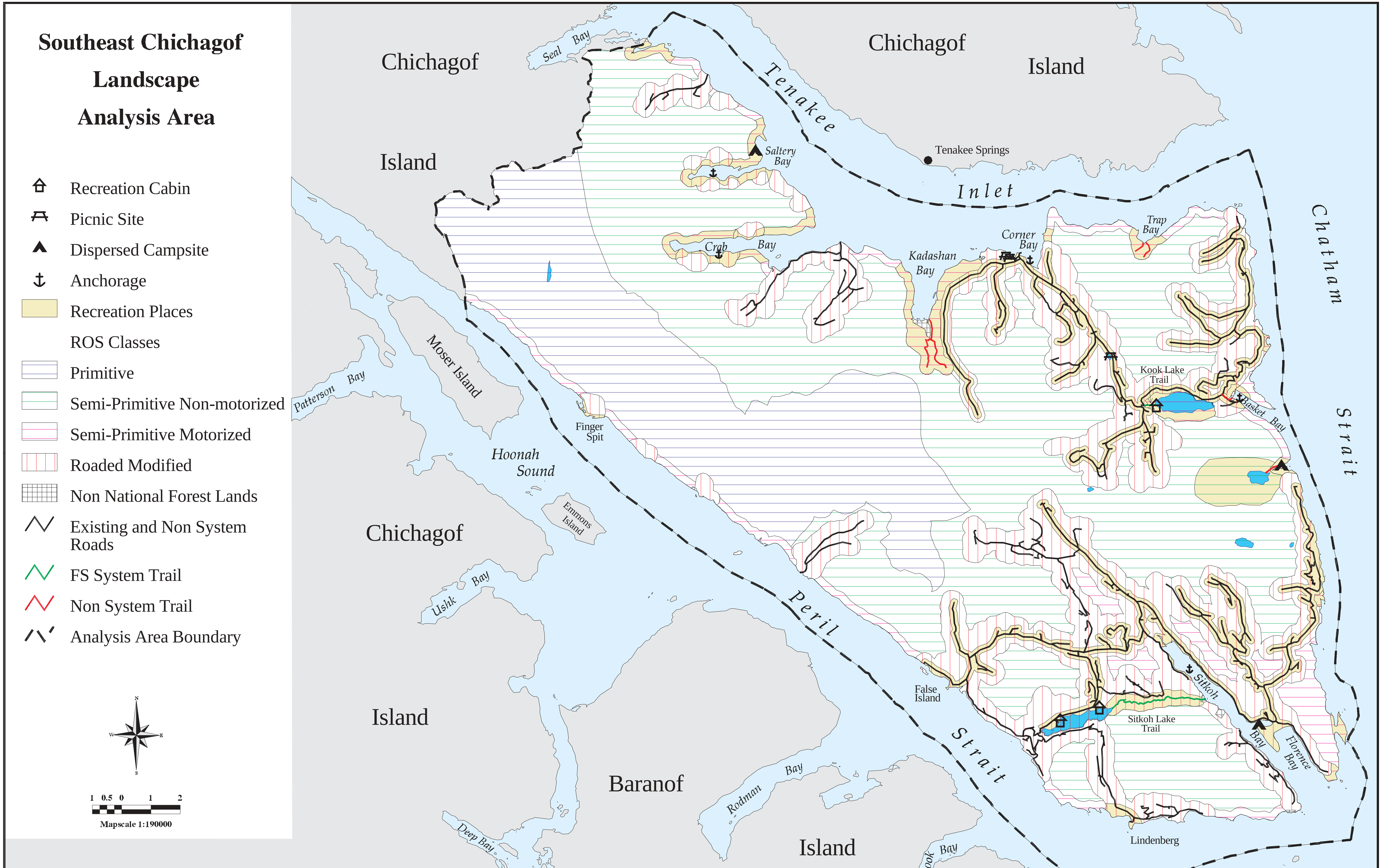


Figure 4-31. Southeast Chichagof Landscape Analysis Area Recreation.

Angoon and to a lesser degree by Sitka and Juneau residents. The Forest Service does not have data quantifying the total amount of unguided recreational use in the Analysis Area; however, unguided use is the predominant use at this time.

Guided Recreation Users. Guided recreation activities in the Analysis Area take place primarily in Tenakee Inlet, Sitkoh Bay and the North Arm of Hoonah Sound. In Tenakee Inlet, 47 trips were conducted, with 44 for the purpose of hunting big game. Two were fishing trips, and one was for sight-seeing. The North Arm of Hoonah Sound hosted 38 trips, with 25 for big game hunting, 8 for fishing, and 5 for sight-seeing. Recorded for Sitkoh Bay are 16 trips, 13 for big game hunting and 3 for sight seeing (Schaefer 1996). These statistics indicate a concentrated use in three specific areas. The complete guide picture includes many more guides who specialize in fishing or sight-seeing charters. For example, travelers view scenery while riding on the Alaska Marine Highway ferries and on the ten small cruise ships that travel the waterways surrounding the Analysis Area. Even though these passengers do not set foot in the Analysis Area, the mountains, bays and forested slopes are an essential part of their recreation experience. These operators do not have special use permits because they operate only on saltwater, not on National Forest lands. An interview by Mary Beth Nelson, Forest Service, with two of the three fishing guides who live in Tenakee Springs revealed they provide fishing trips in Tenakee Inlet for 153 to 192 days annually. In an interview conducted by Brad Flynn, Forest Service, Avrum Gross, co-owner of the Chatham Cannery in Sitkoh Bay, stated there is frequent use of the bay by bear hunting guides, fishing charters, small cruise ships, and guests from the two lodges in Angoon. Gross estimated that, four days out of seven, there are boats in the bay with non-resident tourists on board.

Recreation Opportunity Spectrum. The Forest Service uses the Recreation Opportunity Spectrum (ROS) to help identify, quantify, and describe various recreation settings. There are seven ROS classes that portray a range of recreation activities, settings, and experiences ranging from primitive to urban. The Analysis Area has been categorized according to ROS classes. The four classes at the primitive end of the spectrum best describe lands in the Analysis Area (Figure 4-31).

Nearly two-thirds of the area is classified as primitive and semi-primitive non-motorized. These lands show little or no human influence and are not accessible by boat or road. Portions of the primitive and semi-primitive non-motorized area are legislated Land Use Designation II and so continue to be managed in a roadless state. Recreation use of this area is low because it is difficult to access.

Thirty percent of the Analysis Area is classified as roaded modified. These are lands around roads and timber harvest areas. Use is moderate to high, depending on road condition and season. Roaded modified areas allow motorized vehicle recreation and usually include some interaction with other users. Since a large portion of the Analysis Area is within the Timber Production LUD, it is likely more roaded, modified recreation settings will be created as a result of future timber harvest.

The remaining 6% in the Analysis Area is classified as semi-primitive motorized. These areas are mostly along shorelines in natural appearing settings. Use can vary from low to high depending on the location, and interaction with other users is infrequent. Most of the recreation use in the Analysis Area occurs along shorelines and are in the semi-primitive motorized ROS class. These semi-primitive motorized shoreline areas are the most desirable to recreationists yet are the smallest in quantity. On a forest-wide basis, use of these popular areas is anticipated to reach capacity within the decade (USDA Forest Service 1997 TLMP).

<u>Recreation Places</u>. Within the Analysis Area, 24 Recreation Places have been documented, totaling 31,218 acres. A Recreation Place is an identified geographic area that has natural features which attract people. Examples of these features are beaches, roads, anchorages, trails, cabins or streams. Each Recreation Place has activities associated with it, such as viewing scenery, hiking, fishing, hunting and camping. Nineteen of the 24 recreation places are located along the shoreline, mostly in bays. The large number of shoreline recreation places indicates the importance of this type of recreation use in the Analysis Area. Shoreline recreation places are usually not large in size, and these 19 recreation places account for only 23% of the total recreation place acreage. The Corner Bay road system and the False Island road system are each a large recreation place and account for 60% of the total recreation place acreage. The remaining three recreation places are inland: Kook Lake and the recreation cabin and trail located there; Sitkoh Lake, trail and two recreation cabins; and Basket Lake. These account for 17% of the recreation place acreage.

<u>Developed Facilities</u>. There are few developed recreation sites in the Analysis Area. They consist primarily of trails and cabins. In addition, roads built for timber harvest are used for recreation. Each is discussed below.

Trails. There are approximately 10.4 miles of trail. They can be divided between Forest Service system trails (5 miles) and non-system trails (about 5.4 miles). Forest Service system trails are planned and constructed and are usually maintained regularly.

Kook Lake Trail, 0.7 miles long, provides an opportunity for cabin users to hike through large timber and muskeg and to access the Corner Bay road system. Use is likely to be similar to cabin use, which is low to moderate, as most cabin visitors probably hike the trail. Sitkoh Lake Trail is 4.3 miles long; it extends from Sitkoh Bay to Sitkoh Lake following the north side of Sitkoh Creek and terminates at the East Sitkoh Lake Cabin. The trail receives high use during the spring steelhead season, when anglers use the trail to access Sitkoh Creek. Between 200 and 300 anglers fish the stream each season (ADF&G 1990). Additional trail use originates from people staying at the East Sitkoh Lake Cabin, as most cabin visitors probably hike a portion of the trail.

Non-system trails are created by forest users repeatedly walking the same route to reach an inland destination. Users occasionally add improvements such as placing logs in muddy areas or removing brush. There are trails leading from Kadashan Bay to research cabins along Kadashan River and Tonalite Creek, total length approximately 3.5 miles. Trap Bay has a network of trails about one mile long that leads from the beach to a research cabin and provides access to streams for fishing. A trail at the head of Basket Bay, about a half mile long, passes near caves and karst topography and connects to the

Corner Bay Road system. At Little Basket Bay, a trail leads inland about 0.4 mile to Basket Lake. All these trails are within recreation places and receive recreation use.

Cabins. There are three Forest Service recreation cabins in the Analysis Area: Kook Lake Cabin, East Sitkoh Lake Cabin, and West Sitkoh Lake Cabin. These cabins rent for by the night and are generally accessible May through November; frozen lakes and snowy roads restrict winter access. All are accessed by floatplane or from the nearby road system. The main recreational activities at these cabins are fishing and hunting for deer and bear. Use at these cabins is low to moderate compared with all 22 Sitka District Cabins. Recreation cabins are used by private individuals and groups and may not be reserved by commercial guides.

A private cabin under special use permit is located at the mouth of Crab Bay. On the south shore of Crab Bay an old Forest Service administrative cabin is sometimes used for overnight stays and as a survival shelter, while a cabin at the mouth of Saltery Bay is maintained by Tenakee Springs residents as a survival shelter.

Road Systems. Two large road systems, at Corner Bay (59 miles) and False Island (37.2 miles), make up the two largest recreation places and are the reason for much of the roaded modified ROS class. For people with the desire and capability to transport vehicles to these road systems, the recreation opportunities are extensive. Popular uses of the road system include: deer hunting, ATV riding, hiking, bicycling, freshwater fishing, and gathering forest products. The False Island road system receives more use than Corner Bay. Fishing boats often stop at False Island and some unload ATVs to ride on the roads. A special use permit for equipment storage has been issued at False Island (expires 11/97); the permit holder has five trucks and six ATVs, which are driven by the permit holder and visitors.

Timber. The extent of timber harvest was presented in detail earlier in this chapter and is not repeated here. However, roads, logging camps, and log transfer facilities associated with timber harvest have increased use of the area. Road use was presented above but the latter two are discussed below.

<u>Log Transfer Facilities</u>. There are a total of ten log transfer facility (LTF) sites in the Analysis Area, nine of which were used in past harvest. The Record of Decision for the Southeast Chichagof Analysis Area Timber Sale of September, 1992 proposed use of five LTF sites. One of them, Corner Bay, is a permanent facility. Three others, False Island, Inbetween Creek and Crab Bay, require reconstruction. The other site is proposed: just west of the old LTF site at Oly Creek which, being in deeper water, would be built as a barge facility. The old site at Oly Creek will not be reopened because of the problem encountered in holding log rafts in the area during the initial timber harvest of the Oly Creek drainage. Additional sites would not be needed in the future, and reopening some of the old sites would not be necessary if the possible road connections were made between Corner Bay, Inbetween Creek and Crab Bay.

<u>Logging Camps</u>. Logging camps were based at Oly Creek, Crab Bay, False Island and Corner Bay, the latter two being permanent. When the False Island and Corner Bay camps were in use, many of the residents would leave during the winter. However, some

residents considered the camps home and stayed year-round, typically those who had children in school. Responsibility for the Corner Bay and False Island schools fluctuated between the Sitka School District and the Chatham School District. Throughout the life of these schools, enrollment stayed between 12 to 15 students. Most camp residents considered camp life a positive thing; it provided a relatively steady and comparatively high income in pleasant surroundings. Those we interviewed who went to school in these camps felt they received a good education and that the camps were a great place to grow up.

In 1979 the False Island camp became a Young Adult Conservation Corps base camp, and in 1988 Southeast Alaska Regional Health Corporation began using the camp for a substance abuse rehabilitation camp for adolescents. In 1972 a camp was constructed in Corner Bay and operated almost continuously until 1996. Like the False Island, Corner Bay had its own electrical generating system, water system, company store, and school. The other sites were either land-based or floating camps, which could be towed by boat from site to site. Constructing road connections would eliminate the need to re-establish some of the logging camps, as the complete Analysis Area could be serviced from one camp.

Economic Contribution. The economic contribution of the above current uses is presented.

<u>Subsistence</u>. Nearly a third of rural households in Southeast Alaska get at least half their meat and fish by hunting and fishing (Holleman and Kruse 1991). We can, to a certain extent, measure these uses; however, we cannot measure the social and cultural importance of these uses.

<u>Fish</u>. Assuming estimates of stream production capacity and harvest rates, Analysis Area streams can annually provide an estimated $348,800 worth of pink and $92,000 worth of coho salmon to the commercial fisheries of Southeast Alaska. Currently the commercial harvest rate is approximately 50% of escapement or adult returns. Pink salmon average 3.0 lbs each while coho salmon average 6.6 lbs. From 1991 to 1995 pink salmon values averaged $0.154 per pound while coho salmon averaged $1.01 per pound. Estimated total annual production capability for the Analysis Area include 1,510,000 adult pink salmon and 27,400 adult coho salmon. Although other commercially valuable finfish and shellfish are present in the Analysis Area, pink and coho salmon are representative of the productivity of the Analysis Area. The value of these other finfish and shellfish resources has not been determined.

<u>Deer</u>. Forest Service research has shown that the average person in Region 10 spends about $230 per day to hunt (1992 figures). This cost includes travel to and from the hunting area, supplies, food, fuel and lodging, and amortizes the cost of hunting equipment and vehicles used for hunting. Using this figure and the information gleaned from Table 4-29, we calculate that hunters spend an average of $289,800 to hunt in Analysis Area WAAs each year and that hunters spend an average of approximately $456 for each deer harvested.

Recreation. It is difficult to determine the exact number of dollars generated annually by the Analysis Area due to recreation/tourism. The Forest Service (Nelson 1996) calculates that Tenakee Inlet (including the town of Tenakee Springs) generates $631,300 to $847,200 to the industry each year. The north shore of the Analysis Area includes many of the most desirable and widely used bays that are located within Tenakee Inlet. Since bays, inlets, and points are major attractors to people (as they are to fish and wildlife) much of the recreation and tourism which occur in Tenakee Inlet occur in the Analysis Area.

Timber Harvest. As discussed earlier, 21,603 verified and 1,667 unverified acres (23,270 total acres) of timber have been harvested in the Analysis Area since the turn of the century (Tables 4-10 and 4-11). Although we do not have exact records of the amount of timber harvested, it is likely that yield ranged from 25,000 to 45,000 board feet (25 MBF to 45 MBF) per acre with an average yield of 35 MBF per acre. Thus, since 1900, the Analysis Area supplied approximately 581,750,000 to 1,047,150,000 (814,450,000 average) board feet of timber.

Table 4-30 correlates past harvest in the Analysis Area to the number of jobs which that level of harvest would produce. The economic analysis in the TLMP (1997) estimated that approximately 8.31 timber jobs are created or sustained in Southeast Alaska for every million board feet of timber cut in a year. The TLMP Revision also determined through the IMPLAN economics model that the total number of jobs created throughout the economy of Southeast Alaska could be determined by multiplying the number of direct timber jobs by a multiplier factor of 1.73.

Table 4-30. Employment related to timber reported in 1994 dollars.

Time Period	Total Acres Harvested	MMBF Harvested*	Average MMBF/Yr Harvested	AVG # of Direct Timber Jobs/Year	Total Jobs per Year
1900 - 1956	2282	79.87	1.4	11.6	18.1
1957 - 1967	1036	36.26	3.3	27.4	42.7
1968 - 1978	14335	501.725	45.61	379.0	591.2
1979 - 1995	5583	195.405	11.49	95.4	148.9
1996	34	1.19	1.19	9.8	15.4
Total	23270	814.45			

*Assume 35,000 board feet/acre average

Table 4-31 displays the estimated wages earned due to past logging activity in the Analysis Area. The TLMP (USDA Forest Service 1997) estimates the average wage in Southeast Alaska for jobs created due to timber harvest to be $43,453 per year. Note that total wages alone in the 20th century due to timber harvest in the Analysis Area equals almost 460 million dollars (in 1994 dollars).

These employment and wage estimates are made from 1990-94 averages and relate to an industry and technological level of approximately 1994. Although we can use these numbers to relate the harvest levels and years to each other, *actual* employment and wage levels for each time period would be different from those displayed. Technology and employee productivity levels have changed from 1900 to 1994. Employment estimates are most likely lower than what the actual figures would be for dates prior to 1994, as technological improvements have made employees more productive. Conversely, annual wages prior to 1994 were most likely lower due to the effects of inflation.

Estimates of the actual value of the wood removed from the Analysis Area are difficult to determine due to the extreme volatility of the timber market. Stumpage rates (the price for trees paid as they stand in the woods) are determined by working backwards from the value of a finished timber product and subtracting the costs of mill processing, transporting logs to the mill, and logging. For periods when timber products have a high value, the stumpage rates can be quite high. When timber product prices are low, the stumpage rates can actually be negative.

Table 4-31. Timber-related wages reported in 1994 equivalents.*

Time Period	Direct Income due to Wages/Year	Total Income due to Wages/Year	Total Direct Income in Wages	Total Income in Wages
1900 - 1956	$505,358	$788,237	$28,805,428	$44,929,533
1957 - 1967	$1,191,481	$1,858,919	$13,106,294	$20,448,113
1968 - 1978	$16,469,556	$25,692,455	$181,165,117	$282,617,008
1979 - 1995	$4,148,892	$6,472,324	$70,531,171	$110,029,514
1996	$429,750	$670,480	$429,750	$670,480
Total			$294,037,760	$458,694,648

*Assume 35,000 board feet/acre average
Average annual wage for jobs produced by timber industry is $43,453

Under normal market conditions mills, would not choose to purchase a timber sale with negative stumpage value unless they are willing to gamble that timber product prices will rise after the sale is purchased or the mills are willing to plan on a long-term basis and assume that shutting down and waiting for prices to rise will cost more than continuing to run in the red for the short term. In the APC long-term timber sale contract, APC paid the actual stumpage rate calculated unless the stumpage value fell below a base rate. This assured at least a minimum payment to the U.S. Government for any timber purchased under the long-term timber sale contract. Table 4-32 displays the sawlog stumpage rates paid by APC between 1971 and 1990.

Table 4-32. Sawlog stumpage rates for APC contract (per 1000 board feet).

Years	Spruce	Hemlock	Cedar
1971-75	$3.19	$1.83	$1.54
1976-77	$8.57	$8.75	$1.26
1977-80	$55.31	$30.69	$246.37
1981-82	$215.98	$1.36*	$1.22*
1983-85	$2.26*	$1.36*	$1.22*
1986-90	$2.26*	$1.36*	$1.22*

*represents base rates

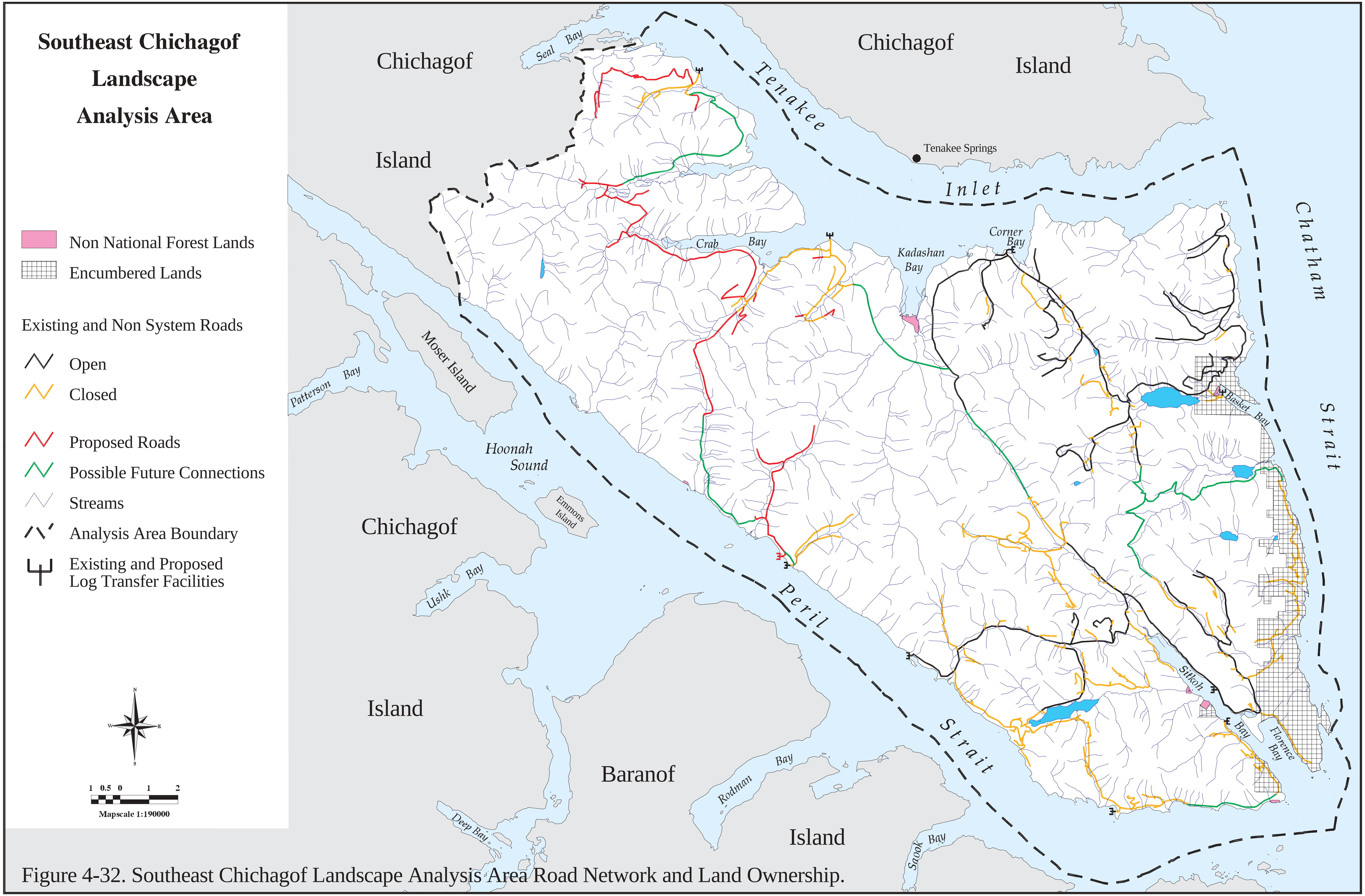


Figure 4-32. Southeast Chichagof Landscape Analysis Area Road Network and Land Ownership.

Obviously, stumpage rates are not always a good indicator of what a tree is actually worth. Even if the stumpage rate works out to be negative, a tree would have value. The negative stumpage rate would simply mean that it would not be economical to harvest the tree, haul it out, and turn it into a product.

Transportation System. There are 250.8 miles of existing system road in the Analysis Area. These roads were built at a cost of approximately $43,000,000 in today's dollars. Of these roads, 116.6 miles have been closed at a cost of approximately $350,000 in today's dollars; to reopen them would cost approximately $5,800,000. Of the existing road system, 96.2 miles are open for vehicle travel. Maintenance is done by contract, the cost of which differs depending on the maintenance level. Even closed roads require at least being walked to check on drainage. On an open road where timber will be hauled, the contractor must barge his equipment in and out to each work center, which can cost as much as $10,000. Maintenance on the road system can run between $300 to $500 a mile. There were approximately 40.0 miles of permanent road that have been proposed for construction under the initial Finger Mountain proposed action (the draft will be completed late in 1999) (Figure 4-32). Other possible connecting roads that would enhance the efficiency of the road network are also displayed in Figure 4-32. However, there are also reasons for not constructing these connections. Roads in what are now roadless areas may affect wildlife migration patterns, allow for more hunting and subsistence gathering, and reduce the roadless recreation opportunities. More miles of road and more bridges would mean higher maintenance costs. There is also the possibility of sediment release into streams during road construction.

Conflict. Through the 18th and 19th centuries, the Analysis Area remained relatively remote. This situation began to change in the early part of the 20th Century. As the century progressed, advances in transportation methods and communications systems have made the Analysis Area effectively less remote and more subject to pressure to harvest natural resources. The consequence of this is an increase in conflicts over resources.

Fish Traps**.** An early resource conflict in Southeast Alaska concerned fish. Companies constructed canneries at Todd and Sitkoh Bay to make use of abundant fish. Advances in canning technology and construction of bigger and faster ships allowed people to preserve the fish and transport them long distances to ready markets. Fisherman resented the large fish companies which could afford to operate the big, expensive, and tremendously efficient fish traps, one of which operated near the mouth of Sitkoh Bay. The fish trap issue was so significant that it was discussed during the drafting of the Alaska State Constitution. The Alaska Ordinance, which banned fish traps statewide, was argued in front of the Supreme Court of the United States (Avrum Gross, pers. comm.).

Commercial Logging. Following is a discussion of conflict surrounding timber harvest in Southeast Alaska; details on the legislative and management history are in Appendix B.

On July 26, 1951 the Forest Service entered into a long-term timber sale contract with the Ketchikan Pulp and Paper Company (KPC). This contract was to terminate in the year 2004. On January 25, 1956 the Forest Service also entered into a long-term timber sale contract with Alaska Lumber and Pulp, now known as the Alaska Pulp Corporation

(APC). This contract was to run from 1961 to 2011. The purpose of these contracts was to stimulate the economy of Southeast Alaska by creating year-round jobs in the timber industry. Southeast Chichagof Island became part of the APC contract area.

Local Perceptions. As logging continued under the APC and KPC contracts, tensions and conflicts over resources grew. Traditionally the Analysis Area has been used by the residents of Tenakee, Angoon, Sitka and Petersburg for subsistence hunting, fishing and gathering. Juneau residents often hunt the area for recreation. (Juneau residents are not considered rural residents and may not harvest fish and wildlife under Federal subsistence regulations.) According to comments from residents of Angoon and Tenakee (TLMP), most people prefer to have the forest around them managed for subsistence rather than timber. This position has essentially not changed since the first TLMP was signed in 1979. The original TLMP states of Tenakee: "Residents stress that their subsistence life-style is more than a conceptual commitment to a simplified way of life; subsistence is essential for many residents." In the most recent round of TLMP scoping, Tenakeeans made a particular point that jobs should not be the reason for determining management of the National Forests. Many of the residents of the communities who use the area for obtaining subsistence commodities feel the large commercial timber sales have been detrimental to the populations of subsistence species and have provided an avenue of access to "outsiders" who harvest "their" deer and, therefore, have inhibited their ability to fulfill their subsistence needs.

APC Closure and Litigation. On September 30, 1993 the Alaska Pulp Corporation indefinitely suspended its pulp mill operations in Sitka. The U.S. Government considered this suspension to be a material breach of contract. On April 14, 1994 the Forest Service terminated APC's long-term timber sale contract. At that point the Forest Service began to release those timber sale offering areas, which had been cleared through NEPA for the APC contract, to independent sale purchasers and to KPC in order to fulfill contractual requirements for the KPC long-term timber sale contract.

On November 1, 1994 the Alaska Wilderness Recreation & Tourism Association (AWRTA) filed suit against Gary Morrison in his official position as Forest Supervisor of the Chatham Area of the Tongass National Forest. The suit was amended November 10, 1996 by the Sierra Club Legal Defense Council. The amendment added the Organized Village of Kake, the Southeast Alaska Conservation Council (SEACC), the Natural Resources Defense Council, and the Wilderness Society as plaintiffs in the case. It also added Abigail Kimbell, the Forest Supervisor of the Stikine Area of the Tongass National Forest, as a defendant in the case. The suit alleged violations of NEPA, ANILCA, and the Tongass Timber Reform Act (TTRA--proportional harvest) in regards to the Kelp Bay, the Southeast Chichagof, and the North and East Kuiu EISs, and the Supplemental Environmental Impact Statements for the 1981-86 and 1986-90 Operating Periods (SEIS). Some of the plaintiffs' central arguments asserted that the cancellation of the APC contract made the purpose and need for the contested EISs no longer valid. AWRTA also claimed that many of the roads and cutting units in the contested EISs would harm tourism due to their visibility from major waterways used for recreation and tourism. A number of the contested roads and units are located in the Analysis Area.

On May 22, 1996 the District Court approved a settlement agreement reached by the plaintiffs and the USFS. The agreement released approximately 105 MMBF of timber, while 165 MMBF remained enjoined pending the completion of supplemental EISs. The TTRA proportional harvest count included in this suit was also settled. Although many units in the Analysis Area were released, a large number in Crab Bay, Inbetween, and Broad Creek remain enjoined. The new EIS, Finger Mountain, has been started, and the decision was made to look at ALL the units again, both the enjoined and released ones.

KPC Developments. In 1996 KPC attempted to obtain a 15-year extension to its long-term timber sale contract. KPC held the position that it needed the extension to amortize the $150 to $200 million it must spend to bring its pulp mill's pollution abatement capabilities to adequate levels; otherwise, it would have to shut down its pulp mill. A hearing concerning the extension was held by the Senate Energy and Natural Resources Committee. As part of the extension proposal, KPC asked to have some of the conditions of the TTRA reversed or eased.

In October of 1996, the Secretary of Agriculture, Dan Glickman, stated:

- The Administration would consider the closing of the pulp mill a material breach of KPC's contract.
- The Administration would not consider an extension of the contract until the revision of the Tongass Land Management Plan is complete.
- The Administration would not accept any conditions reversing any part of the TTRA and "...will accept nothing less than full compliance with all environmental laws."
- The Administration will give KPC all the timber released under contract to it at this time (about 300 MMBF) if KPC agrees to a mutual cancellation of the contract and agrees to limited litigation rights concerning the cancellation of the contract.

KPC closed down its pulp mill but has kept its sawmill operating. Timber volume from the Analysis Area will not be used to meet contractual obligations for the KPC contract.

*TLMP 1997***.** The Tongass Land Management Plan (TLMP) was released in May of 1997. The TLMP Revision Draft Forest Plan and Environmental Impact Statement (DEIS) received the largest number of public comment letters (22,000) for a Forest Plan in the history of the Forest Service. According to Issue 14 of the Newsletter of the Forest Plan Revision (October 1996), comments were received from every state in the Union: 18% from Southeast Alaska, 8% from other places in Alaska, 65% from other states, and 9% from unknown sources. The newsletter delineated the responses into three common-interest categories. Category I - Advocates greater environmental protection. Believes the preferred alternative does not go far enough in regards to conservation, protection, or the minimization of resource extraction. Category II - Generally agrees with the concept of mixing multiple use with ecological protection and restoration; however, does not feel the preferred alternative goes far enough towards meeting this goal. Does not agree with the balance of resource uses in the preferred alternative. Category III - Advocates greater commodity use of timber resources. Believes the preferred alternative abandons the multiple-use mandate of the Forest Service, replacing it with a preservation/conservation ethic which is detrimental to the communities of Southeast Alaska. Feels that environmental values and health of the forest is important but that the Tongass National

Forest is capable of sustaining a higher allowable-sale quantity without jeopardizing future forest health. The response category percentages are given in Table 4-33.

Table 4-33. Public response to draft Tongass Land Management Plan.

Category	SE Alaska Responses	Overall Responses
I	14%	48%
II	49%	24%
III	37%	28%

We feel these responses concerning the whole Tongass National Forest can be applied generally to the Southeast Chichagof Landscape Analysis Area. Of particular interest is that there were not enough responses in support of the preferred alternative to make this response a category in and of itself. (These responses were included in Category II).

In April of 1999 Jim Lyons, Under Secretary of Agriculture for Natural Resources and Environment signed a new Record of Decision. This decision changed the Land Use Designation for several VCUs in the Analysis Area, as well increased the timber harvest rotation from 100 to 200 years for several of the Wildlife Analysis Areas. These changes were discussed in Chapter 1.

Chapter 5 - Guidance for Project Planning

Introduction

This chapter focuses on recommendations related to the issues highlighted in Chapter 3 for the Analysis Area. We discuss four main ecological issues: landscape diversity, forest vegetation, wildlife and fish, and human use. We use the results of the Spectrum model, and the information from Chapter 4, to lace together societal values and ecological capacity.

Ecology

Key Questions:

1) What is the distribution and variety of the landtype associations (landscapes) that make up the Analysis Area? How has management activity been distributed across the landtype associations? [Covered in Chapter 4]

2) How representative are the non-development LUDs as compared to the Moderate and intensive development LUDs for landtype association diversity? [Covered in Chapter 4]

Old-Growth Distribution on Landtype Associations. The landtype associations and their relative amounts are fixed since the end of the last glaciation. As discussed in Chapter 4, past timber harvest has not been spread equally among the landtype associations but has concentrated on the colluvial/alluvial/coastal surfaces (44% of the old growth on this association has been harvested). On a watershed basis, we need to strive to distribute future harvesting equitably over the four main forested landtype associations to maintain a more natural distribution of old growth and all the different forest stand structures across the landtype associations. This will help preserve biological diversity via the coarse-filter approach. This approach is being taken indirectly with TLMP 1997 and the 1999 ROD because of the much larger riparian management areas standards and guidelines.

Representativeness Analysis. The Southeast Chichagof Analysis Area was tested for representativeness with regard to landtype associations between those lands with little management (mostly natural LUDs) and lands where timber management is emphasized (moderate and intensive development LUDs) (Bougeron et al. 1994). See Chapter 4.

Key Questions - Karst:

1) Where does karst occur within the Southeast Chichagof Analysis Area? Is any of it significant and deserving of special consideration? [Covered in Chapters 4 and 5]

2) What restrictions, if any, does responsible stewardship of these karst resources place on future management and human use? [Covered in Chapter 5]

The Tongass Land Management Plan (1997) outlines a procedure designed to assess the vulnerability or sensitivity of karst areas to planned resource activities. The karst vulnerability strategy is outlined in detail in the Karst and Cave Resources Forest-wide Standards and Guidelines (Forest Plan, Chapter 4).   This strategy strives to maintain the natural karst processes and the productivity of the karst landscape while providing for other resource uses where appropriate. It has been used successfully on the Ketchikan Area since 1995 and will be applied to any future Project Level planning which involves karst lands within the Analysis Area.

Three areas stand out for their extensive karst development. In the future we may wish to consider the first two for possible designation as Geologic Special Areas. The three areas are:

1) The area between the eastern shore of Kook Lake and the Native Selected Land adjacent to the head of Basket Bay. The area should include lands on both sides of the outlet stream and atop the underlying cave system. We suggest that the cave system be surveyed and a cave map developed. [An initial core passage mapping was completed in 1998. If this area is ever considered as part of a timber sale again dye tracing and other mapping work would be necessary to understand the drainage network in this karst area.]

This information could be included in an interpretative brochure highlighting the geology, geomorphology, karst development, cultural history, fisheries and wildlife of the area [This is still in consideration].

2) The alpine and sub-alpine karstlands centered around Trap Peak including the resurgences within Trap Bay.

3) An area encompassing the karst features and caves associated with the stream in "Little Little" Basket Bay. The lower portion of this watershed has been transferred to Sealaska Corporation in 1999.

Forest Vegetation

Key Questions:

1) What is the extent of the timber resources within the Southeast Chichagof Analysis Area? [Covered in Appendix G]

2) How might concerns for visuals and deer winter range affect timber outputs? What are some possible scenarios for sustained yields from the Analysis Area? [Covered in Appendix G]

3) What is the extent of old-growth forest within the Southeast Chichagof Analysis Area? What restrictions, if any, do these old-growth resources have on future resource management and human use? [Covered in Chapter 4, and here in Wildlife section]

4) What is the existing mosaic of forest conditions within the Analysis Area, given wind disturbance and timber management? How can future management use this information? [Covered in Chapters 4 and 5]

5) What is the extent of old-growth forest fragmentation within the Analysis Area? How does this fragmentation affect future resource management and human use? [Covered in Chapters 4 and 5]

6) How extensive is second growth within the Analysis Area? How much thinning has occurred? What potential do these second-growth resources have for future timber management? [Covered in Chapter 4]

Implication of Disturbance to Management

Storm of 1968 and the scale of timber harvest. We mapped 3,160 acres of blowdown from the 1968 storm onto aerial photography. We estimated another 350 acres were harvested before the photography, for a total of 3,510 acres. The vast majority of these areas received high intensity, stand-replacing windthrow. This storm also affected an unestimated number of acres with varying degrees of partial stand blowdown that cannot be mapped on photography. Harvest in the last 30 years occurred on approximately 22,000 acres. Assuming some similarity in the magnitude and resulting forest structure between the harvest and windthrow areas, management has contributed the equivalent of about six of these 1968 events in 30 years.

To have this many high intensity storms in a relatively short period of time seems unlikely. Wind events larger than the 1968 storm may have occurred in the past, although no other storm event of the magnitude of the 1968 storm was evident in the 300 year period that we could identify even-aged stands. It follows that if we continue harvesting at the same or similar rate for another 30 years we would likely move well outside the natural range in variation of large-scale disturbance. The 1999 Record of Decision for the Forest Plan FEIS designated approximately 20,500 acres of the Analysis Area into non-development land use designations that do not allow any commercial timber harvest. In addition, Forest Plan standards and guidelines implemented in development areas (riparian, beach, and estuary buffers, marten habitat etc.) will also contribute to significant no harvest areas within the managed landscape. For this reason it is unlikely that the same rate of harvest that has existed to date, can occur within the foreseeable future.

By using the range of natural disturbance as a reference point, we can hope to maintain biological diversity and ecosystem productivity (Swanson and Franklin 1992). More information about wind disturbance within the Analysis Area is needed to understand fully the extent of its effects on forest structure and ecological function. Closer examination is needed of both the large homogeneous patches, and the more complex heterogeneous patches that we did not have enough time or resources to study. This further work may lend additional insights as to types of management that we may wish to emphasize.

Second-growth management. The management of second growth is a responsibility that comes with timber harvest and becomes more important given the magnitude of even-age harvest that has occurred in this Analysis Area. Past clearcut harvest in this area differs in the resulting forest structure from windthrow areas. This harvest has created a large portion of the Forest land in early stand development stages that are more uniform in structure than what would result from natural disturbance. If we manage second-growth stands (or young growth) so that they spend less time in the unmanaged stem exclusion stage, we can reduce the period of time that these areas have minimal understory. In addition to accelerating stand development, we can treat second growth to add variability in structure that can be beneficial today and in the future. We cannot manage young growth to provide all the values provided by old growth before a significant passage of time. The 1999 Forest Plan Record of Decision established 200 year rotations on over 80% of the existing second growth in the Analysis Area. This will allow most old-growth structural characteristics to develop prior to additional regeneration harvests of these areas. A lot can be done to sustain landscape function while still placing some emphasis on timber management on some of the Analysis Area, as directed in the Forest Plan.

At the level of this analysis it becomes clearly evident that, by scheduling even flows of timber (as discussed with the spectrum model), we can facilitate second growth management. This "landscape management" will provide for maintenance of the road network that is critical for second growth management through intermediate treatments. Keeping the road system functioning has the additional benefit of allowing quick responses when new areas of blowdown occur where salvage logging is desirable. This provides an opportunity to use these natural openings as areas to extract timber, thereby not having to introduce as many or as large openings to achieve desired timber outputs.

In addition to maintenance of existing road systems, we should plan development of future roads to facilitate overall management goals. There are opportunities to connect currently separate road systems in this area (Corner Bay and False Island) by investing in planning and construction of connecting segments. A connected road system could greatly facilitate second-growth management and blowdown salvage over the Analysis Area.

Finally, there is significant public interest in the direct jobs created by investing in second-growth management. Funding for investment in second growth is often difficult to secure. Through a steady timber sale program, some of the value of harvested old growth can be retained for investment in the nearby second growth. (For example, there may be opportunities to secure funding through the Knutson-Vandenberg Act.)

Management systems, harvest methods and other silvicultural prescriptions. The desired future condition would have forested land with a diverse mix of forest structure ranging from variable sized open areas in stand initiation to variable sized areas in the old-growth stage. Within this range there would be many areas of young and mature forest that would often exist in complex associations (multi-cohort). The selection of a silvicultural system for any given stand should be based in part on the natural disturbance regime of individual sites, in order to accommodate the effects of future natural disturbances as they interact with the neighboring managed stands (Swanson and Franklin 1992). Because traditional clearcut harvesting has created large areas currently in the stem exclusion stage of development, there are opportunities for aggressive second-growth management. To avoid contributing substantially more forested area into the stem exclusion stage, alternatives to large-scale, even-aged management can be experimented with through adaptive management. Many of these non-traditional forestry practices have yet to be studied in detail, and thus it is uncertain to what extent they will meet the biological objectives for which they have been designed (Swanson and Franklin 1992). New harvest and intermediate treatment prescriptions can contribute significantly under an "adaptive" style of management. Objectives of these prescriptions would lead to a desired future condition for the landscape. In order to achieve these desired conditions several possible methods may be utilized.

Silvicultural Options: The following recommendations are possible solutions to achieve desired effects and are based on specific conditions.

1) Uneven-aged systems. Some silvicultural prescriptions should maintain late successional character at the stand level by creating gaps in a matrix of continuous forest cover (Lertzman et al. 1996). These would include single tree and group selection methods under an uneven-aged management system with extended cutting cycles. Consideration should be given to where in the landscape these methods would best be employed. Guidance can be found in the study of the distribution of forest structure resulting from natural disturbance. For the Southeast Chichagof Analysis Area, it might be in the wind-shadowed or protected areas where forest would have the greatest likelihood of reaching late successional character. In analysis of forest structure and wind disturbance on Kuiu Island, it was estimated that roughly 35% of the forested area occurred in this position (Nowacki, Kramer, Kissinger, personal communication). We believe the distribution on southeast Chichagof to be similar. For example, VCU 233 (south side of Crab Bay) is protected from many of the southeast storms; we mapped very few large-scale blowdown stands. For this area, uneven-aged management may be most appropriate. This strategy would be preferred where it is also economically and logistically feasible.

2) Multi-cohort systems. Prescriptions can be designed to promote or maintain the complex structure of the multi-cohort condition. These prescriptions could include selection methods, other methods of partial canopy removal, and clearcutting with reserves using a two-aged management system. In the case of clearcutting, there would likely be a regime of additional intermediate treatments over time to arrive at the desired condition. Also in the case of even-aged or two-aged management with clearcutting, rotation length would have to be long enough to achieve and allow time for functioning in the desired future condition. Partial disturbance associated with the other methods creates a condition somewhat analogous to the reinitiation stage, thereby skipping the stem exclusion stage (Oliver and Larson 1996). These two-aged methods would be appropriate and feasible in many landscape positions. In the most exposed (wind) locations, blowdown would continue to affect these stands and might be invited in some of

the partial canopy removal options. This disturbance might be looked at either positively or negatively, depending on other objectives of the prescription. Continued wind disturbance, especially in exposed locations, should be planned for and anticipated.

Some studies have found larger scale wind disturbance as an infrequent part of forest dynamics (Ott 1993; Lertzman 1996; and others) in the coastal forests of western Canada and Alaska. Study also suggests that the small scale "gap phase" developmental trajectory often associated with old growth does not dominate (Lertzman 1996; Harris 1989; and others). The extent and importance of forest disturbed at an intermediate intensity and frequency exhibiting a complex multi-cohort structure has been gaining attention and is becoming the focus of study (Kissinger, Kramer, and others, per. comm., 1996). As understanding of forest dynamics in Southeast Alaska increases, prescriptions targeting a multi-cohort desired future condition may become important.

3) <u>Even-age systems</u>. Natural disturbance processes can also be emulated or approximated using clearcut, clearcut with reserves, seed tree, or shelterwood harvest methods. Our mapping of visually apparent wind generated forest stands was mostly even-aged patches or storied in structure. Storied structure results when greater than 25% remnant canopy from a previous condition is left after a more recent disturbance. Also, most patches contain a significant amount of remnants from the previous stand. A silvicultural strategy that would conform closer to natural disturbances would leave significant amounts of preharvest basal area standing. Similar to the remnant standing after a natural disturbance, some of that retained after harvest would subsequently blow down. This subsequent blowdown could serve an important role as down woody debris or soil tillage possibly beneficial to maintaining soil productivity. Any portion that remains standing would provide structural diversity. Basal area retained in these options could be marked from undesirable and unmerchantable tree classes. There are consequences to retaining this material which may or may not promote other objectives, such as increased infection of the regenerating cohort by dwarf mistletoe.

Areas where even-aged management would fit more closely with the natural disturbance regime are along the north shore of Crab Bay, Sitkoh Bay, and along the ridge dividing Oly and Broad Creeks. There may be opportunities to employ adaptive management strategies to understand these relationships further. For example, this ridge system leading down to Peril Strait has large forest patches of apparent even-aged young and mature forest originating from large-scale blowdowns over a wide area. It has a southerly aspect, extends over a significant elevational range, and is highly productive forest. In its current condition, canopies are relatively continuous. Treatments could be tested to break up this continuous canopy with the objectives of benefiting deer habitat and timber production (among others).

Clearcutting in the past has resulted in patch sizes much larger than we found from mapping natural disturbance. This fact was not unexpected nor is it viewed as negative. These harvests were prescribed given a set of objectives at that time. These objectives emphasized timber production on these acres and with appropriate intermediate treatment will achieve the desired future condition envisioned at the time. The Modified 1997 Forest Plan significantly adds to the reserves and restrictions on timber harvest. The Forest Plan established large areas that are unavailable for timber harvest in order to address complex management challenges. This direction may in some cases, result in the remaining available harvest areas being intensively managed for timber production. In those situations, even-aged management (with units much larger than natural disturbance sized patches) may remain a primary tool.

Other Considerations:
Deer. High-intensity and moderate-intensity wind disturbance is especially important in forest dynamics on southerly aspects, at lower elevations, and on sites of higher productivity. These are the same areas that are important to deer; this is probably not a coincidence. The higher turnover rate associated with these levels of disturbance may be very important in maintaining highly productive habitat. We need to look at the relationship between deer and wind disturbance to be able to design better prescriptions with objectives for both deer habitat and timber production. Future research could be done to better understand the role of disturbance and critical deer winter range.

Other Specific Areas with Opportunities. In the next level of planning, where detail can be expanded and individual stand treatments are developed, the peninsula between Crab and Saltery Bays will present opportunities. Because some of this area is inaccessible to roading yet contains productive forest accessible by helicopter, harvest prescriptions could experiment with alternatives to clearcutting with the flexibility that helicopter yarding provides, given that the objectives for the area would best be met with these alternative prescriptions.

Management of the Forest Patchwork. Research of individual species (e.g. Northern Spotted Owl) and ecosystem research have been instrumental in rethinking landscape pattern management (Swanson and Franklin 1992). One of the ecosystem-level contributions has been modeling the effects of dispersed cutting patterns (vs. aggregate cutting patterns) on disturbance regimes and wildlife habitat. Dispersed cutting, where harvest units are between 50-120 acres and are spread out across the landscape, has potential problems associated with blowdown; and altered microclimate in remaining stands may eliminate species or plants that require this interior forest environment. (See Forest Vegetation and Wildlife sections in Chapter 4). A couple of the objectives for which dispersed cutting was designed were to facilitate regeneration by seed fall from adjacent stands, to disperse the hydrologic and sediment effects of cutting through time, and to minimize the visual effects. The point of discussing aggregate and dispersed cutting is not to switch from one narrow set of management rules to another, but to consider a broader range of approaches to meet more varied management objectives. These approaches, such as ranging the sizes of individual cutting units, and aggregates of units, should be applied in the context of constraints imposed by topography and the natural disturbance regime (Swanson and Franklin 1992). Not only are size and distribution of openings important, but the shapes of the openings can effect diversity and mitigate potential wind disturbance following harvest. In some cases, there is little flexibility due to reserves established by laws and the Forest Plan, but in other areas, cutting patterns can be designed with landforms in mind to protect residual structure from excessive windthrow and to maintain visual appeal.

Summary

While managing the land in ways to reflect natural disturbance may be most desirable to maintain biodiversity and landscape function, it is important to recognize that management cannot exactly mimic this disturbance. Landscapes can likely sustain levels of disturbance beyond what we have seen in this snapshot of time analysis. Therefore, we recognize that it is important for our management to reflect natural disturbance whenever feasible but also to determine acceptable levels outside what we have witnessed here.

Given the above points related to natural disturbance history, second-growth management, different management systems, and the Spectrum model results (Appendix G), it is best to utilize a whole landscape approach with a multi-entry planning process. This process would look at all suitable lands for future sales over the long-term for sustainability of ecosystems, timber, and jobs. This approach would maintain the investment in roads and facilitate management of second growth, and be consistent with many of the past Forest Service Chiefs' points stressing ecosystem management and forest health. It would also help build faith with local communities and provide flexibility for the future in that we may be able to use a more holistic approach for future environmental analyses. This would give us flexibility in how much timber is needed (offered) during times of uncertainty in Sitka, in the market, and in the Forest Service.

Wildlife

Key Questions:

1) Where is the high-value deer habitat and how has it changed since 1956? How has timber management affected deer-carrying capacity? What are the habitat effects for bear and marten since 1956? [Covered in Chapter 4]

2) How has old-growth forest fragmentation affected wildlife habitat, and what connections should we strive to maintain or restore?

3) What impacts might future timber harvest have on high-value deer winter range? [Covered in Appendix G]

Wildlife Strategies. The predominate wildlife habitat issue on the Project Area is forest fragmentation. It is important to maintain connections between blocks of interior old-growth forest and also between geographic areas (Ruggiero et al. 1994). A strategy to address the increase in forest fragmentation may include maintaining existing connections, reducing future impacts on connections and rehabilitating "broken" connections.

<u>Maintaining Existing Connections.</u> Based on our fragmentation analysis (Figure 4-17), one corridor of intact interior old growth remains between Peril Strait and Tenakee Inlet. This connection exists between the Broad Finger drainage and Crab Bay. Another important connection that remains is between the Broad Creek drainage and Broad Finger Drainage along Peril Strait. With the 1999 ROD both of these drainages have had their

LUD changed from intensive development to semi-remote recreation, hence there will be no break in these connections or disrupt the flow of animals through these areas.
Reducing Future Impact on Connections**.** Planning of future timber harvest should strive to minimize the impacts on old-growth blocks and corridors. Techniques used may include minimizing road construction by increasing the use of helicopter yarding, and utilization of innovative timber harvest prescriptions to reduce opening sizes and maintain forest structure across the landscape as well as within the stand. Some connections may have vital "nick points" (narrow areas of connection) that may not tolerate any timber harvest without breaking landscape-level connection. These areas should be identified and avoided in timber planning.

Rehabilitation of "Broken" Connections. Based on our fragmentation analysis, several important interior old-growth connections have been fragmented as a result of past timber harvest. These include connections between the following areas (Figures 4-16 and 4-17):

Basket Bay and Corner Bay
Sitkoh Bay and Kadashan
Crab Bay and Kadashan
Kadashan and Trap Bay
Basket Bay and Sitkoh Bay
Connections along the beach on Peril Strait

These connections need to be examined in greater detail to evaluate key areas that may be rehabilitated to improve the function of these connections. Rehabilitation techniques may include riparian or multi-emphasis thinning techniques which may speed up recovery of the connective functions. Road closures or obliteration and restoration may increase the rate of reclamation by the forest.

Existing Protections. Current old growth protection measures in effect (with TLMP 1997 and ROD 1999) include Habitat Conservation Areas, Old Growth Reserve Areas, beach and estuary buffers, Riparian Area buffers, elimination of high-hazard soils areas from timber harvest, and special buffers for certain nest sites such as great blue herons, marbled murrelets or northern goshawks. Efforts should be made to maintain and improve connections between these areas.

Other Recommendations.
-Continue regulatory prohibition of the use of land vehicles in the taking of marten, mink and weasel. With Alaska Department of Fish and Game, explore the need to extend this restriction to brown bear.

-Explore ways to reduce deer harvest in Wildlife Analysis Area 3309 (North Arm of Hoonah Sound). Trip limits in January for GMU 4 have been proposed for consideration to the Federal Subsistence Board.

-Continue to explore, develop and utilize innovative timber harvest prescriptions tailored to the needs of wildlife species.

-Design timber harvest prescriptions considering natural disturbance levels (landslides and wind disturbance).

-Use care during design and placement of timber harvest units in high-value wildlife areas.

Fishery and Riparian Conservation Strategies

Key Questions:

1) What are the past and current conditions of the riparian habitat within the Analysis Area? How will this affect future resource management and human use? [Covered here in Chapter 5]

2) What are the key fish producing habitats within the Analysis Area? [Covered in Chapter 4]

3) What is the current condition of the riparian and aquatic habitat within the Analysis Area? What are the cumulative watershed effects that future management should consider? [Covered in Chapters 4 and 5]

TLMP Revision (1997). The TLMP Revision (1997) was completed after the draft version of this landscape analysis. The new TLMP Revision has substantially increased the protection of streams and associated riparian areas. New standards and guidelines and associated Best Management Practices (BMPs) provide increased protection of headwater areas (steep slopes, high hazard soil areas and Class III and IV streams), and modify and increase streamside buffers on floodplains, alluvial fans and confined alluvial channels. This final draft of the Southeast Chichagof Landscape Analysis incorporates the new TLMP Revision. Therefore, the analysis has been altered since earlier drafts to delete guidance and recommendations that would be repetitive with the new TLMP Revision.

Riparian Management Areas. These areas encompass the zone of interaction between the aquatic and terrestrial ecosystems; they are portions of a watershed that are directly coupled to streams, wetlands, lakes and ponds. Riparian areas sustain hydrologic, geomorphic and ecological processes that directly affect streams, stream processes and aquatic habitats (Federal Agency Guide for Watershed Analysis 1994). In addition to the stream and lake riparian zones described in the TLMP Revision, we have included the wetlands and sediment source areas as primary functional components of the riparian management areas.

Riparian management areas are portions of the Analysis Area watersheds where the potential direct or indirect effects of management activities on fish habitat are highest. These areas represent places of greatest concern for maintaining riparian and wetland functions and hillslope stability. They are tailored to characteristics of each individual watershed to account for inherent variability in geology, soils, vegetation and hydrology among watersheds.

The TLMP Revision (1997) has adopted a management strategy that strictly limits timber harvest and road construction in these riparian management areas unless watershed/site analysis in conjunction with project planning determines that management activities can occur while still maintaining riparian function and fish habitat objectives. Future management must account for the effects of past activities on riparian areas, wetlands and sensitive soils, and the potential for natural disturbance regimes, such as mass wasting and windthrow, to magnify these effects.

Timber Harvest Considerations. The general direction is for no programmed commercial timber harvest within designated riparian management areas. Management activities, including timber harvest, can occur in the sensitive soil areas (SSA) of the riparian management areas if site analysis determines the activity is consistent with SSA objectives. Upon completing a watershed analysis, uneven-aged management, including small group selection and individual tree selection outside of mandatory TTRA buffers, may be acceptable within portions of stream riparian management areas provided that riparian objectives (including: recruitment of large woody debris, flood plain protection, channel stability, and streamside canopy structure) are met. Timber harvest in stream riparian areas should be considered on a case-by-case basis along Class III mountain slope streams where buffer windthrow and resulting destabilization of stream banks is a concern. Small patch cuts using helicopter yarding techniques may be acceptable on some sensitive soils in headwater source areas if detailed site analysis indicates slope stability will not be compromised.

Tables 4-19, 20, and 21 summarize the general distribution and extent of existing harvest units within riparian and high-hazard soil areas for the Analysis Area watersheds. The extensive area of the valley bottom stream riparian harvested to date in the Corner Creek, Muri Creek, Kook Creek, Sitkoh River, Sitkoh Creek, Oly Creek and False Island waters-heds leave little opportunity for additional harvest within valley bottom riparian management areas in these watersheds. Lower current riparian harvest levels in the remaining key watersheds indicate some flexibility may exist for future uneven-age harvest in riparian management areas in these watersheds. Narrow stream buffers along footslopes that are perpendicular to the main valley axis are particularly susceptible to windthrow. The size, shape, orientation of units, and relationship to existing canopy openings must be carefully considered when planning harvest activities adjacent to stream riparian areas.

Protecting fens and associated high-value fisheries habitat, including palustrine channels, is best accomplished by avoiding management activities which decrease the short- and long-term health of beaver populations. Beavers improve fish-rearing habitat by building dams that flood wetland and riparian areas and by increasing the density of large woody debris, which adds complexity and cover.

The acreage of headwater sediment source areas harvested to date has been relatively small except in a few watersheds. Harvest units have not appreciably contributed to sediment loading in these watersheds. Future management in all watersheds should focus on avoiding impacts to sediment source areas (Figure 4-26), especially in proximity to sensitive stream reaches where detrimental changes in stream channel and fish habitat condition are most likely to occur.

Road Management Considerations. The TLMP Revision and BMPs specify standards and guidelines for design and maintenance of the road system to maintain riparian and wetland function and fish habitat condition. These include:
1) Avoid new road construction through fen areas. These will require a large number of oversized drainage structures for fish passage, and require high maintenance due to expected beaver activity.

2) Avoid crossing alluvial fan channels, braided stream bottoms, or mass wasting areas.

3) Use road condition surveys to identify and prioritize road maintenance needs, emphasizing fish passage, improved wetland function, and reduction of sediments. Where possible, minimize maintenance needs by planning temporary roads which can be closed out after harvest entry by removing all drainage structures and putting the roads to bed.

Watershed Risk Assessment

We assessed the risk of cumulative effects for each watershed based on these factors:

1) Watershed Risk Index (provides a very general [by watershed] relative measure of potential sediment production and transport).
2) Level of existing human disturbance, including harvest of streamside riparian areas, total harvest within the watershed, and roading density.
3) Level of potential future human disturbance.
4) Fish habitat capability and location of subsistence and sport fisheries.

The results of this cumulative risk assessment are summarized in Tables 4-19, 20, and 21. Related concerns and management recommendations for watersheds with the highest concerns are summarized here by watershed.

Saltery. <u>Concern</u>: Highly productive fish stream. High overall Watershed Risk Index (WRI), with possibility of future harvest in potentially unstable soil areas and impacts to downstream fish habitat. Transport channels located upstream of Class I depositional streams. Potential roading along valley bottom Class I streams.

<u>Recommendation</u>: Provide wide buffers along large floodplain channels. Maintain windfirm boundaries along Class III channels and steep slopes. Avoid locating units which impact high sediment risk basins and reaches, including those on potentially unstable soils directly uphill of streams. Minimize roading in flood plain and wetland areas. Drainage structures should be designed according to the Aquatic Ecosystem Management Handbook.

Crab, Fog. <u>Concern</u>: Some existing harvest of stream riparian area, including along Class I streams. Moderate to high fish-production streams.

<u>Recommendation</u>: Maintain windfirm boundaries along Class III channels and steep slopes. Drainage structures should be designed according to the Aquatic Ecosystem Management Handbook.

Corner. Concern: Extensive roading and relatively high percentage (25%) of overall watershed harvest, including 17% of the stream riparian area and along 25% of Class I streams. Moderate to high fish-production stream. Beaver activity adjacent to existing roads.

Recommendation: Minimize additional harvest within designated riparian management areas. Continue to monitor existing road system and fish runs using fishpasses.

Muri. Concern: Relatively high percentage of overall watershed harvest, including 25% of the stream riparian area and along 46% of Class I streams (with recent buffer blowdown). Moderate Watershed Risk Index. Roading on footslopes (cutbanks) adjacent to Class I valley bottom stream.

Recommendation: Minimize additional harvest within designated riparian management areas. If considering additional harvest within the watershed, be cognizant of cumulative watershed impacts. Continue to monitor and maintain existing road system and stream buffers. Monitor thinned riparian second growth in lower valley.

Buckhorn. Concern: Roading; past harvest includes 10% of the stream riparian area and along 15% of Class I streams (with recent buffer blowdown). Winds off Chatham increase blowdown risk. High overall Watershed Risk Index, with possibility of future harvest in potentially unstable soil areas and impacts to downstream fish habitat. Moderate to high fish production stream. Beaver activity near existing roads.

Recommendation: Avoid locating units which impact high sediment risk basins and reaches, including on potentially unstable soil areas directly uphill of streams. Minimize future harvest in designated riparian management areas. Maximize windfirmness of boundaries along all stream channels. Continue to monitor and maintain existing road system and stream buffers.

Kook. Concern: Highly productive, karst influenced stream/lake system supporting a key subsistence and sport fishery (sockeye and cutthroat trout). Declining sockeye fishery closed in recent years. Roading along valley bottom channels, and relatively high percentage of overall watershed harvest, including 22% of the stream riparian area and along 44% of Class I streams. Moderate Watershed Risk Index.

Recommendation: Minimize additional harvest in designated riparian management areas. If considering additional harvest within the watershed, be cognizant of cumulative watershed impacts. Restore the sockeye salmon run important to the area subsistence fishery. Assess existing stream habitat survey data and repeat survey in the future to monitor trends in stream condition. Complete a watershed inventory and implement rehabilitation (second-growth riparian thinning, instream structures, etc.) where needed. Monitor and maintain existing road system and monitor stream/lake water quality.

Basket. Concern: Moderate to high overall Watershed Risk Index, with possibility of future harvest in potentially unstable soil areas and impacts to downstream fish habitat. Winds off Chatham increase blowdown risk. Potential road construction across steep slopes and Class 3 channels. Moderate to high production, karst influenced stream/lake system supporting a subsistence sockeye fishery.

Recommendation: Avoid locating units which impact high sediment risk basins and reaches, including on potentially unstable soil areas directly uphill of streams. Minimize size of individual harvest areas or leave trees within the harvest area. Minimize amount of harvest in any single entry. Maintain windfirm boundaries along all streams, including Class III channels and steep slopes.

White Rock. Concern: Highly productive fish stream. Extensive roading and past harvest throughout the watershed, including 16% of the stream riparian area and along 14% of Class I streams. Some road sections located on unstable footslope areas. Extensive wetland fen areas. Moderate Watershed Risk Index.

Recommendation: Minimize additional harvest within designated riparian management areas. Maintain windfirm boundaries along streams. Continue to monitor existing road system, fish runs using fishpass, and instream woody debris structures. Complete second-growth stream riparian thinning.

Sitkoh River. Concern: Highly productive fish stream. Roading along valley bottom channels, and relatively high percentage of overall watershed harvest, including 26% of the stream riparian area and along 36% of Class I streams. High overall Watershed Risk Index, with possibility of future harvest in potentially unstable soil areas and impacts to downstream fish habitat. Moderate amount of recent road construction across midslope area triggered one landslide. Beaver activity adjacent to existing roads in wetland fen areas.

Recommendation: Minimize additional harvest within designated riparian management areas. Avoid locating any additional units which impact high sediment risk basins and reaches, including on potentially unstable soil areas directly uphill of streams. Complete a watershed inventory and implement additional rehabilitation (second-growth riparian thinning, instream structures, etc.) where needed. Monitor trends in stream condition. Monitor and maintain existing road system.

Sitkoh Creek/Lake. Concern: Highly productive stream/lake system supporting key subsistence and sport fisheries (sockeye salmon and steelhead). Historical sockeye subsistence fishery closed in recent years due to declining escapements. Roading and relatively high percentage of overall watershed harvest, including 23% of the stream riparian area and along 29% of Class I streams. Low to moderate Watershed Risk Index.

Recommendation: Minimize additional harvest within designated riparian management areas. Complete an assessment of the lake condition and health of the sockeye salmon run important to the area subsistence fishery. Implement necessary restoration steps. Assess existing stream habitat survey data and repeat survey in the future to monitor trends in stream condition. Complete a watershed inventory and implement additional rehabilitation (second-growth riparian thinning, instream structures, etc.) where needed. Monitor and maintain existing road system.

False Island. Concern: Moderately productive fish stream. Extensive roading has occurred along valley bottom channels, and a high percentage of the overall watershed has been harvested. This includes 50% of the stream riparian area and has occurred along 86% of Class I streams. High overall Watershed Risk Index, indicating potential for elevated sediment delivery to fish habitat from harvest and roading activities. Beaver activity is adjacent to existing roads.

Recommendation: Additional harvest within the False Island watershed should be contingent upon a watershed analysis. No additional harvest within designated riparian management areas. Avoid locating any additional units which impact high sediment risk basins and reaches, including on SSAs directly uphill of streams. Assess the watershed inventory completed in 1995-1996 and implement additional rehabilitation (instream structures, replacement of drainage structures, etc.) where needed. Monitor trends in stream condition. Monitor the extensive second-growth riparian thinning completed in 1996. Monitor and maintain the existing road system.

Watershed Rehabilitation

About 10 of the 26 key watersheds have significant impacts from human activities. Some of these impacts have harmed fish habitat or other aspects of aquatic health. (See Chapter 4, Harvest within Riparian Zones, and Appendix F for more detailed information on impacts and watershed rehabilitation work).

To address these concerns we try to determine which factors most limit watershed function and health and then design projects to address them. The TLMP Revision (1997) provides direction for planning and implementing watershed rehabilitation projects. After inventorying the streams, riparian vegetation, road system and landslides, we plan and complete projects to help fix identified problems. Watershed rehabilitation work aimed at restoring, stabilizing, and improving water quality and fish habitat can include: stabilizing landslides, roads and cut banks along streams; repairing or removing drainage structures; placing large woody debris (LWD) into streams devoid of debris; connecting borrow ponds (fish rearing habitat) to streams; and thinning riparian second growth stands to increase understory diversity and promote faster growth of large trees for future sources of instream LWD and channel stability.

To date, inventory work has included: stream habitat surveys at Kook Creek, White Rock Creek, Sitkoh Creek and False Island Creek; stream riparian surveys at Sitkoh River, Sitkoh Creek and False Island Creek; road surveys of the Corner and Muri Creek system, and False Island and Sitkoh Creek road system. Watershed rehabilitation work has been completed in the False Island, Sitkoh River, Sitkoh Creek, Corner Creek, Muri Creek and White Rock Creek watersheds (Table 5-1).

Table 5-1. Rehabilitation Needs and Accomplishments.

Watershed	Inventory Status	Riparian Thinning need	Riparian Thinning accom	Fish Structures need	Fish Structures accom	Erosion Control need	Erosion Control accom
Corner	complete	N	0	N	0	Y	10 ac
Muri	no need	Y	? ac	?	0	Y	5 ac
Buckhorn	no need	N	0	N	0	N	0
Whale	no need	N	0	N	0	N	0
Kook	complete	N	0	N	0	N	0
White Rock	complete	N	0	Y	0.5 mi	N	0
Sitkoh River	planned	Y	0	Y	0	Y	0
Sitkoh Creek	complete	Y	5 ac	Y	0	Y	5 ac
Oly Creek	no need	N	0	N	0	N	0
False Island	complete	Y	20 ac	Y	1 mi	N	0

Riparian thinning treatment areas: Within the analysis area, many of the riparian associated stands are approaching the age and size where canopy closure is beginning to occur. Silviculture and other resource representatives, including those from fisheries, wildlife, hydrology and soils, should collectively produce prescriptions for these areas and implement thinning activities within the next ten years. Potential silvicultural treatments should address such factors as: desirable species mix, understory biodiversity and site conditions. General suggestions for implementing riparian regrowth treatments are listed in Appendix F.

Instream Large Woody Debris. Future watershed rehabilitation should include continuing to place large woody debris (LWD) into streams currently lacking debris. Use available stream survey information or complete additional stream surveys in areas impacted by past management activities to assess the current condition and trends of key stream habitat, and determine where additional instream LWD is needed.

Borrow Ponds. Rehabilitation work should include identifying existing borrow ponds, such as those in the False Island watershed, which can be connected to nearby streams to provide additional fish rearing habitat.

Lake Habitat (Sockeye Salmon) Restoration. The Kook Lake and Sitkoh Lake sockeye salmon stocks are important subsistence fisheries for many people in this area, including residents of Angoon, Tenakee Springs, Hoonah, Sitka, and Juneau. Both sockeye salmon stocks have been assessed or assumed to be in a declined state within the past decade or longer. Studies completed in 1992, 1994 and 1995 of the Kook Lake system found that the lake habitat quality (chemistry and primary production) is good, but there are not enough returning adult sockeye to seed the system to capacity. Bioenhancement should be investigated as a potential sockeye salmon rehabilitation method at Kook Lake. A lake enhancement feasibility study, similar to the one completed at Kook Lake, should be completed at Sitkoh Lake to help determine what factors may be limiting sockeye salmon numbers. More detailed information on restoring these fish runs is in Appendix F.

<u>Road Maintenance and Restoration.</u> Restoration work should involve placing drainage structures and/or ditching at existing washout sites, cleaning partially plugged culverts, and removing artificial barriers to fish passage (as determined from completed and future road inventories).

Future Work

During project level planning we recommend the following work be completed:

1) Assess the major sub-basins and reaches within each watershed and determine the site specific potential management-induced sediment production, transport and deposition.

2) Complete inventories of existing roads to assess sediment source areas and potential fish barriers, and recommend road rehabilitation work.

3) Complete additional stream riparian transects (by channel types) to verify and improve the existing stream riparian width information.

4) Update the existing stream, fen, and stream riparian GIS layers using field verification, digital orthophoto overlays and aerial photo interpretation. Use this to update information presented in this landscape analysis.

5) Use available stream survey information or complete additional stream surveys for representative channel reaches to assess the current condition and trends of key stream habitat within planning area watersheds. As directed in the TLMP Revision (1997) stream survey information (by channel type) should be compared to Regional Fish Habitat Objectives (Width to Depth Ratio, % Pool Area, % Pool Length, amount and distribution of Large Woody Debris, etc.).

Monitoring Objectives and Recommendations.

Follow general direction in the TLMP Revision (1997). Also, see IRWA Chapter 4, and recommendations in cumulative watershed effects risk appendix.

Human Use

Key Questions:

1) What patterns of prehistoric, historic, and current use can be identified within the Analysis Area? Have prehistoric and historic residents and users of the landscape had any effect on the landscape? What are some recommendations for future Archeological projects? [Covered in Chapters 4 and 5]

2) What are the subsistence resources within the Analysis Area? Who are the subsistence users of the Analysis Area and what portions of the Area do they use? Based on the available data, what is the degree of overlap between the most used areas and the highest quality winter deer habitat? [Covered in Chapter 4]

3**)** What has been the past recreation use of the Area? What is it currently and what will it be in the future? [Covered in Chapters 4 and 5]

4**)** Are there areas that have been changed by human management since 1956 and are there areas that exceed the maximum disturbance threshold? Which areas have the greatest capacity to be managed and still be visually acceptable? [Chapter 4 and Appendix H]

Heritage Resources

In Chapters 2 and 4 we spoke of "prehistoric and historic human use" of the Analysis Area. From a landscape perspective we have looked to the archeological record to shed some light on the nature of human interactions with and effect upon the landscape in the past. These prehistoric and historic sites are a subset of a larger category of resources called "heritage resources." Heritage Resources include prehistoric and historic sites as well as areas of traditional and spiritual significance for contemporary Native Americans. Heritage resources represent an important part of our local, regional and national cultural heritage.

When considering Project activities in the Analysis Area, the Forest Service will continue to comply with the provisions of the National Historic Preservation Act and the guidelines outlined in the Tongass Land Management Plan (RSDEIS Chapter 4.19-22). Section 106 of the National Historic Preservation Act requires that the Forest Service consider the effect of a project on "any site, building, structure, or object that is included in or eligible for inclusion in the National Register. "

The first step in the process of determining effects is, of course, site identification. Sitka Ranger District archeologists compiled all available information concerning the heritage resources of the Analysis Area prior to the 1996 field season. As discussed in Chapter 4, they consolidated information from many primary and secondary sources and conducted limited field surveys throughout the Analysis Area. They compiled a draft document entitled "The Southeast Chichagof Landscape Analysis Area: A Heritage Resource Review and Survey Report" (Muenster et al. 1997).

Considering the effects of agency actions on heritage resources within the Analysis Area is not enough. The National Historic Preservation Act and the Tongass Land Management Plan require far more than simple site protection. We have the opportunity to foster relationships with tribal entities in Angoon, Tenakee, Sitka and Hoonah and with the State Historic Preservation officer and with the public to consider, preserve and enhance areas of traditional cultural significance. We would like to foster relationships with academicians interested in learning more about the prehistoric and historic past in Southeast Alaska and facilitate archeological research efforts where appropriate. In consultation with the public and tribal entities, we would like to identify and develop appropriate interpretive messages for heritage resource sites. Similarly, we would like to promote public education projects within the Analysis Area.

The following list includes some suggestions for future Heritage Resource projects within the Analysis Area. The list is in no way complete; we have not asked for input from the public. It is meant only to provide "seed suggestions" and could easily be expanded.

- Consult with the Angoon Indian Association and other interested parties to foster a cooperative research excavation with an interested researcher or an academic field school at one of the large prehistoric sites on Peril Strait (VCU 245).

- Foster a cooperative oral history project to identify areas of traditional and spiritual significance for contemporary Native Americans in cooperation with the Angoon Indian Association and other interested parties.

- Initiate a cooperative interpretive project of the cultural history of the Basket Bay area in cooperation with Sealaska Corporation. The project would include the karst landscape and the relationship between karst features and the cultural history of the area (VCU 239).

- Initiate a cooperative project with interested groups or a Passports in Time project to research and interpret the history of the fishing industry (including once active canneries at Lindenberg Harbor and Sitkoh Bay).

- Research and interpret the historic use of Tenakee Inlet by loggers, fishers and trappers during the early part of this century with interested groups or as a Passports in Time project. This project could look closely at the relationship between historic sites and early 20th-century timber harvest (VCUs 230-237).

Recreation

In the future, we expect recreation use of the Analysis Area to increase. Southeast Alaska's remote maritime recreation opportunities, common to the Analysis Area, are unique and can be found in few other places in the world. The world-class hunting and fishing opportunities found in the Analysis Area will most likely increase in value in the world market. Thus, competition to provide these opportunities by guide or tour companies will also increase. Regulations restricting commercial recreation providers who operate in the Analysis Area may become a more common aspect of future recreation management. Managing the recreation resources for the future will require monitoring recreation use and user conflicts and adjusting to changing conditions. In the short term, we make the following recommendations. With the 1999 ROD, over 20,500 acres were moved from intensive and moderate development LUDs to Semi-remote recreation LUD.

Proposed Recreation Management. In general we recommend that the Southeast Chichagof Analysis Area continue to be managed for dispersed recreation, its current predominant use. The zones of highest recreation value and use in the Analysis Area are those along shorelines, particularly in bays with anchorages. Most of these shorelines are inventoried in the Semi-Primitive Motorized ROS class. On a Forest-wide basis, use of Semi-Primitive Motorized areas is anticipated to reach capacity within the decade (USDA Forest Service TLMP 1997). These Semi-Primitive Motorized areas are the most desirable and most used by recreationists, yet make up only 6% of the Analysis Area. We recommend that resources be managed to prevent negative impacts to shoreline Semi-Primitive Motorized areas and that recreation values of bays and shorelines be protected. Recreation Places, by definition, are areas which attract people and where recreation use tends to concentrate, thus they tend to be important to people. We suggest that management activities which may impact Recreation Places and their surrounding areas

be analyzed and planned to enhance those attributes which make an area a Recreation Place. If this is not possible, impacts to the recreation place are best minimized.
Specific Recreation Suggestions and Opportunities. Public scoping performed by the Sitka Ranger District indicated a desire by Tenakee Springs residents for construction of a survival shelter in Seal Bay just outside the Southeast Chichagof Analysis Area in Tenakee Inlet. The Sitka Ranger District constructed the shelter with assistance from Tenakee Springs volunteers. The three-sided shelter is available for emergency survival situations and recreation use. The presence of the shelter may help reduce the number of trespass structures constructed on National Forest lands.

If sufficient maintenance funds are available, we recommend that portions of the Corner Bay and False Island road systems remain open for motorized recreation use. In addition, maintenance for Forest Service cabins and trails, need to be sufficient to provide for safe use of the facilities and for customer satisfaction.

Social Values and Conflict

Through most of human history there has been an obvious connection between the primary extraction of natural resources and the creation of jobs and the production of finished goods. As we near the end of the 20th century these connections are more vague. Improved communication and transportation are linking the markets of the world. Because of this link, a local decrease in primary resource extraction no longer has as strong of an impact on employment and the production of finished goods (Daniels and Carroll 1993). In the modern marketplace, when local resource extraction decreases, other parts of the world market take up the slack. Higher productivity on the part of those people who work in primary extraction has required fewer people to be involved in it, contributing to increased urbanization.

Due to increasing urbanization, the rise of the environmental movement, and increasing cultural diversification of American society, many people see little reason for resource-extractive industries to continue, at least at the same rate as they have in the past. Based on the public comments for the TLMP revision process, 14% of the respondents from Southeast Alaska and 48% of the overall respondents "advocate greater environmental protection and believe the preferred alternative does not go far enough in regards to conservation, protection, or the minimization of resource extraction" (USDA Forest Service TLMP 1996). The 34% difference between those respondents who live in the region of primary extraction and those who live in the rest of the country speaks volumes about public perceptions towards natural resources management.

Although conflicts concerning natural resources seem to be at an unbearable high to those of us who work in the field of natural resources management, it is likely that these conflicts will continue to increase for the foreseeable future. Federal agencies (such as the Forest Service) are typically slow to respond to changing public opinion. Public participation will help to make us aware of the concerns and trends in public thinking while at the same time educating interested groups as to the constraints under which we are obligated to work and to the other groups to whose desires we must also be sensitive. Even if those who participate do not totally agree with the final management decisions made by the Forest Service, there is hope they will be more accepting of those decisions since they will have had visible input into them.

For future management of the Analysis Area, we suggest that those key publics interested in management of the Analysis Area be identified and a collaborative social process used to work with these publics. Obviously it is not possible to include every interested party in the United States but we can include local groups in our collaborative process. For the Analysis Area, some of the likely candidates for inclusion would be:

- Local city government representatives and community leaders from the towns of Angoon, Tenakee and Sitka (such as the Sitka Chamber of Commerce)
- The Sitka Conservation Society
- The Southeast Alaska Conservation Council (SEACC)
- The Alaska Forest Association
- The Angoon Community Association
- The Sitka Tribe of Alaska
- The Alaska Native Brotherhoods and Sisterhoods of Angoon and Sitka
- Sealaska Corporation
- Pro Sitka
- The Alaska Department of Fish and Game
- The Alaska Wilderness Recreation and Tourism Association (AWRTA)
- Holders of special use permits within the Analysis Area
- Individuals who own property within the Analysis Area

Scenic Resources

The Southeast Chichagof Analysis Area encompasses eighteen VCUs, each with its own distinct visual environments. Portions of many of the VCUs are viewed from Chatham Strait, Peril Strait and Tenakee Inlet. The travel routes of the Alaska Marine Highway System and the heavily travelled small boat routes are given the highest visual sensitivity designation. See Appendix H for a summary by VCU; and see Figure 1-2 for location of VCUs.

Appendix A - List of Preparers

James M. Thomas
Group Leader
Team staffing, guidance, and supervision. Assembled the Introduction, Ecosystem Management, and Forest Plan Direction.

- Michael Shephard

Ecologist, Landscape Analysis Team Leader
Biodiversity, Landscape Processes, Ecological Classification, Landtype Associations, Landscape Diversity, Climate.

- Bradley Flynn

Natural Resources Planner
Social Values and Conflict; Management History; Commodities and Economics; Human Use; Recreation support, direction, and editorial input.

- Lisa A. Winn

Silviculturist
Management History; Forest Vegetation Issues; Wind Patterns, Blowdown, and other Natural Disturbances; Human Disturbance; Second Growth.

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Archaeologist
Contributing author of "The Southeast Chichagof Landscape Analysis Area: A Heritage Resource Review and Survey Report". Human Environment, Prehistoric/Historic use, Ethnography, Subsistence, Karst. Primary coordinator of all Human Use sections.

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- Jacob Winn

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Archaeology field crew leader. Lead author of "The Southeast Chichagof Landscape Analysis Area: A Heritage Resource Review and Survey Report".

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GIS Support, Data Management.

Appendix B - Ecosystem Principles and Management History

Ecosystem Principles

In 1992, Forest Service Chief F. Dale Robertson signed a letter which committed the Forest Service to an ecological approach to management of the National Forests. He stated that this approach would be used to achieve multiple-use management of National Forests and that we must blend the needs of the people and the environment in such a way that the National Forests represent diverse, healthy, productive, and sustainable ecosystems. He also identified four basic principles that would apply to future management of the National Forests:

1. Take care of the land by protecting or restoring the integrity of its soils, air, waters, biological diversity, and ecological processes.

2. Take care of the people and their cultural diversity by meeting the basic needs of people and communities who depend on the land for food, fuel, shelter, livelihood, recreation, and spiritual renewal.

3. Use resources wisely and efficiently to improve economic prosperity of communities, regions, and the nation by cost-effective production of natural resources such as wood fiber, water, minerals, energy, forage for domestic animals, and recreation opportunities.

4. Strive for balance, equity, and harmony between people and land across interests, across regions, and across generations by sustaining what Aldo Leopold (1949) called the land community, meeting this generation's resource needs, and maintaining options for future generations also to meet their needs.

These principles initiated a reinvention of how the Forest Service looks at the land and its resources and formed the basis for much of the subsequent work in ecosystem management.

To add further meaning to the policy and principles in that letter, Chief Robertson attached a set of working guidelines for ecosystem management. These working guidelines are:

1. Focus on desired present and future conditions of the land and its human communities. Focus management actions to achieve desired current and future conditions of the land at multiple scales (Caplan 1992), always seeking to balance goals for the land with goals for the people.

2. Integrate thinking and actions at multiple spatial and temporal scales. Think about the effects of proposed actions at several geographic scales and through time (Forman and Godron 1986); at least one scale larger and one scale smaller

than the scale you are working at and at least for several decades in the future; more and longer if possible.

3. Be especially careful in sensitive areas. Protect special places such as wetlands, endangered species, rare plant populations, and cultural resources.

4. Employ the ecological capabilities and processes of the land. Work within the ecological potential of sites and landscapes, maintain native diversity, and employ nature's processes to the greatest degree possible.

5. Get people involved in planning and carrying out project work. Involve interested and affected people in the full process of making decisions about common resources; plan as if you are in a fishbowl to make sure everyone who wants to has access and knows what is going on; make conservation partnerships the rule rather than the exception.

6. Involve scientists through adaptive management. Monitor research, interpret, and adapt--integrate research with operational management and set resource management up as the continual experiment and learning opportunity that it always has been and always will be.

7. Integrate resource management for operational efficiency. Integrate resources, integrate actions across geographic scales, and build a community of interests--integrate everything and all the time but not necessarily everything on every acre at all times--this is biologically impossible and, therefore, technically infeasible. Use good judgment!

When Jack Ward Thomas became Chief of the Forest Service, he reiterated the Forest Service commitment to ecosystem management and issued a plan for the Forest Service based on the following goals:

1. Adopt an ecosystem management approach throughout the Forest Service.

2. Integrate ecosystem management into all activities.

3. Strengthen collaboration, flexibility, innovation and creativity.

4. Ensure our management actions are ecologically responsible, economically viable, and socially acceptable.

This was the challenge we faced as we began the Southeast Chichagof Landscape Analysis.

Management History

"...Public lands and their resources --among them fur, minerals, timber and agricultural lands--were major influences in the development of national policy in the United States" (Rakestraw 1981).

The United States purchased Alaska in 1867. Alaska was the last major area acquired by the United States that has been considered part of the original public domain and to which public land laws have applied. Logically, the history of the Southeast Chichagof Analysis Area is directly linked to nationwide and Alaska-wide public land use and forest use legislation and policies. Legislation has had a direct impact on land ownership in the analysis area while management policies have had an impact on land use.

In the following statements we present a synopsis of legislation and events which has been and/or continues to be directly relevant to the Analysis Area. In these paragraphs we periodically mention harvest levels on the Tongass. We present a more detailed description of Analysis Area harvest levels through time in Chapter 4, Human Disturbance.

Before 1950

- In 1891 the U.S. Congress passed the Forest Reserve Act. This act permitted the President to create forest reserves from the public domain (Rakestraw 1981).

- In 1898 U.S. Congress passed a law prohibiting commercial logging in the Alaska District. The act passed under the guise of protecting local settlers and Natives from timber speculators; however the real reason for the law was to protect the timber interests in Washington, Oregon and California (Matter).

- On May 14, 1898 Congress passed the Soldier’s Homestead Act. Christian Buschmann received title to 40.06 acres of land at Sitkoh Bay on January 1, 1908 under the authority of this act.

- In 1902 President Theodore Roosevelt established the Alexander Archipelago Forest Reserve by executive order. The 4.5 million acre reserve included the islands of Kupreanof, Kuiu, Chichagof, Prince of Wales, and Zarembo, as well as some smaller associated islands. Although a permit was required, logging was now allowed on government lands. The small scale hand loggers of the day ignored the permit requirement and continued to log beach fringe trees and tow them to local sawmills.

- On May 17, 1906, Congress passed the Alaska Native Allotment Act. Under this act Native ‘‘heads of households’’ could apply for ownership of up to 160 acres of land if they were able to show continuous use and occupancy of the land prior to establishment of the Forest Reserve. Under this act, two selections were made within the Analysis Area. The first of these Native Allotment parcels was approved on 10/29/38 when Andrew Jack received entitlement to 160 acres at

Kadashan Bay (in VCU 235, see Figure 1-2). The decision on the second Native Allotment selection, located in Sitkoh Bay, is still pending.

- On June 11, 1906 Congress passed the Forest Homestead Act. No parcels of land in the Analysis Area have been conveyed under this act.

- In 1908 President Roosevelt added the Baranof group and some adjacent mainland areas to the Alexander Archipelago Forest Reserve and changed the name to the Tongass National Forest.

- From 1909 through 1942 the timber industry in Southeast Alaska harvested from 15 to 45 MMBF per year on the Tongass. This timber was milled for local use or exported.

- Between 1943 and 1954 average Tongass harvest rose to between 50 and 85 MMBF. Most of the increase was exported as logs (Matter).

1950 through 1979

- 1950s. Elected officials, local citizens, and the Forest Service saw natural resource industry development as a way to provide year-round jobs to support the communities of Southeast Alaska. Fifty-year, long-term contracts requiring mill construction were developed to provide incentive to invest in construction of expensive pulp and saw mills. Originally, four long-term contracts were proposed. On 07/26/51 a 50-year contract was awarded to the Ketchikan Pulp Corporation. A second contract was awarded on 1/25/56 to the Alaska Lumber and Pulp Company (ALP) (Matter). Contracts with the US Plywood-Champion Paper Company and the Pacific Northern Timber Company were also awarded in this time period (Brink 1993).

- By 1955 timber harvest levels on the Tongass National Forest rose to approximately 200 MMBF per year.

- In 1959 Alaska became the 49th state of the United States. The Alaska Statehood Act authorized the state to select 400,000 acres on the Chugach and Tongass National Forests for eventual conveyance to the state. No lands were selected within the Analysis Area.

- From 1960 to 1969 the average annual harvest was 429 MMBF per year. Logging was commonly performed using a barge or log raft mounted A-frame. The logs were cabled downhill to the beach .

- During the 1970s, the average annual harvest on the Tongass rose to 462 MMBF per year.

- On December 18, 1971 Congress passed the Alaska Native Claims Settlement Act (ANCSA) to settle land claims of Alaskan Natives. The act gave Alaska Natives

$962 million in cash and approximately 44 million acres of land including [under Section 14(h)(1)] 2 million acres for Native cemetery and historic sites (Rakestraw 1981). All Native selections under this act have been made; however, the conveyance process is not complete. [As of October 1995 approximately 544,400 acres of the approximately 560,700 selected acres had been conveyed to one regional, 9 village, and 2 urban corporations established in Southeast Alaska by the act (TLMP, Revised Supplement to the DEIS 1996).] Within the Southeast Chichagof Analysis Area, VCUs 239 to 243 and 245 include selected lands. The eastern portion of these VCUs are within the Angoon withdrawal and have been selected by both Sealaska Corporation and Kootznoowoo, Inc. Section 908 of ANILCA provides that these lands may not be entered by a timber contractor nor can the timber be cut except by agreement with the Native corporations, so long as they have remaining entitlement. There are four Native Cemetery and Historic Sites within the Analysis Area which have been selected and conveyed to Sealaska Corporation under Section 14(h)(1) of ANCSA. These include 10.66 acres at Hoonah Sound Village on the north shore of Peril Strait, 14.54 acres at Basket Bay Village on the west shore of Chatham Strait, 17.50 acres at the Sitkoh Creek Petroglyphs, and 7.0 acres at Point Craven Village near the east end of Peril Strait.

- During the 1970s, annual average harvest on the Tongass rose to 462 MMBF per year.

- In 1976 the contract with the US Plywood-Champion Paper Company was cancelled by mutual consent. No ground operations for this contract had ever occurred. (Brink 1993)

- In 1979 the Chief of the Forest Service signed the Tongass Land Management Plan (TLMP), the nation’s first national forest land management plan. The Tongass Land Management Plan established guidelines for acceptable land uses. We discuss TLMP and Land Use Designations (LUDs) in greater detail in Chapter 1.

Since 1980

- In 1980 Congress passed the Alaska National Interest Lands Conservation Act (ANILCA). With the passage of ANILCA, Congress recognized the importance of subsistence resource gathering to the rural communities of Alaska. ANILCA (16 USC 3113) defined subsistence as: "The customary and traditional uses by rural residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of nonedible by-products of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade." ANILCA provided for "the continuation of the opportunity for subsistence uses by rural residents of Alaska, including both Natives and non-Natives, on public lands." It also stated as policy that subsistence uses of renewable resources shall be the priority consumptive uses of all such resources on the public lands of Alaska. ANILCA also authorized the Tongass Timber Fund to augment timber sales and mandated a timber supply rate of 4.5 billion board feet per decade. ANILCA also required the evaluation of effects of National Forest management on subsistence uses and the evaluation of alternatives to minimize adverse effects. ANILCA established 5.5 million acres of Wilderness in 14 separate Wilderness Areas and two National Monuments.

- In 1981 ground activities for the Pacific Northern Timber Company contract were completed. The contract had been shortened to 25 years because the company had built the required sawmill but not the pulp mill specified in its contract. (Brink 1993)

- During 1985 and 1986 the Forest Service amended TLMP to reflect ANILCA.

- In 1990 Congress passed the Tongass Timber Reform Act (TTRA). The TTRA repealed the 4.5 billion board feet per decade harvest level and the Tongass Timber Funds specified by ANILCA. The TTRA also required operators working on the long-term contracts to harvest higher volume class timber only in proportion to its occurrence (calculated by VCU). It also mandated 100-foot-minimum buffers on all Class 1 fish streams and those Class 2 fish streams which flow into Class 1 streams. The TTRA designated five new wilderness areas and 12 new legislated LUD II areas. This prohibited logging on 700,000 acres of the Tongass National Forest.

- On September 30, 1993 the Alaska Pulp Corporation indefinitely suspended its pulp mill operations in Sitka.

- On April 14, 1994 the U.S. Forest Service canceled the long-term timber sale contract with APC due to a breach of a contract provision which required APC to operate a pulp mill or similar facility.

- After the cancellation of the APC contract in 1994, timber volume from the Analysis Area was offered as independent sales or to KPC to help the Forest Service meet its contractual obligations to KPC.

- On November 1, 1994 the Alaska Wilderness Recreation & Tourism Association (AWRTA) filed a lawsuit claiming the cancellation of the APC contract made the purpose and need for timber harvest, cleared under several Tongass National Forest EISs, no longer valid. Some of the Analysis Area was included in this lawsuit. Settlement was agreed upon on May 22, 1996.

- In 1996 KPC attempted to obtain a 15-year extension to its long-term timber sale contract. The extension was denied. KPC announced plans to close of its Ketchikan pulp mill. The Secretary of Agriculture stated the Administration would consider the closing of the pulp mill a material breach of KPC's contract.

- In May of 1997 the U.S. Forest Service released the Tongass Land Management Plan Revision.

Management Boundaries

Value Comparison Units (VCUs). In 1979, the Tongass Land Management Plan (TLMP) established Value Comparison Units (VCUs) for the Tongass National Forest (USDA 1979). These VCUs are distinct geographic areas that generally encompass a drainage basin or watershed containing one or more large stream systems. Boundaries usually follow easily recognizable watershed divides. These units provide a common set of areas for resource inventories and resource value interpretations. Table 1 displays the TLMP VCU acres and the Analysis Area VCU acres.

Table 1. VCU Acre Comparisons

VCU	TLMP Acres	SELSA Acres	Difference	Percent
230	9,479	9,396	-83	-0.88%
231	18,411	18,925	514	2.79%
232	11,371	11,259	-112	-0.98%
233	10,372	10,102	-270	-2.60%
234	5,967	5,807	-160	-2.68%
235	34,298	34,300	2	0.01%
237	6,473	6,473	0	0.00%
238	9,930	9,835	-95	-0.96%
239	17,430	17,346	-84	-0.48%
240	9,564	9,384	-180	-1.88%
241	7,614	7,642	28	0.37%
242	11,420	11,459	39	0.34%
243	27,173	27,209	36	0.13%
244	11,969	12,283	314	2.62%
245	24,208	23,919	-289	-1.19%
246	16,915	17,291	376	2.22%
247	16,386	16,386	0	0.00%
Total	259,884	260,048	164	0.06%

When VCUs were established by the TLMP, they were mapped at a scale suitable for Forest planning. The boundaries, as established, were digitized into the Tongass National Forest Geographic Information System (GIS) as they were originally mapped. The original, established boundaries continue to be used today for Forest-scale analysis. In project-level planning, however, the scale and accuracy of the VCU boundaries established by the TLMP are not adequate. As a result, an early step in most project-level planning is to refine VCU boundaries to accurately reflect watershed divides and other geographic features that TLMP VCU boundaries were intended to follow. This refinement results in minor acreage discrepancies between project and Forest Plan VCUs, but usually has little other effect.

The southeast Chichagof Analysis Area contains 18 VCUs (Figure 1-2). We decided early in the analysis process to use refined, project VCU boundaries for the Analysis Area. As a result, the VCU boundaries and their acreages vary from those established by the TLMP in 1979. These acreage discrepancies are not significant.

Appendix C. Lands Resource Report

(Prepared by: Lorraine P. Thomas)
Date: November, 1996
Minor revision: January, 1998

There are approximately 269 acres of private land in the analysis area. These are located along the shore in small parcels. Additionally, approximately 10,545 acres are overselected by Kootznoowoo Inc. and Sealaska Regional Corporation in what is called the Angoon Withdrawal. These overselected lands are currently restricted from timber harvest until the conveyance process is completed.

Listing of Private Lands, Encumbrances, Use Restrictions, and Partial Interests Within the Study Area. Sources: BLM Master Title Plats (MTP) and Historical Index (as of 1/22/98), Land Status Atlas (as of 1/22/98), BLM Mining Claim Computer Listing (dated 9/6/92), GIS, Sitka Ranger District Log Transfer Facility (LTF) records and Special Use records, and the sources listed in the bibliography at the end of this report.

Private Lands

The Southeast Chichagof Landscape Analysis area contains primarily National Forest System lands with six parcels of private land or lands of other ownership:

Hoonah Sound Village. USS 559837 located in VCU 246; USGS Quad Sitka C-5 SE; Sec. 14, T49S, R62E, CRM - conveyed 9/29/86 to Sealaska Corporation under authority of Section 14(h)(1) of the Alaska Native Claims Settlement Act of 1971 (ANCSA) - BLM Case File AA-10486, Parcel A. Surveyed 2/6/91, 10.66 acres.

Basket Bay Village. IC-1261 located in VCU 239 (Basket Bay); USGS Quad Sitka C-3 NW; T48S, R65E, CRM - 14.54 acres conveyed 9/30/86 to Sealaska Corporation under authority of Sec. 14(h)(1), ANCSA - BLM Case File AA-10504.

Sitkoh Creek Petroglyphs. IC-1273 located in VCU's 243 and 244 (Sitkoh Bay); USGS Quad Sitka C-3 SW; T50S, R65E, CRM - 17.50 acres conveyed 9/30/86 to Sealaska Corporation under authority of Sec. 14(h)(1), ANCSA - BLM Case File AA-10515 - two easements reserved under authority of Sec. 17(b), ANCSA:

EIN 1 D9 G C4 C5 - 25 ft. wide easement for Sitkoh Lake Trail.
EIN 2 G - 100 ft. wide easement for a proposed road.
EIN 3 D1 C4 C5 - a 1 acre site easement at the mouth of Sitkoh Creek
EIN 4 C4 C5 D1 - a 25 foot wide trail easement

Chatham Cannery. Native Allotment Cert. 73, USS 290 located in VCU 243 (Sitkoh Bay); USGS Quad Sitka C-3 SW; T50S, R65E, CRM - 40.06 acres patented 1/20/08 as a Precreation Soldier's Homestead to Christian Buschmann under authority of the Act of May 14, 1898 - BLM Case File AA-70788, Serial # Juneau 73.

Kadashan Bay. Native Allotment, USS 1836 located in VCU 235; USGS Quad Sitka C-4 NW; T48S, R63E, CRM - 159.64 acres (includes some tidelands) allotted 10/29/38 to Andrew Jack under authority of the Act of May 17, 1906, Serial # 06600.

Point Craven Village Site. IC 1561 located in VCU 245 (Point Craven); USGS Quad Sitka B-3 NW; T51S, R66E, CRM - 7.0 acres conveyed 5/26/93 to Sealaska Corporation under authority of Sec. 14(h)(1), ANSCA - BLM Case File AA-10513.

State Selections

The Alaska Statehood Act of 1959 authorized the State of Alaska to select 400,000 acres of National Forest System lands. The Alaska National Interest Lands Conservation Act of 1980 (ANILCA) provides that the State had until 1994 to complete its selections. The State of Alaska has completed its National Forest selection process and most of the land requested has been approved by the Forest Service. No State selections occurred within the Landscape Analysis Area.

Native Selections

The Alaska Native Claims Settlement Act of 1971 (ANCSA) provided for conveyance of certain lands to the ten Native village corporations, the two Native urban corporations, and to the one Native regional corporation located in Southeast Alaska, and up to 160 acres to Native individuals who had occupied that land as a primary place or residence on August 31, 1971. As of October 1995, approximately 544,400 acres of a total of approximately 560,700 acres had been conveyed (TLMP, Final Environmental Impact Statement, January, 1997). All Native selections have been made, but the conveyance process is not complete.

VCUs 239 to 243, and 245 contain Native selections within the Southeast Chichagof Landscape Analysis Area. The eastern portion of these VCUs are within the Angoon Withdrawal and have been selected by both Sealaska Corporation and Kootznoowoo, Inc. Section 908 of ANILCA provides that these lands may not be entered by a timber contractor nor can the timber be cut except by agreement with the Native corporations, so long as they have remaining entitlement.

There are three Native Selections in the Landscape Analysis Area:

Kootznoowoo, Inc. Selection application AA-6978-C located in VCU’s 239 to 243, and 245 (Whiterock); T49S, R66E; T50S, R66E; T51S, R66E; CRM - selected under authority of ANCSA.

Kootznoowoo, Inc. Selection rights to 20 contiguous acres within Sections 29 to 33, T48S, R65E, CRM at Basket Bay (VCU 239), subject to valid existing rights and designation of a trail easement, as provided in Section 506(a)(4) of the Alaska National Interest Lands Conservation Act of December 2, 1980 (ANILCA).

Sealaska Regional Corporation. Selection application AA-14015 located in VCU's 239 to 243 and 245 (Whiterock); T49S, R66E; T50S, R66E; T51S, R66E; CRM - selected under authority of Sec. 14(h)(8), ANCSA. Conveyance is currently in progress.

Native Allotment Applications

The Alaska Native Allotment Act of 1906 provided that Native individuals who had occupied lands prior to the designation as National Forest could apply for conveyance of up to 160 acres. ANCSA repealed the Native Allotment Act, eliminating future allotments.

One Native allotment application was pending in the Landscape Analysis Area, but has recently been rejected by BLM:

AA-059061. Located in VCU 243 (Sitkoh Bay); T50S, R65E, CRM - applied 4/6/87 under authority of the Alaska Native Allotment Act of 1906, occupancy since 1938, BIA Cert. Rejected by BLM on 7/15/97.

Mining Claims

None, as per BLM computer printout dated 9/6/92. All prior claims within the study area have been closed by BLM without conveyance.

Withdrawals

McClellan Rock Lighthouse Reserve. Located in VCU 245; USGS Quad Sitka B-4 NE; T51S, R65E, CRM - .10 acres withdrawn indefinitely on 2/13/21 under authority of EO 3406, Parcel 94.

Point Craven Lighthouse Reserve. Located in VCU 245; USGS Quad Sitka B-3 NW; T51S, R66E, CRM - .50 acres withdrawn indefinitely on 2/13/21 under authority of EO 3406, Parcel 73.

Tideland Permits

There are six current tideland permits in the Landscape Analysis Area. Three tideland permits, located at the east and west sides of Sitkoh Bay, and at Oly Creek, have expired. A State Easement Grant was issued to the Forest Service to construct a Log Transfer Facility at Trap Bay, but facilities will not be built. The site is now legislatively designated LUD II under the Tongass Timber Reform Act of 1990. The current tideland permits are:

Broad Creek. SET 94-017 located in VCU 245; USGS Quad Sitka C-4 and C-5, T49S, R62E CRM. Tideland Permit issued to the USDA Forest Service on 4/15/94 authorizing construction and maintenance of a Log Transfer Facility (LTF), dolphins, loading ramp, and dock, expires 4/14/99. Corresponding DOA Corps Engineers Permit Broad Creek I was issued to the Forest Service on 5/20/94, modified on 9/25/95, construction authorization ends on 3/31/97, permit expires 5/20/09. Facilities have not been constructed.

Corner Bay. ADL 100237 located in VCU 236; USGS Quad Sitka C-4 NE; Sec. 1, T48S, R63E, CRM - 96.30 acre State Easement Grant issued to the USDA Forest Service on 7/26/83 authorizing construction and maintenance of a Log Transfer Facility (LTF), expires 7/25/2008. Corresponding DOA Corps Engineers Permits are Tenakee Inlet 17 and 25. Tenakee Inlet 25 was issued to the U.S. Forest Service on 2/2/81, modified on 10/18/88, with no expiration date. Facility has been constructed. Corresponding EPA NPDES Permit is AK-004831-3 issued to the Forest Service on 10/7/88, expires 10/6/92. Renewal was requested on 3/5/92.

Crab Bay. ADL 103944 located in VCU 233; USGS Quad Sitka C-4; Sec. 1, T48S, R62E, CRM - 194.95 acre State Easement Grant issued to the USDA Forest Service on 5/1/85 authorizing construction and maintenance of an LTF, expires 4/30/2000. Corresponding DOA Corps Engineers Permit is Tenakee Inlet 20 issued to Alaska Lumber and Pulp Company, Inc. on 12/21/76, modified on 5/2/78 and 9/18/78, to authorize addition of a boat dock and walkway was transferred to the Forest Service on 9/1/94, no expiration date. Facility has been constructed. On 1/24/95, the DOA Corps Engineers issued a modification authorizing changes to construct a low angle slide, however the corresponding Coastal Zone Consistency Final Determination is pending .

False Island. ADL 104598 located in VCU 245; USGS Quad Sitka C-4; Sec. 13, T50S, R63E; Sec. 18, T50S, R63E, CRM - 15.6 acre State Easement Grant issued to the USDA Forest Service on 5/26/88 authorizing construction and maintenance of an LTF, expires 5/25/98. Corresponding DOA Corps Engineers Permit is Peril Strait 14 issued to Alaska Lumber and Pulp Company, Inc. on 2/8/66, transferred to the Forest Service on 3/17/89, no expiration date. Bulkhead was removed in 1994. On 4/5/95 the DOA Corps Engineers Permit Peril Strait 14 was modified to allow construction of a permanent float dock facility, which has been constructed. On 9/19/96, the Forest Service submitted application for a long term lease for the same area as covered in the State Easement Grant.

Inbetween Creek. ADL 103945 located in VCU 230; USGS Quad Sitka D-5; Sec. 6, T47S, R62E, CRM - 104.35 acre State Easement Grant issued to the USDA Forest Service on 10/21/85 authorizing construction and maintenance of an LTF, expires 10/20/2000. Corresponding DOA Corps Engineers Permit is Tenakee Inlet 24 issued to Alaska Lumber and Pulp Company, Inc. on 7/11/79 with no expiration date; however, if not constructed by 7/11/86, authorization expires. A temporary structure was constructed for beach bundle lift off. It has been removed and the site restored. On 2/8/95 DOA Corps Engineers issued to the Forest Service a modification to Tenakee Inlet 24 to install a drive down ramp. Work must be completed by 1/31/98.

Lindenberg Harbor (Todd). ADL 103478 located in VCU 245; USGS Quad Sitka B-4 NE; Sec. 8, T51S, R65E, CRM - 33.6 acre State Easement Grant issued to the USDA Forest Service on 7/26/83 authorizing construction and maintenance of an LTF, expires 7/25/2008. Corresponding DOA Corps Engineers Permit is Peril Strait 21 issued to

Alaska Lumber and Pulp Company, Inc. on 8/8/72, transferred to the Forest Service on 12/9/82, no expiration date. Facility has been constructed.

Non-Recreation Special Use Permits

Chatham Cannery, Sitkoh Bay. Permit to Chatham Cannery Ltd. issued 3/16/92 authorizing the trespass portion of the old Chatham Cannery bunkhouse, expires 12/98. Located at the east end of Chatham Cannery (Sec.32 T.50S. R.65E.) in VCU 243

Moore Mt. electronic site. Permit to Silver Bay Logging. Issued 3/29/96 authorizing occupancy and use of an electronic site, expires 12/99. Located on Moore Mt. (Sec.31 T.49S. R.64E.) in VCU 245.

Crab Bay cabin. Permit issued 4/24/71 authorizing occupancy and use of an isolated cabin, expires 12/02. Located at the northern mouth of Crab Bay. (Sec.35 T.48S. R.62E.) in VCU 232.

False Island helicopter fuel storage and landing site. Permit issued 1/96 authorizing fuel storage and landing at the road end adjacent to the False Island dock, expires 12/00. Located on the northern shore of Peril Strait. (Sec.18 T.50S. R.64E.) in VCU 245.

Kadashan River camp and weir. Permit issued 3/69 authorizing occupancy and use of a cabin, storage, fisheries related facilities and weir, no expiration date. Located about 1/2 mile south of the head of Kadashan Bay. (Sec.21 T.48S. R.63E.) in VCU 235.

Other National Forest Use

Maye Thomas Cabin. The City of Tenakee Springs is using the old cabin at Little Saltery Bay as a survival shelter. (Sec.21 T.47S. R.62E.) in VCU 231.

Trap Bay camp and research facilities. The Forestry Sciences Lab is using a cabin and trail system in connection with research. Located at the mouth of the Trap River system at Trap Bay. (Sec.3 T.48S. R.64E.) in VCU 237.

Transportation and Utility Systems

Transportation and utility systems are major rights-of-way corridors and their associated sites. These systems include State and Federal highways, powerlines of 66 kV capacity of greater, and pipelines 10 inches or more in diameter if they are a public utility. The Tongass Land and Resource Management Plan 1997 includes a Transportation and Utility System Land Use Designation (LUD) which can be applied to these potential corridors.

The Tongass Land and Resource Management Plan 1997 includes a potential power transmission corridor within the Southeast Chichagof Landscape Analysis Area. The corridor enters the Analysis Area near Lindenberg Head from Baranof Island. It extends to the head of Sitkoh Bay where it forks. The north fork proceeds through Kadashan Bay then to Tenakee Springs and beyond. The south fork extends to Angoon where it terminates. Until potential power transmission corridors are constructed, the area would be managed according to the other land use designation indicated (TLMP 1997). There are no existing power transmission corridors, nor any existing or proposed State road corridors within the analysis area (TLMP 1997).

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Appendix D - Climatic Data

The nearest climatic station is at Tenakee Springs (Latitude 57°47’, Longitude 135°12’) near the north side of the Analysis Area. Data from this station indicates only 28 °F (15.5°C) difference between the mean average temperatures of the warmest and coldest months. The climate is predominantly cloudy, cool, and wet throughout the year. The normal storm track aims frequent "Gulf Lows" at southeast Alaska (Curtis 1993). Short-term measurements in the Kadashan River watershed indicate that it receives approximately 66 in. (1670 mm) of precipitation a year (Stednick 1981). A climate station on the outer coast of Chichagof Island receives 113 in. (2870 mm) of precipitation, while Angoon on the west coast of Admiralty Island receives an average of 39 in. (991 mm) of precipitation (Farr and Hard 1987). All of these measuring stations are very close to saltwater and are less than 50 ft. (15 m) in elevation. Precipitation at higher elevations further inland varies considerably (Farr and Hard 1987).

Table 1. Climatology Information for Tenakee Springs, Alaska.

	Metric	English
Mean annual temperature	5.7 °C	42.3 °F
Mean temp. May-Sept.	11.7 °C	53.1 °F
Mean temp. June-Aug.	12.9 °C	55.3 °F
Mean temp. warmest month (Aug)	13.5 °C	56.3 °F
Mean temp. Nov.-Feb.	-0.6 °C	30.8 °F
Mean temp. coldest month (January)	-3 °C	28.6 °F
Mean number of days of frost	210	210
Mean frost-free period (days)	146	146
Mean number of months with mean monthly temp. greater than 10 °C (50 °F)	4	4
Mean number of months with mean monthly temp. below 0 °C (32 °F)	3	3
Mean total precipitation	1605 mm	63.2 in.
Driest month: June Mean total ppt. June	64 mm	2.5 in.
Wettest month: October Mean total ppt. October	286 mm	11.3 in.
Mean number of days with measurable ppt.	152	152
Mean annual potential evapotranspiration (Thornthwaite method) (Patric and Black 1968)	533 mm	21.0 in.

Averages from 1941 to 1951 (Farr and Hard 1987).

Appendix E - Landtype Association Descriptions

Alpine and subalpine summits and ridges

Geomorphic Setting. This unit includes alpine and subalpine areas on both gently sloping summits and steep side slopes (10 to 120% slopes). The summits are both rounded and rugged. Many of the rugged summits are limestone and have many karst features. The soils are shallow and primarily formed in residuum or colluvium. On some of the flatter benches, the soils are slightly deeper and may have an organic epipedon (USDA Forest Service 1986).

Hydrologic function. This LTA is both a *conveyor* and a *receptor*. Sheet flow and shallow pools appear temporarily during large storm events. This association conveys water to downslope landscapes. These areas accumulate considerable snow during some winters, which often lasts into May (Garvey et at, unpublished map). Water primarily moves via surface and subsurface runoff in summit areas with bedrock other than limestone. Where limestone occurs, water also moves through subsurface fissures and streams (USDA Forest Service in prep). This water therefore often bypasses the downslope Steep Forested Mountain Slopes LTA to resurface as springs and resurgent streams above the valley floor. The soils are moderately well to somewhat poorly drained.

Vegetation, disturbance, and successional pathways. These summits and ridges generally have extensive areas of heath plant community types. Crowberry (*Empetrum nigrum*), Luetkea (*Luetkea pectinata*), Mertens mountain-heather (*Cassiope mertensiana*) and deer cabbage (*Fauria crista-galli*) are common species. Where soil has developed, these alpine and subalpine slopes have a rich diversity of plants, especially on the calcareous summits. Mountain hemlock (*Tsuga mertensiana*) with minor amounts of Sitka spruce (*Picea sitchensis*) occurs in protected areas as a dwarf forest called *krummholz*. Tall blueberry (*Vaccinium spp*.) and copperbush (*Cladothamnus pyrolaeflorus*) are scattered among the trees (Martin et al. 1995). Alpine meadows, rock outcrop, and fellfield communities also occur. Disturbance processes include snow creep and wind effects. Successional changes are slow and plant communities are relatively fragile.

Brushfields

Geomorphic Setting. These snow accumulation and avalanche slopes are dominated by communities of Sitka alder and salmonberry. The steep avalanche slopes (50-140% slope) occur below summits and typically grade into Forested Mountain Slopes, depending on the slope and the avalanching that occurs. Avalanche slopes may extend to the valley floor in some areas. Mass wasting events are partially responsible for location and extent of this association. Water flowing over an impermeable layer probably initiates the mass wasting events. The soils are shallow to bedrock and have a high percentage of rock fragments. The soils are deeper in depositional areas with moderate slopes (USDA Forest Service 1986).

Hydrologic function. These surfaces are moderately well drained and often have ample water running through the soil parallel to the slope. This association is a conveyer and donor of water to downslope associations (USDA Forest Service 1986).

Vegetation, disturbance, and successional pathways. These brushfields are dominated by Sitka alder (*Alnus sinuata)* and salmonberry (*Rubus spectabilis).* Other common species include lady fern (*Athyrium filix-femina),* Sitka willow (*Salix sitchensis),* stink currant (*Ribes bracteosum),* and false hellebore (*Veratrum viride).* Inclusions of subalpine meadows and krummholz mountain hemlock communities also occur. In some areas, Sitka spruce is slowly invading the brushfields (pers. observ.). This may be due to less snow accumulation and avalanching since the end of the Little Ice Age (approximately 1850).

Steep Forested Mountain Slopes

Geomorphic Setting. These forests occur primarily on steep slopes (50%+) on parent material of colluvium and residuum (Martin et al. 1995). Some of the steepest areas probably originated via disturbances such as Little Ice Age avalanche tracks. Slopes are commonly broken or frequently dissected by small streams. This is a common type within this subsection.

Hydrologic function. This association is very steep and hence water is conveyed quickly to downslope LTAs such as the Colluvial/Fluvial/Coastal Surfaces landtype association. The soils are shallow to very deep and well to moderately well drained (USDA Forest Service 1986).

Vegetation, disturbance, and successional pathways. The dominant overstory species are Sitka spruce *(Picea sitchensis*), mountain hemlock (*Tsuga mertensiana*), and western hemlock (*Tsuga heterophylla*). Devil's club (*Oplopanax horridum*), blueberry (*Vaccinium* spp.) and copperbush (*Cladothamnus pyrolaeflorus*) [at higher elevations] are the primary tall shrubs (Martin et al. 1995). There also are open stands of mountain hemlock at higher elevations. On benches of broken slopes, mixed conifer open forest and nonforested wetland areas occur as inclusions in this LTA. Disturbance factors such as wind, snow, and soil movement are frequent enough to maintain Sitka spruce as a dominant tree species in this association.

Moderately Steep Forested Slopes

Geomorphic Setting. This unit contains productive forested slopes (10-45% slope) on parent material of till, colluvium, and residuum.

Hydrologic function. Water moves through these slopes, but not as quickly as it does through the Forested Mountain Slopes. This association is less steep and contains more benches than the Forested Mountain Slopes.

Vegetation, disturbance, and successional pathways. The dominant overstory species are western hemlock (*Tsuga heterophylla),* Sitka spruce (*Picea* *sitchensis)*, and yellowcedar (*Chamaecyparis nootkatensis*). A wide variety of plant associations from the western hemlock, western hemlock-yellowcedar, and mixed conifer series occurs on this association. Devil's club (*Oplopanax horridum*) and blueberry (*Vaccinium* spp.) are the dominant tall shrubs. Bench inclusions may have mixed conifer open forest or nonforested wetland vegetation.

Forested Hills

Geomorphic setting. This landscape is primarily located on compact till. Organic soils develop in swales where drainage is slowed because of low permeability and gentle terrain. The soils are shallow over the till on slopes. These areas have no direct connection to alpine summits or ridges.

Hydrologic function. These areas are receptors and conveyors of water. Numerous depressions and swales are very poorly drained, while areas of colluvium are well drained (USDA Forest Service 1986).

Vegetation, disturbance, and successional pathways. The forests are moderately to marginally productive for timber. Two common plant associations are western hemlock/blueberry and mixed conifer/blueberry. The vegetation mosaic is slowly changing, as some areas are invaded by *Sphagnum* moss and other wetland species while other areas slowly accumulate enough upland microsites that upland species dominate. Skunk cabbage (*Lysichitum americanum*) is a common forb in the wetter areas.

Colluvial/Fluvial/Coastal Surfaces

Geomorphic setting. Fluvial and colluvial processes are the primary influences along the flood plains, dissected footslopes, alluvial fans, uplifted beaches and rock headlands of the study area. The substrate within the river corridors is primarily gravel and coarse sand alluvium with inclusions of colluvium. Footslopes also have mineral soils with colluvium and alluvium in fan areas. Uplifted beach sediments are generally sand and gravel. These surfaces are all well to moderately well drained.

Hydrologic function. Except for the gently sloping or flat uplifted beaches, this landtype association is a major conveyor of water downslope. Within the flood plains, the soils are generally well drained near present channels. Farther away from current channels, the soils may be somewhat poorly drained because of old overbank deposits and beaver activity. Soil development is dependent on surface age, material size, degree of material sorting, and flooding disturbance periodicity. Uplifted beaches are receptors of upslope water and conveyors of water to tidal flats and estuaries.

Vegetation, disturbance, and successional pathways. On the frequently disturbed flood plains and fans, the vegetation is composed of a wide to narrow band of red alder (*Alnus rubra*), Sitka alder (*Alnus sinuata*), and salmonberry (*Rubus spectabilis*). Highly productive Sitka spruce and western hemlock forests dominate the raised alluvial terraces above the yearly flood plain communities and the uplifted beaches and rock headlands. Disturbance maintains Sitka spruce as the dominant of most stands within this LTA. Infrequently disturbed alluvial terraces and colluvial slopes may have mixed conifer forest, tall shrub communities (e.g., Sitka willow [*Salix sitchensis*]), or nonforested wetlands.

Lowland Wetland-Forest Complex

Geomorphic Setting. Wide areas of forested and nonforested peatlands occur on compact till and glaciomarine silt deposits on flat to gently sloping areas. The soils are deep organics with inclusions of better drained mineral soil throughout.

Hydrologic function. Water primarily enters the system from precipitation. Water moves slowly across these wetlands except during large storm events, when the whole organic mat becomes saturated and sheet flow occurs. These wetlands are important in water retention for flood control. This LTA is primarily a donor of water to other landscapes. Some groundwater-fed wetlands are inclusions in this LTA, and they are both receptors and donors. Because of the fine-grained substrate and low gradient, this landscape is a prime location for *Sphagnum* growth.

Vegetation, disturbance, and successional pathways. Bogs (muskegs) are common, where peat moss (*Sphagnum* spp.) and sedge peat have accumulated and filled in small depressions and flats. They are primarily dominated by shore-pine/sedge (*Pinus contorta/Carex* spp.) and tufted clubrush/peatmoss (*Scirpus caespitosum/Sphagnum*) community types. Where drainage is better, as along small stream channels, a shore pine or mixed conifer forested wetland occurs. Rich fens occur in this LTA where waters are calcium rich because of limestone bedrock, such as in the vicinity of Trap Mountain.

Estuaries/Beaches

Geomorphic setting. These areas are directly influenced by tidal action (daily or yearly basis), such as supratidal meadows and intertidal flats. Riverine sands and silts are accumulated and reworked by tidal action. The extent of these deposits is highly influenced by the size of the inlet or bay, and tidal action. Many of these areas are not within the Analysis Area, since National Forest jurisdiction does not apply to lands below the mean high tide line.

Hydrologic function. The fine grained substrates are deep and poorly drained. This LTA is a receptor of water from upslope and from saltwater. Along sloughs or small incised stream channels, drainage is better. Fine sand and silt limit water movement through the soil. Sea water inundates areas during large storms.

Vegetation and successional pathways. On the upper tidal flats, lyngbyei sedge (*Carex lyngbyei*), alkali grass (*Puccinellia* spp.), and other salt-tolerant species dominate. Adjacent to estuaries, in the supratidal meadows, bluejoint (*Calamagrostis canadensis*), cow parsnip (*Heracleum lanatum*), and Sitka sedge (*Carex sitchensis*) are common species.

Appendix F - Stream, Fish, and Watershed Data

Habitat Distribution and Use. The estuary (ES4), flood plain (FP3, FP4, FP5), and low-gradient-contained (LC1 and LC2) channels contain most of the critical stream habitat for pink, chum, and coho salmon, steelhead trout, Dolly Varden char and sculpin. Aquatic capability ratings for these channel types are listed in the planning record. Where accessible, these low gradient channels provide much of the available spawning habitat for all fish species present in the Analysis Area. These channels, along with associated secondary channels and smaller flood plain (FP0) channels, provide abundant rearing habitat for juvenile coho salmon, steelhead and cutthroat trout, and Dolly Varden char. The accessible lakes in the Kook Creek, Basket Creek and Sitkoh Creek watersheds provide rearing habitat for juvenile sockeye salmon.

Very low gradient, palustrine (PA0, PA1, and PA2) channels, sloughs and associated beaver ponds occur within some of the Analysis Area watersheds. Primarily associated with fens, palustrine channels and beaver pond areas are characterized by organic sediments, abundant deep pool and glide area with cover, and spring-fed tributaries. The palustrine channels and beaver ponds provide high-quality rearing and limited spawning habitat for coho salmon, Dolly Varden char and cutthroat trout.

The highly productive estuary channels (ES) provide high-quality spawning habitat for pink and chum salmon and provide important rearing habitat for many salmonids during at least part of their life cycle. In addition, all fish species use the accessible habitat in the moderate gradient channels (MM1, MM2, MC1, MC2, AF1 and AF2). These channels contain low to moderate amounts of spawning and rearing habitat. The stronger swimming coho salmon, cutthroat trout and char make the most use of the habitat in these channels.

These channels types and the associated riparian widths are displayed in Table F-1. Half bankfull width was derived from the mean bankfull width from the R10 Channel Type User Guide (Paustian, 1992). Stream Riparian Zone (SRZ) values are average riparian zone widths based on field transects; channel types not sampled were assigned 100-foot values. The actual riparian zone is adjusted for each Class I or II stream in the Project Area by using orthophoto base maps.

Table F-1. Stream riparian widths used to determine riparian area for each channel type.

Channel Type	Half bankfull width	SRZ	GIS Riparian
AF1	11 feet	100 feet	111 feet
AF2	7	100	107
AF8	25	50	75
ES1	14	100	114
ES2	17	100	117
ES3	17	100	117
ES4	38	100	138
ES8	108	100	208
FPo	5	30	35
FP1	29	100	129
FP2	30	100	130
FP3	10	100	110
FP4	25	205	230
FP5	54	332	386
FSo	5	30	35
GO1	43	100	143
GO2	70	100	170
GO3	108	100	208
GO4	52	100	152
GO5	22	100	122
HC1	7	50	57
HC2	9	50	59
HC3	12	50	62
HC4	9	50	59
HC5	7	50	57
HC6	10	50	60
HC8	32	50	82
HC9	28	50	78
LC1	27	152	179
LC2	30	187	217
MCo	5	30	35
MC1	9	62	71
MC2	15	70	85
MC3	16	100	116
MMo	5	30	35
MM1	9	49	58
MM2	23	99	122

Table F-1. Stream riparian widths used to determine riparian area for each channel type.

Channel Type	Half bankfull width	SRZ	GIS Riparian
PAo	5	30	35
PA1	8	100	108
PA2	30	100	130
PA3	20	100	120
PA4	50	100	150
PA5	17	100	117

These adjustments are stored in the GIS data layer STRMRIP. The sum of the half bankfull channel width and the SRZ is the GIS Riparian value for the channel type. These are the starting points from which stream specific adjustments are made in GIS.

Fish Escapement Condition and Trends. Salmon escapement is the number of adult salmon returning to a stream or lake system during any given year. Weir data are much more reliable than peak, one-day aerial or foot escapement counts, but weir data are available only for a few streams in the Analysis Area. Depending on how long they are in, well designed weirs can count most of the adult fish passing upstream of them. Aerial and foot counts are a rough visual estimate of the number of salmon in a stream reach at one specific time, and counts tend to be low compared to actual total annual escapement. For these reasons, weir data are not directly comparable with other survey (aerial or foot) data. Usually, more fish are counted at weirs and, within the Analysis Area, the few existing weir counts tend to be considerably higher than foot or aerial surveys at the same stream. For example, at Kadashan River, annual salmon escapement counts from a weir operated from 1970 to 1988 averaged 148,000 (high of 282,000) pink salmon and 29,000 (high of 66,000) chum salmon (ADF&G 1996). Between 1989 and 1996 (after the weir was discontinued), annual salmon aerial survey counts at Kadashan River have averaged only 51,000 pink salmon and 8,000 chum salmon.

Although they are not good estimates of complete escapement, foot and aerial stream surveys provide a relative index of year-to-year variability in salmon escapement numbers. Allowing for annual fluctuations in adult escapement, available stream escapement surveys indicate most salmon stocks are healthy, with some relatively large returns of pink and chum salmon throughout the Analysis Area in recent years. An assessment of Southeast Alaska salmon stocks was recently completed by Halupka et al. (1995). They reviewed all available information on the biological characteristics and population status of anadromous salmon in Southeast Alaska. Within the Analysis Area, there were adequate survey data to estimate escapement trends for 21 pink, 13 chum, and one sockeye salmon system. For the stocks with available survey data, eight pink streams showed increasing escapement trends, two chum stocks (Crab Bay and Inbetween) showed declining escapement trends, and Sitkoh Lake sockeye showed a declining escapement trend. Most chum salmon escapement surveys are completed coincidentally during pink salmon surveys, and surveys are usually not completed during the peak timing of the chum run. Therefore, chum data should be interpreted cautiously. Kadashan is the exception in the area, with good data for chum escapement, and data there indicate a stable system. Although sockeye escapements at Sitkoh Lake may be depressed from historical levels, the declining trend had to be concluded from low survey data quality for this assessment.

Escapement data are not available to track population trends for coho salmon, Dolly Varden char, steelhead and cutthroat trout. These species are most dependent on good-quality stream rearing habitat. Therefore, we used stream habitat condition (based on existing harvest and roading impacts to riparian and sensitive soil areas) within each watershed as an indicator of current and future fish stock health for these species.

Modeled Fish Habitat Capability. There are not adequate and accurate enough fish escapement data available to compare potential fish production among all the Analysis Area watersheds (see discussion in Escapement Trends section). Therefore, to compare watershed productivity on a similar scale, we determined the pink and coho salmon estimated annual production capabilities for each watershed based on stream channel type capabilities. Past stream sampling and surveys, smolt and adult fish weir counts, and fish production studies have been used to estimate the number of pink and coho salmon smolts that can be produced for each channel type in the Tongass National Forest (located in the planning record). By multiplying the total length of each channel type in a watershed by the estimated number of smolts produced for each channel type, we get the total estimated number of salmon smolts a watershed can produce.

Although they may not be 100% accurate, these estimated values provide a relative and comparable measure of each watershed's potential productivity. For this analysis, we assumed all fish-producing channels were accessible to anadromous fish, but we did not calculate potential coho production from lakes. This tends to underestimate the production of adult coho salmon from the few lake systems. We calculated the number of adult pink salmon by multiplying the number of smolts (based on channel type capability) by 0.024 (based on average survival rate of 2.4% from smolt to adult). We calculated the number of adult coho salmon by multiplying the number of smolts (based on channel type capability) by 0.10 (based on average survival rate of 10% from smolt to adult). Actual estimated pink salmon escapement counts were included to compare with the productivity estimates. (The individual channel type lengths and estimated fish production numbers for each watershed are listed in the planning record.)

Disturbance Factors Influencing Fish Habitat and Populations.
Harvest (commercial, sport, subsistence). Directed fisheries for chum, pink and coho salmon can substantially reduce the number of spawning adult salmon returning to the Analysis Area streams in a given year. A comparison of past and recent escapement counts (see escapement trends later in this section) indicates

that most Analysis Area streams are not being over-fished or negatively impacted by current fishing practices.

Predation (in streams). The more common bird species that are potential predators on either young or adult fish include the bald eagle *Haliaeetus leucocephalus*, American dipper *Cinclus mexicanus*, common merganser *Mergus merganser*, belted kingfisher *Ceryle alcyon*, and great blue heron *Ardea herodias*. Brown bear feed heavily on returning adult salmon, especially where they congregate in shallow riffle areas.

Flooding. High flow events change channel morphology by redistributing large woody debris, scouring pool areas, undercutting streambanks, mobilizing larger substrates, and transporting sediments. These changes can be both beneficial and negative. Without adequate instream large woody debris and stable banks, the pool habitat and associated cover necessary for rearing juvenile salmonids can be substantially decreased during major flood events. Also, spawning gravel can be scoured and transported downstream.

Beaver. Beaver have created and modified wetlands in valley bottom areas throughout the Analysis Area. Impacts have been substantial, both recently and historically. Sampling at several sites at nearby Indian River shows many fens and associated ponds and palustrine channels are the result of very old beaver dams (USDA Forest Service, IRWA 1996). Some of these dams were 200-500 years old. In some watersheds, beaver activity has created a complex of flooded forested wetlands, riparian areas, ponds and terraced sedge meadows. By cutting down trees and branches, beaver activity also provides an additional source of large woody debris and leaf litter to streams.

Beaver ponds and channels provide quality rearing habitat for juvenile salmonids and resident Dolly Varden char and trout. Within Southeast Alaska, Sampson (1994) found larger juvenile coho salmon in beaver ponds and associated wetland areas than cohorts in other stream habitat. Other studies also document the substantial impacts of beaver activity and value of subsequent habitat modifications for fish and wildlife habitat (Naiman et al. 1986). Beaver activity and associated dams can block upstream fish passage, although many dams allow fish passage, especially during flood events.

Wind. A natural process, windthrow (blowdown) along stream riparian areas is a primary source for instream large woody debris and for maintaining and creating fish habitat. Management activities, however, such as clearcuts and road rights of way next to stream side riparian areas, can greatly increase the rate of blowdown along a stream and negatively impact future stream habitat condition.

Roads and Timber Harvest. Most of the road systems in the Analysis Area are in the valley bottoms or along foot slopes, reducing the amount of cut banks and potential sediment sources, but providing more potential direct impacts (riparian harvest, fish passage barriers, sediment sources from washouts) to fish streams. Beaver activity also is more likely to conflict with road structures in valley bottom areas and to require increased road maintenance. Drainage structures on roads at Corner Creek, False Island Creek and Sitkoh River have been plugged by beaver activity in recent years. The potential effects on water quality and fish habitat from timber harvest within stream riparian zones and sensitive sediment source areas were discussed in Chapters 4 and 5.

Watershed Rehabilitation

About 10 of the 26 key watersheds have significant impacts from human activities. Some of these impacts have harmed fish habitat or other aspects of aquatic health. (See Chapter 4, Harvest within Riparian Zones for more detailed information on impacts.) Timber harvesting in the 1960's and early 1970's had particularly heavy impacts on the stream systems. During this time, timber harvest activities were concentrated along the backs of Class I and II streams within the Analysis Area watersheds. In several of the watersheds, much of the riparian vegetation along the Class I streams was logged. Soil disturbance from yarding and site preparation in these areas disturbed the valley bottom soils, causing aggressive alder regeneration, which quickly over topped the sparse conifer regeneration. The loss of large conifers along the streams eliminates the future supply of large woody debris for the streams, can decrease vegetative diversity and nutrient inputs, and will lead to decreased channel and bank stability. In places, logs were yarded down streams, which damaged channel and banks and removed some of the existing large woody debris. Some road systems in valley bottom areas have not been maintained and divert water from original channels and cause surface erosion. Widespread harvesting in some watersheds has increased the potential for landslides, which can increase sedimentation to streams.

To address these concerns, we try to determine which factors most limit watershed function and health and then design projects to address them. The TLMP Revision (1997) provides direction for planning and implementing watershed rehabilitation projects. After inventorying the streams, riparian vegetation, road system and landslides, we plan and complete projects to help fix identified problems. Watershed rehabilitation work aimed at restoring, stabilizing, and improving water quality and fish habitat can include: stabilizing landslides, roads and cut banks along streams; repairing or removing drainage structures; placing large woody debris (LWD) into streams devoid of debris; connecting borrow ponds (fish rearing habitat) to streams; and thinning riparian second-growth stands to increase understory diversity and promote faster growth of large trees for future sources of instream LWD and channel stability.

To date, inventory work has included: stream habitat surveys at Kook Creek, White Rock Creek, Sitkoh Creek and False Island Creek; stream riparian surveys at Sitkoh River, Sitkoh Creek and False Island Creek; and road surveys of the Corner and Muri Creek system, and False Island and Sitkoh Creek road system. Watershed rehabilitation work has been completed in the False Island, Sitkoh River, Sitkoh Creek, Corner Creek, Muri Creek and White Rock Creek watersheds (Table F-2).

Table F-2. Rehabilitation Needs and Accomplishments.

Watershed	Inventory Status	Riparian Thinning need	Riparian Thinning accom	Fish Structures need	Fish Structures accom	Erosion Control need	Erosion Control accom
Corner	complete	N	0	N	0	Y	10 ac
Muri	no need	Y	? ac	?	0	Y	5 ac
Buckhorn	no need	N	0	N	0	N	0
Whale	no need	N	0	N	0	N	0
Kook	complete	N	0	N	0	N	0
White Rock	complete	N	0	Y	0.5 mi	N	0
Sitkoh River	planned	Y	0	Y	0	Y	0
Sitkoh Creek	complete	Y	5 ac	Y	0	Y	5 ac
Oly Creek	no need	N	0	N	0	N	0
False Island	complete	Y	20 ac	Y	1 mi	N	0

<u>Riparian thinning treatment areas:</u> Depending on site conditions, second-growth riparian vegetation regenerates as dense alder-dominated, alder and conifer mix, or conifer- dominated stands. Along with some alder, spruce and hemlock are desirable because they provide future sources of large woody debris in streams, provide wildlife habitat, and reduce erosion and sedimentation. There is some uncertainty regarding the proper management of second-growth riparian areas for both fisheries and wildlife. Within the Analysis Area, many of the riparian-associated stands are approaching the age and size where canopy closure is beginning to occur. Silviculture and other resource representatives, including those from fisheries, wildlife, hydrology and soils, should collectively produce prescriptions for these areas and implement thinning activities within the next ten years. Potential silvicultural treatments should address such factors as: desirable species mix, understory biodiversity and site conditions.

General suggestions for implementing riparian regrowth treatments within the Analysis Area include:

1) Along the smaller alluvial fan footslope and floodplain channels, riparian thinning treatments should more closely mimic the open canopy structure found in the natural old- growth streamside riparian condition.
2) Along the larger valley bottom channels, treatments should emphasize an open canopy structure that promotes faster growth of streamside conifers. Stocking densities should mimic natural densities of the old-growth stand which existed prior to harvest.
3) Along all streams, silvicultural prescriptions should also emphasize streambank stability and include retention of some deciduous trees (alder and cottonwood) for nutrient sources to the soil and stream (allochthonous inputs).

<u>Instream Large Woody Debris.</u> Future watershed rehabilitation should include continuing to place large woody debris (LWD) into streams currently lacking debris. Use available stream survey information or complete additional stream surveys in areas impacted by past management activities to assess the current

condition and trends of key stream habitat, and determine where additional instream LWD is needed.

Borrow Ponds. Rehabilitation work should include identifying existing borrow ponds, such as those in the False Island watershed, which can be connected to nearby streams to provide additional fish rearing habitat.

Road Maintenance and Restoration. Restoration work should involve placing drainage structures and/or ditching at existing washout sites, cleaning partially plugged culverts, and removing artificial barriers to fish passage (as determined from completed and future road inventories).

Lake Habitat (Sockeye Salmon) Restoration. The Kook Lake and Sitkoh Lake sockeye salmon stocks are important subsistence fisheries for many people in this area, including residents of Angoon, Tenakee Springs, Hoonah, Sitka, and Juneau. Both sockeye salmon stocks have been assessed or assumed to be in a declined state within the past decade or longer. In addition to closing the fisheries, current potential sockeye salmon rehabilitation and enhancement work includes lake fertilization and hatchery incubation and fry stocking or bioenhancement. Lake fertilization is intended to increase the primary productivity of lakes in which sockeye production is thought to be "forage limited." Bioenhancement is used to increase the survival of sockeye eggs and fry, or to introduce additional juvenile sockeye into a lake when there are so few sockeye returning to a lake that natural rebuilding of the run would take many years.

A lake enhancement feasibility study completed in 1992, and a follow-up two-year cooperative (ADF&G and U.S. Forest Service) investigation of the Kook Lake system in 1994 and 1995, found that the lake has adequate primary production and available forage for sockeye but lacks recruitment (production of juvenile sockeye) to use the available forage. Total adult sockeye salmon escapements were 1,817 and 5,817 for weirs operated in 1994 and 1995 respectively. The initial indications from this work are that the lake habitat quality (chemistry and primary production) is good, but there are not enough returning adult sockeye to seed the system to capacity. Bioenhancement should be investigated as a potential sockeye salmon rehabilitation method at Kook Lake.

A lake enhancement feasibility study, similar to the one completed at Kook Lake, should be completed at Sitkoh Lake to help determine what factors may be limiting sockeye salmon numbers. Total adult sockeye salmon escapement was 9,465 sockeye for a weir operated in 1996 at Sitkoh Creek. Additional investigations of the Sitkoh Lake system should include sampling of water quality, primary production, sockeye smolt production, and adult escapement. This information will determine the present condition of the Sitkoh Lake system and what rehabilitation measures may be needed.

Fisheries Enhancement. Two fish passes were built at Corner Creek about 1 and 2 miles up from tidewater in the early 1980s to provide passage for pink and chum salmon to most of the available floodplain habitat in the watershed.

Another fishpass was built on the west fork of White Rock Creek in 1991 to provide passage for coho, pink, and chum salmon.

The stream reaches above the barrier falls at Whale, Broad, Broad Finger, "Pinky" and Little Basket Creek systems have low to moderate production potential for pink, chum, and coho salmon. The potential pink and coho salmon production upstream of the barrier falls was estimated using smolt capability estimates based on the length and type of each stream channel. With current technology and values, these systems do not appear to be viable fisheries enhancement sites. However, this can be further evaluated during project level planning.

Sensitive Sediment Source Areas

Sensitive sediment source areas (SSAs) combine landform and slope class to create a landtype which is unstable and has the ability to transport sediment. Using the "smu" attribute of the "clu" GIS layer, D (55%-75%) and E (>75%) slope classes were combined with mountain and hill slope landforms that are frequently dissected by headwater channels or those with steep ravines. Landslides are more likely to occur on these slope classes, and the headwater channels have ability to transport sediment from these areas to main channels. High and extreme hazard soils (MMHAZ 3 and 4) occurring on infrequently dissected landforms are excluded from SSAs. While slides may occur in these areas, fewer drainages are available to transport sediment to streams. In summary, slides are not necessarily more likely to occur in SSAs; however, when they do occur, sediment is more likely to reach streams and harm water quality.

Appendix G - Spectrum Model: Future Scenarios

Caveat

This analysis was done in 1997 just before TLMP (1997) came out. We anticipated many of the changes TLMP (1997) made at that time. However, the 1999 Record of Decision signed by Jim Lyons completely changed many LUDs and the rotation length for about half of the Analysis Area. These are major changes that we have not incorporated into this SPECTRUM analysis. We have left the analysis in this document since we believe it is still an illustrative approach even though the results are no longer timely.

Introduction

In the body of this document, we discuss individual resources, features, issues, conditions and uses associated with southeast Chichagof. In this appendix, our goal is to integrate some of these diverse aspects as they apply to management in southeast Chichagof over the next 200 years. These types of integrative analyses have been done for the last thirty years. Ian McHarg was one of the first to describe the process as early as 1969. The advantage we have today is that we can do much of the work using Geographic Information Systems (GIS), which give us the ability to take spatial information and display it using tools such as the Spectrum model.

It is important to keep in mind that the value of a planning tool such as the Spectrum model is less in charting the actual course of management activities than in understanding the interactions and trade-offs between different resources as they interact with each other. Future management scenarios represent opportunities to generate valuable resources from the landscape; however, with each scenario come tradeoffs in terms of other valuable resources. Virtually all resources, features, issues, conditions and uses are interrelated and often in conflict with each other, and modeling the future outputs of all of these over 260,000 acres presented challenges which we were not prepared to tackle. Reasoning that project-level planning, such as the Finger Mountain timber sale, will allow us the chance to explore the interactions of every resource and use for a much smaller land area, we limited our landscape analysis model to look at just three key resources simultaneously: timber volume, deer winter range, and old growth. We consider these the three most pressing issues and the most subject to conflicting interactions on southeast Chichagof.

Using Spectrum Model for Long-range Analysis

For our model we used Spectrum, a FORPLAN-based linear programming (LP) model for ecosystem management, developed by the USDA Forest Service Washington Office Ecosystem Management Analysis Center (USDA Forest Service, 1996). The major components of Spectrum, as for any LP model, are land stratification, management actions, outputs (or yields), objectives, and constraints. A brief description of the specifics of these components for southeast Chichagof follows.

Land Stratification. Using GIS, we built five layers of land attributes -- VCU, Timber Suitability and Site Productivity, Existing Condition, Deer Winter Range Potential, and Scenic Importance -- which we then overlayed to generate 362 analysis units.

VCU layer. This layer includes all land and freshwater (but no saltwater) within the 18 Value Comparison Units in southeast Chichagof.

Timber Suitability and Site Productivity Layer. Two separate components went into this layer. For the suitability component, we assayed the GIS timber (timtype) and CLU layers for tentatively suitable timber lands [those forested or once-forested areas with stable soils, non-steep slopes, commercially-suitable tree species, outside of 100-foot stream buffers, and not in roadless (LUD II) VCUs). The Site Productivity (high, medium or low) component is a refinement of timber volume class, adjusted for soil moisture and slope (Forest Plan interdisciplinary team, 1995].

Existing Condition Layer. This layer describes the current size class of forested areas.

Deer Winter Range Potential Layer. This layer distinguishes areas with high, low and no potential for deer winter range value. High value range potential is defined as having a Habitat Suitability Index (HSI) value ≥ 0.6; low range values are between 0 and 0.6; no value range is zero.

Scenic Importance Layer. For this layer we used a combination of Visual Quality Objectives and Visual Absorption Capacities (see Chapter 4, Scenic Resources for a description) to identify areas with high scenic importance -- roughly those areas that are seen from Peril Strait, Chatham Strait, and Tenakee Inlet.

We combined these five land attribute layers into analysis units representing a unique combination of VCU, Suitability/Site, Condition, Winter Range, and Scenic Importance, making 2,700 possible combinations in all. Some combinations did not occur, and others occurred with such small acreages that it made no sense to assign them to their own analysis units. To consolidate, we collapsed some combinations together into analysis units that were at least 100 acres in size. For example, scenic importance has little bearing on management activity in nonforested or unsuitable timber areas, so we essentially ignored the Scenic attribute in building analysis units in these areas. Similarly, where condition classes 1 and 2 (seedling-sapling and poletimber) did not meet the 100-acre minimums for a particular combination of the other layers, we combined their acres into one analysis unit. Some of these combined analysis units are heterogeneous for at least one attribute but are assumed to be homogeneous for ease of modeling.

Management Actions. We identified six possible management actions that could be applied in southeast Chichagof with differing effects on our three key resources. These are: (A) Minimum level of management (no action), (B) Clearcut without reserves, (C) Clearcut with 15% reserves, (D) Overstory removal (30% reserved), (E) Group selection with 5 entries -- 20 years between entry, (F) Group Selection with 5 entries -- 50 years between entries. As with our selection of resources to monitor, we forced ourselves, for ease of analysis, to be restrictive in the actions we would consider in our modeling efforts. This in no way suggests that the above list of six management actions exhausts the possible management prescriptions that could be applied to a given piece of ground in the next 200 years. Presenting a range of choices from no cutting to clearcutting allows us to examine the outputs and effects of the widest possible range of management actions.

Yields. We assigned yields (outputs) for timber volume (thousand-board-feet, or mbf, per acre), winter range (acre-equivalents), and unmanaged and managed old growth (acres). We adopted the timber volume yields from the TLMP, with adjustments made according to the percentage of volume left in a given prescription. Yields vary by prescription, by age of the stand, and by the site productivity component of the Suitability/Productivity layer. A sample timber yield for clearcut without reserves, by 10-year period, is presented in Table G-1.

Table G-1. Timber volume yield by stand age, clearcut with 15% reserves.

Age 10-yr per.	TimVol mbf/acre	Age 10-yr per.	TimVol mbf/acre
1	0.00	11	24.40
2	0.00	12	27.29
3	0.00	13	29.92
4	0.00	14	32.90
5	0.00	15	35.96
6	0.00	16	38.85
7	0.00	17	40.97
8	12.50	18	44.12
9	17.60	19	46.58
10	21.42	20	48.79

For winter range, we modified the HSI values adopted by an interagency wildlife panel in May, 1996. The HSI scale ranges from 0 to 1, with every acre of land receiving a rating that describes its relative ability to provide winter range, which is the key limiting resource for deer in Southeast Alaska. We multiplied the average HSI for a given area by the number of acres to generate an acre-equivalent value for winter range. It is important to note that there can be significant differences in the distribution of high-quality, mediocre, and poor habitat between two areas with the same acre-equivalent winter range value; the winter range yields are averages.

Model Objectives. Linear programming models are called optimization models because they are used to find the best possible solution for a given objective. For the model of future management in southeast Chichagof, our primary objective was to examine effects of maximizing outputs of winter range, old growth or timber volume. Another objective was to keep an above-minimum value for winter range in all periods, while minimizing the deviation from timber volume goals. We plan to experiment further with diverse objective functions as our planning efforts continue in the future.

Constraints. Constraints limit the value that the objective can reach. We used them to establish minimum outputs, to disallow some management actions in areas with certain land attributes, or to even the flow of outputs (like timber volume) over time. As we identify more objective functions to use in the model, we will likewise find more constraints that could or should be added. We used the timber type (timtyp), CLU, streams, and land status (landstat) layers within GIS to compute the acres that are suitable for current or future (within the 200-year window) timber harvest, as shown in Table G-2.

Table G-2. Timber land suitability for the Analysis Area.

Classification	ACRES*
1. Nonforest land (including water)	109,154
2. Productive forest land	150,897
3. Land in LUD II (both productive and non-productive forest land)	57,157
4. Tentatively suitable (for timber harvest) forest lands (current TLMP - numbers will be different under revised TLMP)	105,519
5. Forest land not appropriate for timber production (unsuitable due to soil concerns)	12,496
6. Forest lands withdrawn as riparian buffers (Tongass Timber Reform Act)	6,602
7. Total suitable forest land (item 4 minus items 6)	98,917
8. Total suitable forest land (If new TLMP revision is completed in its current draft form - difference is due to 1000 ft. beach buffers, small old-growth reserves, and expanded riparian management areas)	**65,871**[a]
9. Current amount of productive forest land that has been clearcut.	21,035
10. Current tentatively suitable lands that are clearcut, and hence will not be available for harvest again in the next 5-10 planning horizons (10-year periods)	19,250
11. Other acres not ready for timber harvest	1,109
12. Maximum harvestable timber land **at present** (item 7 minus 10 and 11)	**78,558**
13. Total national forest land (items 1 and 2)	260,048

*These numbers are from timtype layer in GIS; they are rounded somewhat for modeling purposes.

[a]This number reflects a 33% reduction for new standards and guides for TLMP revision. The numbers were taken from the timtype layer in GIS.

Running the Model. Combining the five elements described above allows us to ask -- and answer -- many questions about future resource outputs in southeast Chichagof over the next 200 years. "How much timber is really out there now?" "How long will what’s out there last?" and "What harvest level is sustainable?" Another question asked is "If our goal is to maximize deer winter range, what does this do to potential timber outputs?"

Timber availability. In this section, we first determine what is the approximate amount of timber available today for the whole Analysis Area. This information is then used to determine the maximum timber volume that could come out of the area over the 200-year modeling period with the existing constraints required by law and the current Forest Plan (USDA Forest Service 1979). After setting this benchmark, which we call the "maximum timber output," we run the model using two other variables important to society -- functional deer winter range and visual objectives -- as constraints on types of timber harvest. Similarly, by manipulating the range of harvest options, we can identify changing trends and relationships of our other two resource outputs. This information allows us to discuss the longer-term desires we have for the Analysis Area.

Timber Yields. Using GIS, we found 127,830 acres of old-growth (Size Class 4) timber land in southeast Chichagof. Of these, 78,558 acres (61%) are suitable for timber harvest and thus represent the maximum harvestable suitable timber land **at present**. (See Table G-3 for an approximate breakdown by VCU). In addition to the present available timber base, another 23,067 acres are forested but not old growth.* Most of these acres are in past clearcuts, harvested during the last 40 years. This young growth provides a source of potential timber volume during the span of the 200-year planning horizon. These are mostly in the seedling/sapling or poletimber stages. For the Analysis Area we use the total suitable acres (98,918) in the 200-year span for the Spectrum model (Table 5-1). The following acres could be considered unsuitable, but we retained to simplify modeling and because the new TLMP revision has not come out:

Acres of Native overselection
Acres of private land
Acres in beach and estuary buffers
Additions to the TTRA buffers for most streams
Acres in old-growth reserves.

Although the TLMP revision has not been finalized, we can get a rough idea that there will be a 1,000-foot beach and estuary buffer, small old-growth reserves in each watershed, and larger riparian conservation areas for most channel types. These additional acres restricted from management amounts to a 33% reduction in total suitable acres for the Analysis Area (Table G-2). It is best to reduce the Spectrum runs by this amount to be more realistic. Additional modeling is recommended after the completion of the TLMP revision.

As mentioned above, we classified all forested acres as High, Medium or Low site productivity, according to the TLMP revision’s volume, slope and soil moisture criteria. Of the 98,918 suitable acres (including old growth and previously harvested stands), 46,271 (47%) are High Site, 36,031 (36%) are Medium Site, and 16,597 (17%) are Low Site.

*This number is different from Table G-2 as the GIS layer was modified for the Spectrum model.

Table G-3. Total old growth, suitable old growth, scenic importance and winter range potential for suitable old growth, by VCU.

			Scenic Importance		Winter Range Potential (Unseen)		
VCU	Total OG Acres	OG Suitable Acres	Seen Acres	Unseen Acres	High Acres	Low Acres	None Acres
230	4,599	3,921	0	3,921	979	2,756	186
231	7,828	6,192	809	5,382	1,762	3,478	142
232	5,484	4,306	466	3,840	1,534	2,133	173
233	4,940	3,870	698	3,171	946	2,001	224
234	3,121	2,582	1,209	1,373	181	814	377
235	20,509	0	0	0	0	0	0
236	5,733	5,006	3,365	1,641	452	901	289
237	4,294	0	0	0	0	0	0
238	4,747	3,749	3,017	732	236	496	0
239	7,837	6,344	5,149	1,195	113	857	225
240	5,105	4,085	837	3,248	1,330	1,731	187
241	3,831	3,115	2,103	1,012	355	657	0
242	5,605	4,752	2,602	2,150	762	1,204	184
243	12,770	10,222	2,541	7,682	2,867	4,298	517
244	5,246	4,263	4,080	183	0	183	0
245	11,304	9,908	8,730	1,178	0	1,038	140
246	8,291	6,640	3,179	3,461	836	2,066	560
247	7,419	0	0	0	0	0	0
Total	**128,662**	**78,956**	**38,786**	**40,170**	**12,353**	**24,613**	**3,204**

By applying a timber maximization objective in the Spectrum model, we determine the upper limit of board feet that southeast Chichagof can produce over the next 200 years to be 6,132 million board feet (MMBF). The details of this run are found in Table G-4, line 1. This maximum timber harvest is attainable only with a most unrealistic harvest schedule, in which all suitable old growth is harvested in the first ten years and little is harvested again until Period 20 (200 years). To even out the flow of timber, we set limits on the timber volume in any given period to ±15% of the volume in the previous period. These flow constraints result in a reduction of volume removed (4,779 vs. 6,132 MMBF) but a much more realistic harvest schedule, as shown in Table G-4, line 2.

There is still somewhat of a horseshoe affect: the volume harvested in Periods 1 and 20 is four times more than that harvested in Period 10. Hence we can tinker with the magnitude of the flow constraint further (Table G-4, line 3 shows the result of a ±5% flow constraint). It is probably best to consider this 4,779 MMBF as the maximum timber harvest southeast Chichagof could sustain. This number then needs to be reduced 33% for TLMP revision. Hence 3,680 MMBF, or an average of 184 MMBF per period, is a more realistic maximum timber possible for the Analysis Area. We must, however, also take into account what is actually **feasible** to log.

"Tentatively suitable" land does not mean that all this land is really suitable or feasible to log. For the future Finger Mountain Sale Area there are 19,867 acres of tentatively suitable land, of which **62%** is feasibly turned into the possible unit pool. Obviously these numbers are rough, but they provide some realism into the Spectrum model. This means that 2,281 MMBF is the maximum timber yield out of this 200-year period (e.g., an average of 114 MMBF per 10-year period). This difference between the tentatively suitable land, and what is really out there **and** feasible to log is a long-standing problem which often has not been fully addressed. Multi-entry planning could responsibly deal with this issue. It takes into consideration the desire for a more steady wood flow and corresponding economy from the Analysis Area, as well as easier maintenance of roads and bridges, and more efficiency in applying young-growth management.

Table G-4. Timber volume maximization outputs.

	TIMBER VOLUME						PLAN HRZN	With TLMP revision (-33%)
MODEL CONSTRAINTS	**PER 1 MMBF**	**PER 2 MMBF**	**PER 3 MMBF**	**PER 5 MMBF**	**PER 10 MMBF**	**PER 20 MMBF**	**Total MMBF**	**Total MMBF**
1. Unconstrained - Max. Timber Vol.	1,439	0	0	17	0	4,665	6,132	4,722
2. Constrained by ±15% Flow by Period	311	264	225	162	130	525	4,779	3,680
3. Constrained by ±5% Flow by Period	225	213	203	183	191	311	4,426	3408
4. Finger/False Target ± 15% Flow	311	264	225	162	130	525	4,779	3,680
5. VCU 2 MMBF Min/Per ± 15% Flow	310	264	224	162	130	524	4,773	3,675

Other Constraints on Timber. Other constraints applied to the volume of timber available include possible volume removed in Period 1 from the Finger Mountain Sale Area (75 MMBF from VCUs 230-234 and 246), and from False Island Sale Area (67 MMBF in VCUs 236 and 238-245), and a minimum of 2 MMBF per period removed from each non-LUD II VCU. (It is important to note that these timber volumes are theoretical only, and the volume that will be targeted will be determined in the NEPA process.) Neither of these constraints results in much, if any, change in the schedule of harvested volume over the planning horizon; in fact, with the ±15% flow constraint, they are essentially redundant (Table G-4, lines 4 and 5).

The real value in a model of future management based on linear programming is its ability to constrain one resource output while at the same time limiting the production of other related resources. In managing southeast Chichagof for multiple use, acres of high value deer winter range and high scenic importance could be incorporated as constraints on timber harvesting in one of two ways. We can set a minimum winter range output (acre-equivalents) and let the model optimize the allocation of timber volume available based on that minimum. Alternatively, we can disallow specific management practices (clearcut without reserves, for example) in specific areas explicitly to force the model to preserve the habitat and/or scenic value in those areas. In most cases, we chose the latter route.

The location of the high, medium and low deer winter range potential is shown in Figure G-1 while the location of the seen and unseen old growth is shown in Figure G-2. Table G-3 shows that 27,817 acres of suitable old growth have both low scenic importance and low- to no-winter range potential (Table G-3).

Table G-5 shows the maximum timber volume resulting from scenic or winter range constraints. Line 2 indicates the volume harvested when areas of high scenic importance (seen) are not allowed to be clearcut (with or without reserves). This decreases the total volume by 460 MMBF (line 2 vs. line 1). This is a very likely scenario given the TLMP revision, which amounts to a further 10% reduction in the total volume over the 200-year planning horizon.

When the TLMP revision is finalized, 33% of the suitable acres are taken off the top as old-growth reserves, etc., to address wildlife concerns. Whether we want to reduce further the potential volume by also managing the matrix for high potential winter range is then called into question. If we do, results from applying the winter range constraints alone, or in combination with the scenic constraint, are shown on lines 3 through 8 (without TLMP revision reductions). Line 3 indicates the volume harvested when areas of high winter range potential are withdrawn from all timber harvests except group selection. Further limiting these acres to only the 50-year group selection prescription (line 4), or to no timber harvest of any kind (line 5), again reduces the timber volume to 64 and 57% of the timber maximum run (Table G-5). Thus, if we choose to emphasis deer winter range, we need to plan on a much reduced timber output of 30-40 over the long term. Constraints of this kind shift harvest towards more uneconomical stands (Volume class 4, often with high logging costs). This shift raises concerns for being able to offer economic timber sales.

Table G-5. Scenic and winter range constraints on timber volume maximization outputs. These numbers need to be reduced ca. 33% with the TLMP revision and by ca. 50% for reality of suitable lands.

	TIMBER VOLUME						PLAN HRZN	Percent
	PER 1	PER 2	PER 3	PER 5	PER 10	PER 20	TOTAL	of max timber
MODEL CONSTRAINTS	MMBF	MMBF	MMBF	MMBF	MMBF	MMBF	MMBF	
1. ±15% Flow By Period	311	264	225	162	130	525	4,779	100
2. Grp Sel/Ovrem In Seen ±15% Flow	278	236	201	145	118	477	4,319	90
3. Grp Sel Only In Hi Pot W.R. ±15% Flow	251	214	182	131	95	383	3,605	75
4. 50-YR Grp Sel In Hi Pot W.R. ±15% Flow	217	185	157	113	79	319	3,039	64
5. No Hvst In Hi Pot W.R. ±15% Flow	188	160	136	98	72	290	2,717	57
6. Grp/O.R. Seen, Grp In Hi Pwr ±15% Flow	234	199	169	122	89	359	3,373	71
7. GRP/O.R. Seen, 50-Grp In Hi Pwr ±15% Flow	200	170	144	104	73	295	2,807	59
8. Grp/O.R. Seen, No Hvst Hi Pwr ±15% Flow	171	145	123	89	66	266	2,485	52

Table G-6 displays the number of acres that would be harvested in each period given the scenarios mapped out in Table G-5. It is important to note that, for the scenarios which contain group selection in the 28,885 acres of high potential winter range, the numbers appear inconsistent. This is because these acres are not "entered" in each period, so for the 20-year group selection scenario, a larger number of acres are entered. For the 50-year cutting cycle these "units" are entered in Periods 1, 6, 11 and 16. The model tallies the total acres of the entire unit, even though only a portion of the unit is actually cut during that period.

Table G-6. Acres of harvest with scenic and winter range constraints on timber volume maximization outputs. These numbers need to be reduced by ca. 33% with the TLMP revision and another 50% for reality of suitable lands.

MODEL CONSTRAINTS	AREA HARVESTED FOR TIMBER PER 1 Acres	PER 2 Acres	PER 3 Acres	PER 5 Acres	PER 10 Acres	PER 20 Acres
1. ±15% Flow By Period	21,204	13,866	11,501	7,246	8,648	13,817
2. Grp Sel/Ovrem In Seen ±15% Flow	26,820	16,168	10,812	6,481	5,944	20,399
3. Grp Sel Only In Hi Pot W.R. ±15% Flow	44,224	13,020	34,938	31,269	4,152	13,718
4. 50-Yr Grp Sel In Hi Pot W.R. ±15% Flow	41,995	11,742	8,665	4,488	3,573	12,272
5. No Hvst In Hi Pot W.R. ±15% Flow	15,822	9,961	7,496	3,882	3,311	10,969
6. Grp/O.R. Seen, Grp In Hi Pwr ±15% Flow	44,262	13,256	34,319	31,137	4,350	13,962
7. Grp/O.R. Seen, 50-Grp In Hi Pwr ±15%Flow	41,807	12,033	8,083	4,362	3,568	12,848
8. Grp/O.R. Seen, NoHvst Hi Pwr ±15% Flow	16,234	9,790	6,807	3,877	3,305	11,503

Maximizing Winter Range. We used a MaxMin run that maximizes the winter range value at its lowest period (Table G-7). This run attempts to raise the "safety net" for the deer population, based on the idea that the value of habitat at its ebb is more of a limiting factor for the population than is the total winter range value over the course of the planning horizon. The inherent periodicity in wildlife population dynamics makes this MaxMin a more attractive approach. Using a straight maximum, high habitat values in one period could become superfluous if the habitat in subsequent periods cannot maintain the increased deer population; similarly, increases in habitat value in later periods have benefit only if the population is able to survive the earlier periods of low habitat values. This MaxMin approach follows an example first proposed by Hof and Rafael (1994).

Just as we constrained timber volume by winter range, so can we limit the amount of winter range through setting timber volume minimums. Table G-7, line 2 shows the results of a 75 MMBF timber volume minimum in Period 1 in Finger Mountain, using a MaxMin winter range objective. The decline in winter range is minimized through harvesting as many low- and no-potential acres as possible before scheduling high-potential acres for harvest. Indeed, of the 3,167 old-growth acres cut in Period 1 in this scenario, 1,812 have no potential for winter range value, 1,355 have potential for low winter range value only, and none have potential for high winter range value. In addition, 144 acres of Size Class 3 trees, which contribute far less to winter range than do old-growth acres, are cut in Period 1. Line 3 shows the effects of a minimum harvest per VCU per period of 2 MMBF, again on a MaxMin winter range objective.

Table G-7. Winter range outputs.

	WINTER RANGE						
CONSTRAINTS	PER 1 ACRES	PER 5 ACRES	PER 10 ACRES	PER 15 ACRES	PER 20 ACRES	MEAN ACRES	MIN PERIOD ACRES (PER)
Timber Max, ±5% Flow	62,392	46,717	36,460	36,231	37,561	41,852	35,690 (9)
Tim. Max, F/F Target ±15%Flow	61,882	44,102	35,461	36,288	38,578	41,098	34,858 (9)
Tim. Max, VCU 2 MMBF Min ±15% Flow	62,063	44,080	35,412	36,209	38,697	41,129	35,034 (9)
Tim. Max, Grp Sel In Hpwr, ±15%Flow	61,563	47,833	37,604	40,914	45,563	44,816	37,604 (10)
Tim. Max, 50-Yr Grp Hpwr, ±15%Flow	61,753	51,745	45,330	45,155	49,461	48,491	42,872 (12)
Tim. Max, No Hvst Hpwr, ±15%Flow	62,462	54,174	50,314	53,539	57,951	54,517	49,750 (9)
W.R. Maxmin, Unconstrained	62,969	61,503	62,027	65,479	69,081	63,837	61,503 (many)
W.R. Maxmin, Finger Tgt Per1	62,808	60,973	61,479	64,456	68,100	63,146	60,973 (many)
W.R. Maxmin, VCU 2 MMBF Min Hvst	62,911	60,898	61,155	60,894	60,894	61,136	60,894 (many)

Maximizing Old Growth. It is no surprise that the no-action model, with the minimum level of management applied to every analysis unit, results in the maximum number of old-growth acres, managed and unmanaged. There are 128,668 acres of existing old growth (unmanaged) at the beginning of the planning horizon, with another 22,209 acres of past harvests that grow into (managed) old growth over the 200-year planning horizon. All remaining acres in southeast Chichagof are nonforested and can never contribute to old growth.

Adding a timber harvest constraint such as a 10 MMBF minimum harvest in each period reduces the number of old-growth acres from an average of 131,656 acres to 129,478 acres per period (Table G-8, line 2). Because low-volume acres count as much toward old growth as high-volume acres, any scenario that maximizes old growth and produces some timber volume will dictate cutting high-volume acres first to minimize the number of affected acres. Specifying that the volume must come from certain areas, such as those unseen with low to no winter range potential, forces more acres into solution by reducing the extent to which the volume can come from high-volume acres. The results of such a constraint are found in Table G-8, line 3.

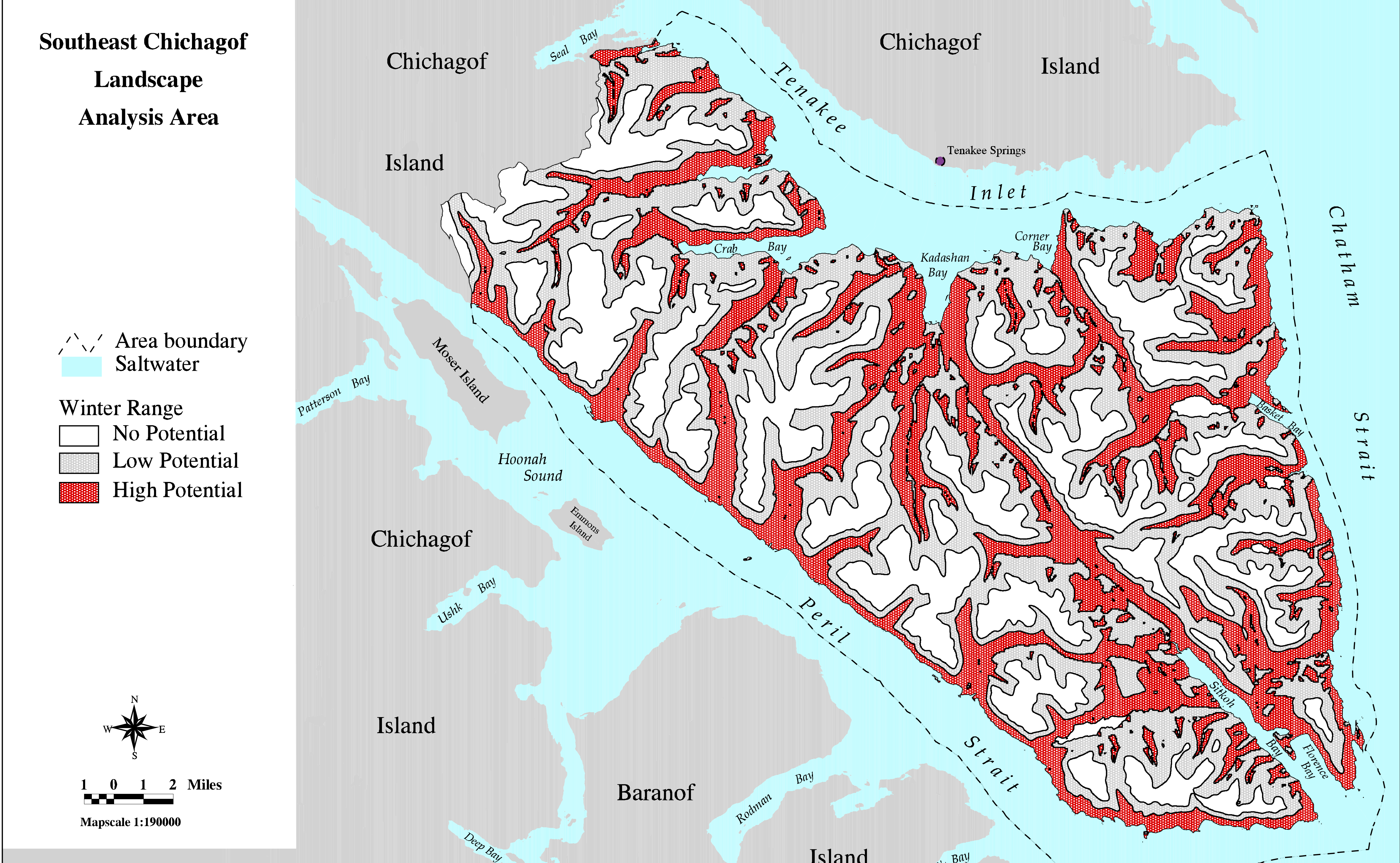

Figure G-1. Winter Range Potential in Southeast Chichagof

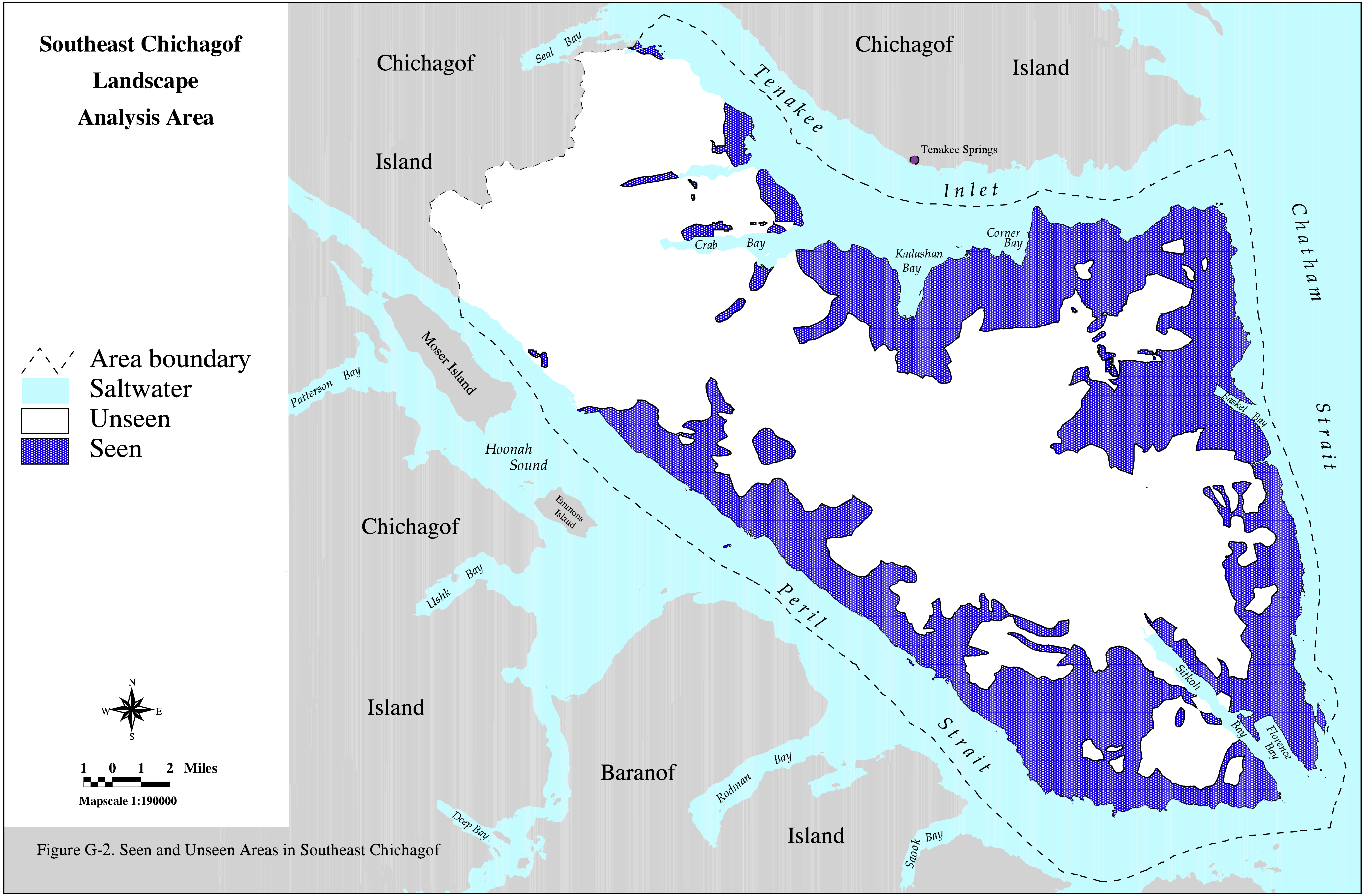

Figure G-2. Seen and Unseen Areas in Southeast Chichagof

Table G-8. Outputs from maximizing old growth.

	OLD GROWTH (MNGD & UNMNGD)					
CONSTRAINTS	**PER 1 ACRES**	**PER 5 ACRES**	**PER 10 ACRES**	**PER 15 ACRES**	**PER 20 ACRES**	**AVERAGE ACRES**
UNCONSTRAINED MAX OG	128,668	128,668	128,668	130,000	150,877	131,656
10 MMBF MIN HVST/PER	128,500	127,303	127,285	127,810	146,680	129,825
10 MMBF, SEEN/HI WRP LIMITS	128,500	127,153	126,225	127,557	146,545	129,471

Assumptions Behind Modeling of Future Management

No discussion of a management model would be complete without a description of some of the central assumptions that went into it. Some of these assumptions have been alluded to in the preceding discussion of yields and constraints. Here is a somewhat exhaustive list of assumptions we made:

1. Assumptions in Building GIS Layers

Timber Suitability and Site Productivity Layer

- Unsuitable areas are nonforested (< 10% tree cover), developed for non-forest use (e.g. powerline clearings); roads and road clearings; industrially incapable tree species (black cottonwood, lodgepole pine, alder); susceptible to very high mass soil movement; not restockable (e.g. > 41% McGilvery soils); show low productivity due to alder, glaciers, high elevation, muskeg, rock, recurrent slides, willow or low (tim-typ) site index; have (CLU) site index < 40; or are legally withdrawn from timber harvest (wilderness, LUD II, Tongass Timber Reform Act (TTRA) buffers).
- Suitable areas are those for which none of the above is true.
- Acres with existing volume class 4 (8 - 20 mbf/acre) and slope <= 55% and > 50% hydric soils are classified as Low Site.
- Acres with existing volume class 4 (8 - 20 mbf/acre) and slope > 55% or <= 50% hydric soils are classified as Medium Site.
- Acres with existing volume classes 5 - 7 (> 20 mbf/acre) and slope <= 55 % and > 50% hydric soils are classified as Medium Site.
- Acres with existing volume classes 5 - 7 (> 20 mbf/acre) and slope > 55% or <= 50% hydric soils are classified as High Site.
- Past clearcuts are classified as High Site.
- Unsuitable areas without a site classification (forested muskegs, for example) are reclassified as nonforested.
- Some suitable areas without a site classification (forested windthrow and forested willow, for example) are reclassified as nonforested; others, such as non-clearcut areas with existing volume less than 8 mbf/acre, are given a site value on a case-by-case basis depending on site values of surrounding acres (using Arc View).

Existing Condition Layer

- Size Class 1 (seedling-sapling stage) and not clearcut are classed as Class 1.
- Clearcut acres with cut-years from 1977 to 1996 are classed as Class 1.
- Size Class 2 (poletimber stage) and not clearcut are classed as Class 2.

- Clearcut acres with cut-years from 1947 to 1976 are classed as Class 2.
- Size Class 3 (< 150-year-old sawtimber) and not clearcut are classed as Class 3.
- Clearcut acres with cut-years before 1947 are classed as Class 1.
- Size Class 4 (>= 150-year-old sawtimber) and not clearcut are classed as Class 4.
- Acres with no size class are classified as Class 0 - nonforested.

Winter Range Potential Layer

- South-, east- and west-facing aspects below 800’ are classified as having potential for high value winter range.
- North-facing aspects and flat areas below 800’ and all land between 800’ and 1500’ are classified as having potential for low value winter range.
- Everything above 1500’, plus all freshwater, is classified as having no potential for winter range. The resulting cover of High, Low and No Winter Range Potential areas is displayed in Figure G-1.

Scenic Importance (Seen) Layer

- Areas with a ’Retention’ Visual Quality Objective are initially classified as Seen.
- Areas with a ’Partial Retention’ Visual Quality Objective and a ’Low’ or ’Intermediate’ Visual Absorption Capacity are initially classified as Seen.
- With the help of a Forest Service landscape architect, we identified areas initially classified as Seen that aren’t really seen from major water routes and reclassified them as Unseen. Final Seen and Unseen Areas are displayed in Figure G-2.

2. Assumptions in Generating Yield Tables

Timber Yield

- Volume in old-growth stands varies by site productivity but is constant through time.
- Volume in regenerated stands (including past harvests) varies by stand age but does not change with site productivity.
- Clearcut without reserves removes 100% of the standing volume.
- Clearcut with reserves removes 85% of the standing volume.
- Overstory removal removes 70% of the standing volume.
- In group selections, 40% of the volume is retained (never cut), a combination of intentional reserves and volume that is unharvestable (v-notches, etc.) regardless of intent. In each of five entries, 20% of the remaining 60% is harvested, with either 20 years or 50 years between entries. In the 6th entry, the harvest becomes second-growth and yields change accordingly.

Winter Range Yield

- While winter range <u>potential</u> is a function of aspect, elevation, and snow depth (consistent throughout southeast Chichagof), the actual winter range values assigned to an analysis area vary by existing condition, site productivity, stand age, and treatment (where applicable) within a given level of winter range potential. We created many yield tables to reflect the number of possible outcomes.

- Acres classified as having no winter range potential receive no winter range value, no matter what their vegetative characteristics.
- Nonforested acres yield a consistent winter range value in high winter range potential areas, and a lower value in low winter range potential areas.
- Old-growth acres are assigned a winter range value independent of age for each combination of site productivity and winter range potential, ranging from 0.86 in high site, high potential areas to 0.18 in low site, low potential areas.
- Winter range value responds to clearcutting by dropping to about 1/3 of the old growth value in the first 20 years, dropping again to about 1/10th of the old-growth value for the next 90 (high site), 110 (medium site), or 130 years (low site). At that point, winter range begins to improve in a linear fashion, until it reaches the previous old-growth value at 300 years.
- The winter range yields for clearcut with reserves and overstory removal follow the same pattern as for clearcut without reserves but are adjusted up 5% and 10%, respectively.
- In group selections, winter range declines more slowly because the volume is removed more slowly. The group selection value for an analysis unit in group selection is determined by the area-weighted average of the HSIs of the individual parcels of land in the unit. The value of the 40% permanently retained acres in the unit is included in the average, but is accorded only half its weight relative to its size because of its inherent patchiness and inaccessibility to deer.

Old-growth Yields

- Each existing condition class 4 acre counts as one unmanaged old-growth acre until it is treated by a prescription other than minimal level of management. Acres that enter the model as existing old growth can never count as managed old growth; even if they are cut in Period 1, they have only 190 years to grow before the end of the planning horizon.
- Each existing condition class 1-3 acre counts as one managed old-growth acre once its stand age reaches 200 years. These acres never count as unmanaged old growth.
- Group selection reduces the unmanaged old-growth value of treated acres in stages, as more of the unit is harvested in each successive entry. After five entries, the unmanaged old-growth value is 0.

3. Assumptions about Application of Treatments

- Group selection is applied only to existing old-growth stands.
- Clearcut without reserves is applied only to Finger Mountain old-growth stands.
- Overstory removal is applied only in Seen Areas.
- Minimal level of management can be applied to every acre.
- Only minimal level of management can be applied to unsuitable and nonforested acres.

Appendix H - Scenic Resources

Scenic Values

In order to analyze impacts to visual resources, an overall viewshed approach was used, which analyzes impacts as seen by forest visitors as if in a small aircraft. Scenic values are quantified by the Forest Service by comparing the number of disturbed acres to the Chatham Area guidelines. These guidelines include Visual Quality Objectives (VQO), Maximum Disturbance Thresholds (MDT), Visual Absorptions Capacity (VAC), and Visual Management Class (VMC).

VQO. The VQOs are a management goal and provide a baseline from which to measure changes for use in managing National Forest lands. The component used to determine the objectives are scenic variety in the landscape (Variety Class), distance between the landscape and the viewers (Distance Zone), and how important the landscape is to the public (Sensitivity Level). The VQOs include Preservation, Retention, Partial Retention, Modification, and Maximum Modification. Each objective describes a different degree of acceptable alteration of the natural landscape. Harvest constraints for each VQO are shown in Table H-1. Table H-2 shows the percentages and acres of each VQO type for each VCU.

Table H-1. Harvest constraints based on VQO type.

VQO	Harvest Constraints - Maximum Disturbance Threshold (MDT)
Retention	Maximum of 8% of the area disturbed.
Partial Retention	Maximum of 16% of the area disturbed.
Modification	Maximum of 25% of the area disturbed.
Maximum Modification	Maximum of 35% of the area disturbed.

MDT. Maximum Disturbance Thresholds (MDT) are an analytical tool to determine areas that should have limited activities. Proposed activities are combined with existing impacts as a percentage of the total acres of the visual quality objective within a value comparison unit. The resulting percentage is then compared to the MDT to determine potential negative visual impacts. Approximately 30 years is required for a regenerated clearcut to grow trees 30 feet tall, the minimum height required to return the area to a continuous textured landscape. The amount of disturbance allowed in any given area (shown as a percentage) over an approximate 30-year period is the maximum disturbance-at-one-time constraint. Proposed activities should be calculated against the MDTs.

VAC. The factors of slope, landscape complexity, and landscape magnitude have been adopted by Region 10 as the input to determine the Visual Absorption Capacity

(VAC). This term is defined as "an estimate of the relative ability of the landscape to accept management manipulations without significantly affecting its visual character" and provides a basis to determine how difficult it would be to meet a particular objective.

TABLE H-2. Percentages of VQO by VCU**.**

	RETENTION (8%)		**PARTIAL RETENTION (16%)**		**MODIFICATION (25%)**		**MAXIMUM MODIFICATION (35%)**		**TOTAL**
VCU	ACRES	%	ACRES	%	ACRES	%	ACRES	%	
230	0	0.0	42	2.9	253	3.2	0	0.0	295
231	0	0.0	0	0.0	0	0.0	0	0.0	0
232	0	0.0	0	0.0	0	0.0	0	0.0	0
233	126	26.9	88	4.0	89	2.7	31	0.7	334
234	0	0.0	254	7.3	272	22.0	0	0.0	526
235	0	0.0	0	0.0	0	0.0	0	0.0	0
236	85	12.7	1,338	19.2	737	24.2	47	13.9	2,207
237	0	0.0	0	0.0	0	0.0	0	0.0	0
238	44	2.2	838	13.6	158	10.0	22	35.5	1,062
239	424	14.7	1,663	17.5	561	12.8	32	5.6	2,679
240	0	0.0	0	0.0	0	0.0	0	0.0	0
241	0	0.0	787	15.1	0	0.0	0	0.0	787
242	7	1.8	443	8.7	1,290	21.5	0	0.0	1,740
243	0	0.0	1,622	23.2	2,370	12.7	3	0.2	3,995
244	345	33.0	1,676	17.8	251	13.7	0	0.0	2,272
245	16	98.1	3,634	20.0	477	8.4	0	0.0	4,126
246	0	0.0	0	0.0	0	0.0	0	0.0	0
247	0	0.0	0	0.0	0	0.0	0	0.0	0
TOT-AL	1,046	5.2	12,385	61.9	6,457	32.2	135	0.7	20,023

VMC. By combining VQOs and VAC to "indicate in each land unit both the management objective and the relative effort required to meet it." Four classes are defined (Table H-3). These classes and associated guidelines are generalizations and are intended to establish a method for determining the relative difficulty and cost of achieving VQOs. Class 1 areas should have very limited impacts to scenic resource, Class 2 areas are most compatible with light development projects, and Class 3 and 4 areas are suitable for more intense landscape alteration, such as timber harvest. Table H-4 shows the Visual Management Class acreage by VCU for the Analysis Area.

Table H-3. Harvest strategies for each Visual Management Class (VMC).

VMC	Harvest Technique	Yield Potential	Other Developments	Landscape Architect Design Involvement
Class 1	Single tree, shelterw-ood, group selection and other minimum impact systems -- small clearcuts.	Moderate to substantial decrease	Minimum road building, primitive recreation facilities, wildlife and fisheries enhancement and utilities with no visual impact.	In-depth for planning and design phases
Class 2	All partial harvest systems, lengthened rotation, smaller clear cuts, minimum impact systems	Normal to moderate decrease	Utilities, recreation facilities, roads and associated structure, wildlife and fisheries enhancements.	In-depth for planning and design phases
Class 3	All	Normal to slight decrease	All	Especially in design phase
Class 4	All	No appreciable decrease	All	General guidance

Impacts to Scenic Resources

Impacts to visual resources which do not meet the VQOs are displayed as negative impacts. In the Analysis Area, proposed activities will also occur adjacent to or near previous management activities. The term "disturbance at one time" is therefore used to address how much management activity can occur in a given area in a given time period. In other words, even though individual harvest units meet the VQO assigned to an area, as a group they may disturb or change too much of the natural landscape during one period of time. There are some general design considerations that can be applied to each VMC. These considerations need to be developed further during the Project Area planning process to reflect the type of land-use management to be implemented and other resource goals.

Recommendations

Portions of the VCUs in the Analysis Area can be seen from Chatham Strait, Peril Strait, and Tenakee Inlet. The travel routes of the Alaska Marine Highway System and the heavily travelled small boat routes are given the highest visual sensitivity designation.

Table H-4. Visual Management Class acreage by VCU for the Analysis Area.

	VMC 1		VMC 2		VMC 3		VMC 4		TOTAL
VCU	ACRES	%	ACRES	%	ACRES	%	ACRES	%	
230	174	1.9	642	6.8	6,064	64.5	2,516	26.8	9,396
231	198	1.0	1,732	9.2	5,792	30.6	11,203	59.2	18,925
232	328	2.9	724	6.4	3,244	28.8	6,962	61.8	11,259
233	132	1.3	1,071	10.6	3,768	37.3	5,131	50.8	10,102
234	178	3.1	2,484	42.8	1,368	23.6	1,777	30.6	5,807
235	5,150	15.0	6,106	17.8	9,190	26.8	13,854	40.4	34,300
236	1,606	14.6	5,471	49.6	2,499	22.7	1,456	13.2	11,032
237	2,211	34.2	4,075	62.9	135	2.1	53	0.8	6,473
238	1,443	14.7	5,693	57.9	1,066	10.8	1,633	16.6	9,835
239	4,220	24.3	8,167	47.1	1,561	9.0	3,397	19.6	17,345
240	187	2.0	1,464	15.6	1,508	16.1	6,225	66.3	9,384
241	610	8.0	4,026	52.7	584	7.6	2,423	31.7	7,642
242	1,638	14.3	3,112	27.2	2,893	25.3	3,815	33.3	11,459
243	1,828	6.7	5,855	21.5	14,743	54.2	4,783	17.6	27,209
244	4,901	39.9	5,826	47.4	1,069	8.7	488	4.0	12,283
245	3,720	15.6	14,254	59.6	2,829	11.8	3,116	13.0	23,919
246	1,328	7.7	5,007	29.0	3,201	18.5	7,756	44.9	17,291
247	92	0.6	3,428	20.9	5,521	33.7	7,344	44.8	16,386
TOTAL	29,943	11.5	79,137	30.4	67,035	25.8	83,934	32.3	260,049

<u>VCU 230 - (In-between)</u> In 1966 21 acres were A-frame logged and 274 have been logged as part of the APC contract. During this time 3.5 miles of road were constructed. Most of this VCU is visible from Tenakee Inlet in the middleground of a small boat route. The area receives use from campers, hunters, fishermen, and beachcombers.

The majority of this VCU is Class 3 and Class 4; there is some Class 1 and 2 located along the shoreline. No areas are approaching the Maximum Disturbance Threshold. By remaining approximately one mile inland from the shoreline, most management activities can be accommodated within the Visual Quality Objectives.

<u>VCU 231 - (Saltery Bay)</u> Prior to 1971, 200 acres were cut; since that time an additional 125 acres have been logged. Most of this VCU is viewed in the background from Tenakee Inlet. The area is utilized by hunters, fishermen, and is used as an anchorage.

The majority of this VCU is Class 3 and Class 4; there is some Class 1 and 2 located along the shoreline. No areas are approaching the Maximum Disturbance Threshold. By remaining approximately one mile inland from the shoreline, most management activities can be accommodated within the Visual Quality Objectives.

<u>VCU 232 - (Crab Bay)</u> 267 acres of timber have been harvested here. Most of the VCU is visible in the fore and middleground from small boat and plane routes and the small boat anchorage and as background from the ferry route. Recreation use is by stream fishermen, wildlife viewers, and saltwater fishermen.

The majority of this VCU is Class 3 and Class 4; there is some Class 1 and 2 located along the shoreline. No areas are approaching the Maximum Disturbance Threshold. By remaining approximately one mile inland from the shoreline, most management activities can be accommodated within the Visual Quality Objectives.

<u>VCU 233 - (South Crab Bay)</u> This VCU includes the well used anchorage in Crab Bay. In the past, 334 acres of timber were harvested from this VCU. The area is viewed as background from the ferry and as middleground from small boat routes and anchorages in Tenakee Inlet.

The majority of this VCU is Class 3 and Class 4; there is some Class 1 and 2 located along the shoreline. The Maximum Disturbance Threshold has been exceeded for areas of Retention; no other areas are approaching MDT. By remaining approximately one mile inland from the shoreline, most management activities can be accommodated within the Visual Quality Objectives.

<u>VCU 234 - (Fog Creek)</u> The area faces the town of Tenakee Springs. 526 acres of timber have been harvested here and 9 miles of road have been built. This VCU is visible in the middleground and background from the ferry route and the small boat route.

About two-thirds of this VCU is Class 3 and Class 4; these areas are located primarily in the southwest half of the VCU and on southeast facing slopes. No areas are exceeding MDT; however, Modification (22%) is approaching the 25% maximum. By avoiding areas less than one mile inland from the shoreline and areas with a VQO of Modification and Intermediate VAC, most management activities can be accommodated.

<u>VCU 235 - (Kadashan River)</u> The area is has had little timber harvested. 5.8 miles of road have been constructed and 238 acres of timber have been harvested. This VCU was legislated as LUD II in the Tongass Timber Reform Act of 1990. Visibility to this VCU is predominantly from the foreground and middleground viewing distances of the use area around the tidal flats. The Kadashan area is also visible in

the middleground and background from the small boat routes and Alaska Marine Highway in Tenakee Inlet.

The majority of this VCU is Class 3 and Class 4. No areas exceed MDT. Given the LUD II status, any management activities permitted should meet VQOs.

VCU 236 - (Corner Bay) A total of 2,433 acres have been logged. Visibility to this VCU is predominantly from the middleground and background viewing distances of the Alaska Marine Highway and small boat routes traveling to and from Tenakee Springs. Much of this VCU is visible in the foreground from the Corner Bay logging road system.

Approximately one-third of this VCU is Class 3 and Class 4. These areas are located in the southern third of the VCU. MDT has been exceeded in Retention and Partial Retention; it is close to the threshold in Modification. Management activities will be easiest to accommodate if contained in areas that are VMC Class 3 and 4 excluding areas of Partial Retention.

VCU 237 - (Trap Bay) This VCU was legislated as LUD II in the Tongass Timber Reform Act of 1990. Visibility to this VCU is predominantly from the middleground and foreground viewing distances of the Alaska Marine Highway and small boat route in Tenakee Inlet and the hiking trail from Coffee Cove to Tenakee Springs.

There is only a very limited amount of Class 3 and 4: less than 3%. No areas exceed MDT. Given the LUD II status, any management activities permitted should meet VQOs.

VCU 238 - (South Passage) Recent timber harvest and road construction is visible from Chatham Strait. Visibility to this VCU is predominantly in the middleground and background viewing distances of the Alaska Marine Highway and small boat route in Chatham Strait.

The VCU is predominately Class 1 and 2; there is an area of Class 3 and 4 located in the intersection of VCUs 238, 239 and 236. Maximum Modification has just barely exceeded MDT; no other VQOs have exceeded MDT. By containing management activities to areas of VMC Class 3 and 4 and avoiding areas of Modification, most can be accommodated.

VCU 239 - (Kook Lake) About half of the VCU is visible in the middleground from the ferry route. The area is used by hunters and fishermen and by campers who use the USFS cabin at Kook Lake.

Most of this VCU is Class 1 and 2; a small area in the southwest quadrant is Class 3 and 4. Retention and Partial Retention have exceeded MDT, no other VQOs have exceeded MDT. Management activities should be limited to the southwest quadrant of this VCU.

<u>VCU 240 - (Little Basket Bay)</u> Most of the VCU is visible in the background from the ferry route in Chatham Strait and a small portion is visible in the middleground from both the ferry and small boat route. It receives use from recreation hikers, fishermen, and hunters.

The majority of this VCU is Class 3 and Class 4; there is some Class 1 and 2 located along the shoreline. No areas have exceeded MDT. By remaining approximately one mile inland from the shoreline, most management activities can be accommodated within the Visual Quality Objectives.

<u>VCU 241 - (Do To Station)</u> Most of the VCU is visible in the background from the ferry route in Chatham Strait and a small portion is visible in the middleground from both the ferry and small boat route. In the past, 6.1 miles of road were constructed and 787 acres of timber were cut.

The majority of this VCU is Class 2; there is a small area of Classes 3 and 4 located in the northwest quadrant. No areas have exceeded MDT, but Partial Retention is just barely below. By containing activities to areas of VMC Class 4, management activities can be accommodated.

<u>VCU 242 - (White Rock)</u> About half of the VCU is viewed in the middleground from the ferry route and the other half is viewed as middleground from the small boat routes. In the past, 13.5 miles of road were constructed and 1,740 acres of timber were harvested.

Approximately the western half of this VCU is VMC Class 3 and 4. No MDT has been exceeded, but Modification is approaching the threshold. By avoiding areas less than one mile inland from the shoreline, most management activities can be accommodated.

<u>VCU 243 - (Sitkoh Bay)</u> The area is utilized by hunters and fishermen as well as hikers and campers. There is an anchorage in Sitkoh Bay. 274 miles of road have been constructed and 4,025 acres of timber have been harvested.

Most of this VCU is VMC Class 3 and 4. MDT has been exceeded for Partial Retention, no other VQO is exceeding MDT. By avoiding areas less than one mile inland from the shoreline and areas less than one-half mile from the north side of Sitkoh Bay, most management activities can be accommodated. Most of this area, however, already has been cut.

<u>VCU 244 - (Sitkoh Lake)</u> There are two USFS cabins on the Lake utilized by campers and recreational users. 12.2 miles of road have been constructed and 2,272 acres of timber were harvested. The majority of this VCU is visible in the foreground from the trail from Sitkoh Bay to Sitkoh Lake.

Most of this VCU is VMC Class 2; there is a small area of Classes 3 and 4 located in the northwest corner. MDT has been exceeded for both Retention and Partial Retention. There is a small area in the northwest quadrant of the VCU which presents opportunities for additional activities, but it has been previously entered for timber harvest.

VCU 245 - (False Island) The area has an anchorage at Lindenberg Harbor and False Island. Almost all of the VCU is highly visible in the middleground from the ferry route and the small boat and small plane route. The area is utilized by hunters and fishermen. 20.8 miles of road have been constructed and 41,26 acres of timber have been harvested.

Most of this VCU is VMC Classes 1 and 2 because of being visible from the ferry route. MDT has been exceeded for Retention and Partial Retention. Very little of this VCU is appropriate for activities which heavily alter the scenic quality of the landscape; there are some pockets on the north side of Moore Mountain that could accommodate timber harvest.

VCU 246 - (Broad Island)   This VCU is visible in the middleground from the ferry route and small boat route.   There has been little timber harvest in this VCU.

There are a large area of VMC Class 4 in the east half of this VCU and a large area of Class 3 in the northwest quadrant. No VQOs have exceeded MDT. The Broad and Broadfinger drainages offer areas that present opportunities for management activities provided these are more than one mile inland from the shoreline.

VCU 247 - (Finger Mountain)   This VCU is visible in the middleground from the small boat route.   There has not been any previous timber harvest in this VCU.

Approximately three-quarters of this VCU is VMC Classes 3 and 4; there are a small area of Class 2 located near the mouth of Finger Creek and several pockets further north. No VQOs have exceeded MDT. Given the LUD II status, any management activities permitted should meet VQOs.

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