1974
USDA FOREST SERVICE **GENERAL TECHNICAL REPORT PNW-12**

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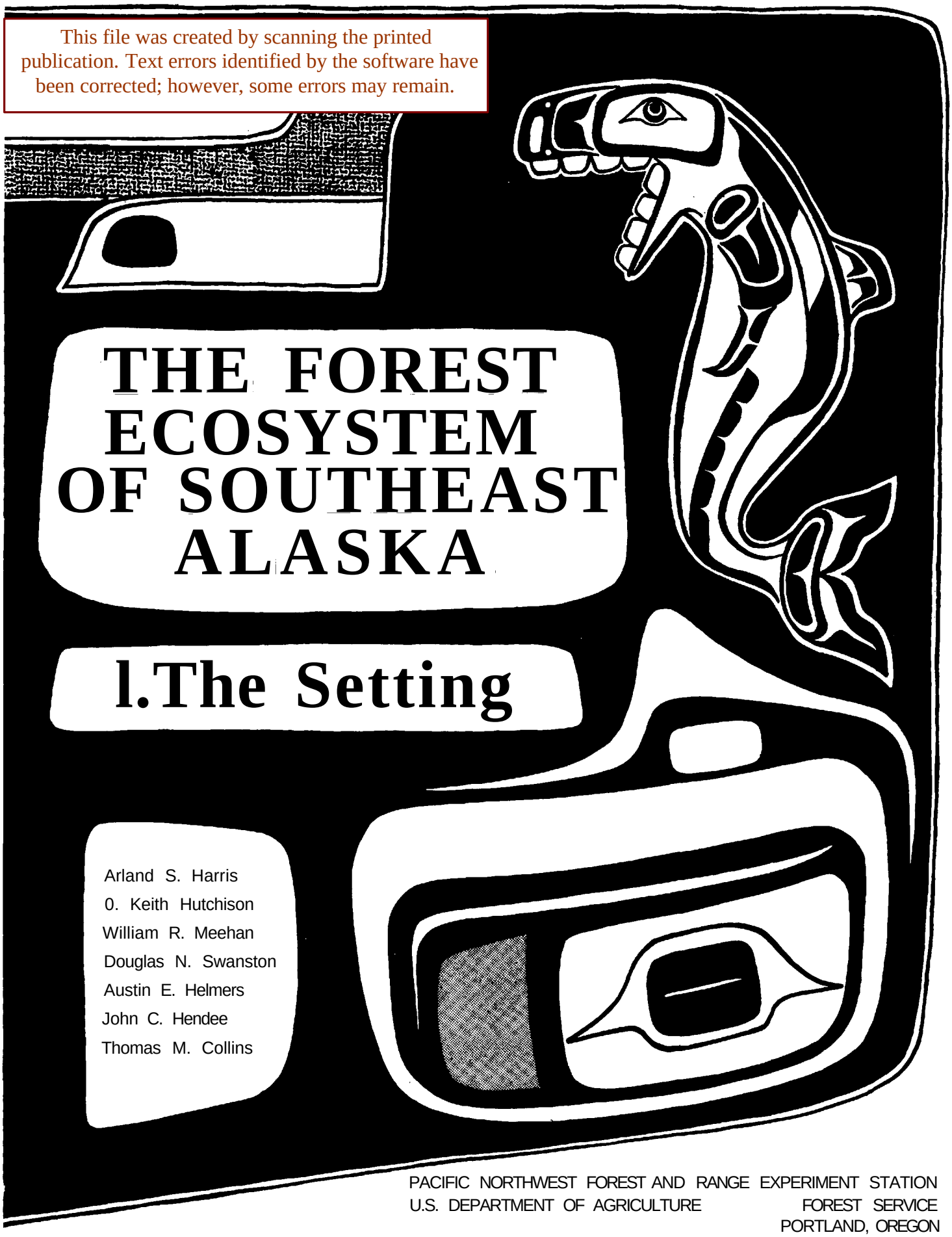

THE FOREST ECOSYSTEM OF SOUTHEAST ALASKA

1. The Setting

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ABSTRACT

A description of the discovery and exploration of southeast Alaska sets the scene for a discussion of the physical and biological features of this region. Subjects discussed include geography, climate, vegetation types, geology, minerals, forest products, soils, fish, wildlife, water, recreation, and esthetic values.

This is the first of a series of publications summarizing present knowledge of southeast Alaska's forest resources. Publications will follow which discuss in detail the subjects mentioned above and how this information can be helpful in managing the resources.

Keywords: *Forest surveys, Alaska, resource planning, research.*

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PREFACE

This, the first in a series of publications summarizing knowledge about the forest resources of southeast dlaska, describes the physical, biological, and socioeconomic setting of southeast Alaska. It provides a background for the more technical reports which will follow.

Our intent in presenting the information in these publications .is to provide managers and users of southeast Alaska's forest resources with the most complete information available for estimating the consequences of various management alternatives.

In this series of papers, we will summarize published and unpublished reports and data as well as the observations of resource scientists and managers developed over years of experience in southeast Alaska. These compilations will be valuable in planning future research on forest management in southeast Alaska. The extensive lists of references will serve as a bibliography on forest resources and their utilization for this part of the United States.

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INTRODUCTION

In the changing fashions of organized study, science has passed through an era of emphasis on basic research. This emphasis has often left undone the interpretation of findings and their incorporation into the decisionmaking process. The reservoir of knowledge and technology accumulated through research is needed now more urgently than ever before to help solve natural resource management problems, The series of papers, of which this is the first, is an attempt to transfer technology from researchers to managers and users of southeastern Alaska ecosystems.

The objectives of this series of compilations are (1) to provide guidelines in managing the forest resources of southeast Alaska, (2) to establish a framework for multidisciplinary research, and **(3)** to bring together the pertinent published and unpublished information concerning the forest resources of southeast Alaska.

The geographic scope of this series is that portion of Alaska east of the 141st meridian (fig. 1). A problem analysis and "state-of-the-art" evaluation for the central and southwest coasts are also needed; however, research information for that area falls off sharply compared with southeast Alaska.

The scope of this group of papers includes:

Forest ecology	*Eroswn and sedimentation*
Timber management	*Water,*
Timber inventory	*Recreation and esthetics*
Fish and wildlife habitats	*Forest insects and diseases*

There are probably few places in the world where geologic and climatic variations are greater than in southeast Alaska. Around Juneau, for example, one can go from the salt-water depth of the Inland Passage to the perennial snow and ice of the Juneau Icefield in a horizontal distance of less than 8 miles and an elevational range of only 4,000 feet.

Physiography and climate combine to intensify glaciation, which is presently active; soils are young and poorly developed; many slopes are unstable; abundant rainfall and cool summers favor reforestation of logged-over areas; water in great quantity is important to fish resources. These features profoundly affect use and management of the land,

Industrial and economic developments are both old and new--fishing has a long history; large-scale timber harvesting is new; gold mining has come and, at least temporarily, is gone. There is a continuing small but steady interest in the extraction of minerals--some with large potential. The fur industry is essentially inactive. The social setting is new--Alaska is a new State, and a rapidly expanding population is responding to the opportunities to build and to benefit from newly tapped resources. It seems that "everyone wants to come to Alaska," at least to see the "great land," which means that the already important recreation and tourism activities will continue to expand.

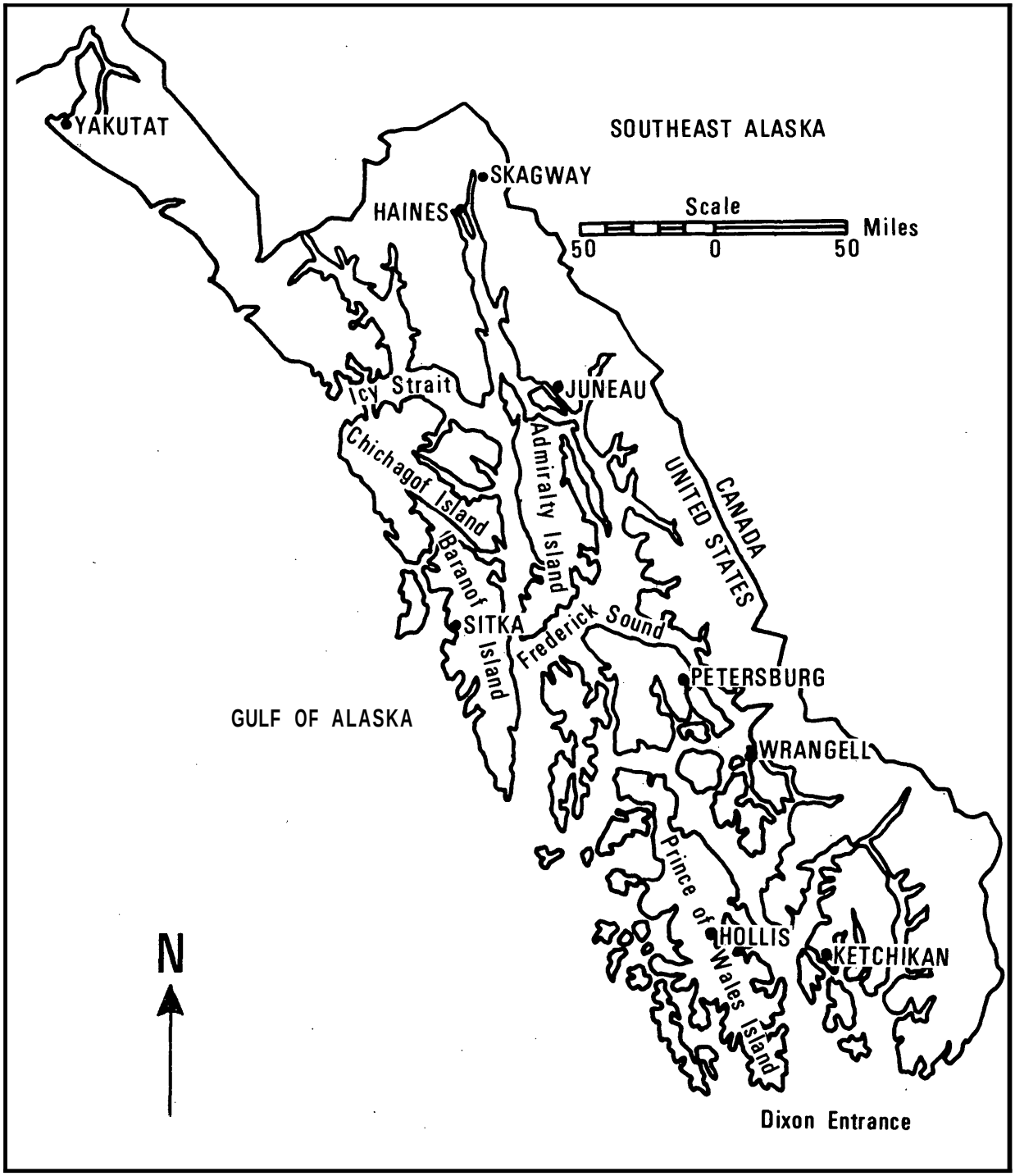

Figure 1.--Map of southeast Alaska east of the 141st meridian.

DISCOVERY AND HISTORY

The discovery of northwestern America by white men perhaps began when the Russians became curious about "the east." Shortly after Yermak Timofeief heard of "land to the east" from Anika Stroganoff in 1578 (Hartman et al. 1970), the Cossacks pushed across Siberia, until in 1639 Dimitrii Kopylov founded Okhotsk. The Chukotsk Peninsula was discovered in 1648. Mikhail Gvozdev was near, or landed on, Cape Prince of Wales, Seward Peninsula, in 1730 while exploring for the "great land" reported by the Chukchi natives (Alaska Chamber of Commerce 1938).

Southeast Alaska was first sighted during Captain-Commander Vitus Bering's second expedition of discovery. This expedition, which sailed for America from Petropavlovsk, Russia, on June 4, 1741, included two ships — the *St. Peter* with Bering and the scientist George Wilhelm Steller on board and the *St. Paul* under the command of Alexei Chirikov (Gruening 1954'). After sailing eastward together for some days, the ships became separated and they proceeded independently.

On July 15, Chirikov sighted land near Cape Addington on Noyes Island off the west side of Prince of Wales Island. Lacking a suitable landing place he turned north and on July 19 entered a bay which is believed to be today's Sitka Harbor. Two boats were sent ashore--the first with 11 men and, several days later, a second boat with three men, which is presumably the first time that white man set foot in Alaska. Both boats failed to return; Chirikov returned to Petropavlovsk.

Bering searched for 3 days for the *St. Paul* after the ships became separated. He then sailed ENE and at about noon, July 16, sighted Mount St. Elias. Bering landed briefly on Kayak Island in Prince William Sound, where Steller went ashore to collect specimens and make observations. Bering subsequently made his way back as far as one of the Kommandorski Islands (Bering Island) during the first year of the expedition. There, he died, along with many of his crew.

A Spanish expedition, commanded by Juan Perez in the ship *Santiago*, sighted Prince of Wales Island on July 18, 1774. The next year, Lieutenant Juan Francisco de la Bodega y Quadra, with the schooner *Sonora*, sighted Mount Edgecumbe and, on the following day, anchored in Krestof Bay. He continued as far as 57°57' N. latitude before returning southward. Captain James Cook, on his third and last voyage of discovery in the Pacific, reached the Alaskan coast on May 1, 1778, named Mount Edgecumbe, Mount Fairweather, and Bering Bay (now Yakutat Bay). Quadra again visited southeast Alaska, arriving at Bucareli Bay on May 2, 1779. The French explorer La Perouse sighted Mount St. Elias on June 3, 1786, and entered Lituya Bay on July 3.

Captain George Dixon in the ship *Queen Charlotte*, and Captain Nathaniel Portlock in the *King George* visited southeast Alaska in 1787 in the service of the King George Sound Company. Captain Dixon sailed to Yakutat Bay, visited Sitka Sound, and then went to Dixon Entrance. Captain Portlock went to Chichagof Island where he entered and named Portlock Harbor.

In the wake of these early explorers and traders, so many Americans followed that "during the next 25 years.. .the Yankee skippers and their bucko mates were known in every bay and cove of the coast of southeastern Alaska." (Andrews 1931).

The last Spanish exploration was in 1792 when Lieutenant Jacinto Caamaño came to the Alexander Archipelago. He named Cape Chacon and other points but did not reach the mainland.

Captain George Vancouver explored much of southeast Alaska in 1793 and 1794. His surveys were finished at the harbor he named Port Conclusion. His departure from the southeast Alaska coast terminated the main era of exploration.

The Russian fur trade in Alaska began in 1743, but it was not until 1781 that it touched southeast Alaska. Fur exploration gradually expanded along the Aleutian Islands-and the Alaska Peninsula until finally, as fur animals were depleted, the time and expense of seeking new grounds necessitated the formation of companies. In 1788 Eustrate Delaref sent the company navigator, Bocharof, on an exploratory voyage eastward on the ship *Three Saints,* which visited Yakutat Bay and Lituya Bay. At the time, Delaref was in charge of the Russian settlement on Kodiak Island, which had been established by the Shelekof-Golikof Company.

Alexander Baranof, who relieved Delaref as manager of the Shelekof-Golikof Company at Kodiak, extended sea otter hunting on a substantial scale to Yakutat and Cross Sound in 1794. In 1795, attempts to establish a colony at Yakutat miscarried, but Baranof visited Sitka to look for a possible post site. The Yakutat colony, called New Russia, was established in 1796, and in the spring of 1799 the Sitka site was occupied in what is now known as Starrigavan Bay.

The Sitka post was destroyed by the Tlingits in 1802; survivors returned to Kodiak. It was retaken in 1804 when the Tlingits were driven away and their fort destroyed. The regained outpost was named New Archangel.

In the ensuing years, the fur resources declined and competition from other countries increased. Leontii Hageimeister relieved Baranof as chief manager in January 1819, followed by M. Muravief, who assumed these duties in September 1820. Muravief allowed the Tlingits to return to Sitka in 1821.

The second charter of the Russian American Company was granted on September 13, 1821. The Russian government made treaties with the United States and with Great Britain, agreeing on provisions for coastal sailing, fishing, and trading with natives. These were regarded as an infringement of rights by the Russian American Company; the company continued to have difficulty with the natives of the Alexander Archipelago. After the U.S. trade agreement expired and was not renewed, intense competition developed between the Russian American Company and the Hudson's Bay Company, who had reached the Pacific coast and started trading in southeast Alaska. To prevent an English settlement on the Stikine River, Lieutenant Zarembo was sent in 1833 to the mouth of the river to establish a fort on

Wrangell Island at the present site of Wrangell. The failure of the Hudson's Bay Company attempt led to a 10-year lease to the Russian American Company of the coast from Portland Canal to Cape Spencer. Upon renewal, the coverage of the lease was extended to the time of transfer of the territory to the United States.

The fort at Wrangell was transferred to the Hudson's Bay Company in June 1840. In the same year, Fort Taku was built in Taku Harbor.

Under the third charter of the Russian American Company, which was dated October 10, 1844, the company discontinued the policy of trade expansion and acquisition of territory. Fur conservation begun by Baron Wrangell was continued. During the last of the Russian American Company period, the conservation of animals in the Seal Islands began to bear fruit and the company continued to prosper through sea otter hunting. Throughout this period the company employed Aleuts.

Support and trade activities in the Russian American colonies included the sale of ice to California. Another interesting product of southeastern Alaska could be obtained in Seattle and elsewhere by asking for "Zarembo Water"--bottled from a spring on Zarembo Island (Brown 1909). Sawmills were introduced at an early date. The machinery for one at Sitka was ordered by Rezanof in 1806. In 1848, a second mill was placed on Sawmill Creek at Silver Bay. Two flouring mills ground the grain brought from California and Chile. One mill was at Sitka and the other at Redoubt Lake near Sitka.

A tannery prepared leather from cattle hides from California and from sea lion skins from the coast. There was a well-equipped brass and iron foundry, with a machine shop.

Limestone, marble, graphite, coal, and gold were discovered. The waters off the Alaska coast became important whaling grounds by the early 1800's. Gold was discovered on the Stikine in 1861, and the little steamer *Flying Dutchman* ran as far upstream as Telegraph Creek. In southeast Alaska, the first gold discovery was made by Mix Sylvia at Windham Bay and Sumdum Bay in 1869. The first mining company was the Alaska Gold and Silver Mining Company at Silver Bay.

By mid-1850's during the Crimean War, the Emperor of Russia feared that England would seize Russian America. Also, by this time the Russians were suffering various encroachments in the colonies and were gradually losing their hold. The combined effect was an offer to sell the Russian America Colonies to the United States. The treaty of purchase was signed on March 30, 1867, and proclaimed by President Johnson on June 20. The formal transfer of Alaska to the United States took place at Sitka on October 18, 1867.

In the first half-century of United States rule, mining reached a peak with the gold production of southeast Alaska a substantial part of the total mineral values. Prospecting, discovery, and some development of other minerals also occurred. The fisheries were developing rapidly by the end of these first 50 years. Fur production, the main industry before U.S. rule, was continuing, and remained important partly due to the start of fur farming. The timber industry was small and producing for local use.

In the years that followed the first half-century, there were major shifts in resource use. From 7878 (when the first salmon cannery was erected) until the late 1950's fishing was the main prop of the regional economy (Rogers 1960), reaching a peak in 1941.

At present, mining is much reduced over previous production levels, especially since the closure of the Alaska Juneau, Treadwell, and Chichagof gold mining properties. Considerable prospecting and exploration continues with some small developments and production, in response to changing prices for various minerals, Price increases, such as for uranium, copper, and nickel, result in new flurries of prospecting and development.

In addition to trapping wild fur bearers, there was a period of fur farming in the 1920's and 1930's. However, generally unfavorable markets have reduced the fur trade to the low level of traditional winter activity for some of the indigenous population and to an incidental sport activity.

One of the major long-term values of Alaska is in recreational opportunities and associated wildlife and mountain scenery. Tourism, which started in the 1800's, is now developing rapidly with improved transportation means and routes.

Wood has become the basis for a major industry in southeastern Alaska. The big jump in annual cut was in 1954 when the first large pulpmill, Ketchikan Pulp Company (fig. 2), opened near Ketchikan.

Figure 2.--Ketchikan Pulp Company mill at Ward Cove, near Ketchikan, Alaska.

GEOGRAPHY

Southeastern Alaska is here defined as that part of the State lying east of the 141st meridian, consisting of the large group of islands known as the Alexander Archipelago and the narrow mainland strip between Dixon Entrance and Icy Bay. This area lies between latitudes about 54-1/2° and 60-1/2° North, extends east to the 130th meridian. It is about 120 miles in width and 525 miles in length in the northwesterly-southeasterly direction.

Southeastern Alaska is in about the same latitude as the northern part of the British Isles and the southern part of Norway and Sweden. Its latitudinal range is similar to the Kamchatka Peninsula of the U.S.S.R. and the west coast of the Sea of Okhotsk from Nikolayevsk to Okhotsk.

The Alexander Archipelago has hundreds of islands, of which 65 exceed 4 square miles in area, 15 exceed 100 square miles, and six exceed 1,000 square miles. These six large islands are: Prince of Wales (the largest, 2,770 square miles in area); Chichagof (2,062 square miles); Admiralty (1,709 square miles); Baranof (1,636 square miles); Revillagigedo' (1,134 square mi1es); and Kupreanof (1,084 square mi1es).

The islands are separated by a system of seaways including sounds, straits, canals, narrows, and channels, There are nearly 10,000 miles of shoreline along the islands and mainland. For the most part the coastline is rocky and steep, but there are accessible beaches located within the numerous sheltered inlets, bays, arms, coves, harbors, and anchorages.

PHYSIOGRAPHY

The topography of southeast Alaska includes parts of two high mountain arcs (the Coast Mountains) and the intervening low mountains. These three features are part of the Pacific Mountain System. The eastern boundary range consists mainly of the mountains associated with the Coast Range Batholith. These are an extension of the Cascades in Washington and the Coast Mountains of British Columbia. Northwestward these mountains appear again in Alaska as the Nutzotin Mountains and the Alaska Range.

Major rivers in southeast Alaska originate in Canada, apparently as antecedent streams that maintained their courses as the coastal mountains rose. The principal rivers are the Alsek, Chilkat, Klehini, Taku, Whiting, and Stikine. Other important mainland rivers include the Salmon, Chickamin, Unuk, Bradfield, Speel, and Taiya Rivers.

Elevations along the boundary range peaks are 6,000 to 10,000 feet, with most of the main peaks between 7,000 and 9,000 feet. These elevations are of interest in terms of airmass lifting, precipitation, large number of glaciers, and several icefields. These mountains are the main factor in the spectacular scenery,

The seaward belt of mountains in southeastern Alaska is a discontinuous extension of the Vancouver system in British Columbia (Atwood 1940), manifest as the mountains of Baranof Island. Northwestward along the coast these mountains appear again as the Fairweather Range and the St. Elias group which connect to the westward with the Chugach Range.

Mount Fairweather rises to 15,300 feet; Mount St. Elias, the highest point (18,008 feet) in the southeast Alaska system, is the fourth highest peak in North America (Williams 1958). Areas of subdued relief are uncommon in southeast Alaska, but the most subdued is the belt of comparatively low islands that make up the Alexander Archipelago (U.S. Geological Survey 1958).

The northern part of southeast Alaska is rising as much as 2 to 4 centimeters (0.8 *to* 1.6 inches) per year (Hicks and Shofnos 1965), at least partly an isostatic rebound in response to the diminishing load of glaciers. Beach deposits are found above sea level at elevations ranging from a few feet on the southern end to many hundreds of feet in the Fairweather Range.

CLIMATE AND WEATHER

Southeast Alaska climate is maritime--cool, and moist. The narrow temperature range is limited partly by the moderating influence of adjacent seas. The abundant moisture is derived from airmass lifting by the Coast Mountains (Fitton 1930). The overall effects are cool summers, moderate winters, considerable precipitation well distributed throughout the year, heavy snowfall at higher elevations resulting in large numbers of glaciers and several icefields, and a high incidence of cloudiness. All these climatic features have important effects on resource uses and management. For example: cool air temperatures and general cloudiness reduce the effect of timber harvesting on summer stream temperatures; moisture is not a limiting factor in tree regeneration; wildfire is not a major problem; a high percentage of the land is occupied by muskegs; and high winds cause heavy losses of potential timber by windthrow.

Southeast Alaska is far enough north to experience a wide range in daily hours of possible sunshine during the course of a year, which lessens the daily temperature fluctuation (Watson et al. 1971). During long hours of sunlight in the summer, there is only a brief nighttime period of radiational cooling. During the shortest days in winter, the reduced hours of sunshine and low sun angle result in little surface heating, and most of what is received is lost through reflection. Even on the longest days, the sun is so low that there is no pronounced peak in surface heating (Watson et al. 1971). The other major temperature effect is the moderating influence of the open waters of the inland passage. These waters are warmed by the circulation of the Alaska current, which is an eddy off the Kuroshio Drift (Johnson and Hartman 1969). Sea temperatures off southeast Alaska range from about 55" F. in the summer to about 42" F. in the winter. The coast is free of ice except in protected waters.

The Coast Mountains that back southeastern Alaska effectively interrupt the surface atmospheric circulation (Fitton 1930). In response, precipitation generally accumulates to between 60 and 200 inches a year (extreme values for means are 26 inches at Skagway and 211 inches at Little Port Walter) as steady, light to moderate rain or snow during 220 to 230 days in the year. June is the driest month, 4 inches normal; October the wettest, almost 12 inches of rain (Searby 1968). On the average, cloudy skies occur on 275 days, 43 are clear, and the remainder are partly cloudy.

Maximum precipitation is usually associated with low pressure centers which develop in', or cross, the Gulf of Alaska. The flow aloft is usually either southerly or southwesterly as a result of a trough moving eastward over the Alaska Peninsula area into the Gulf of Alaska (Miller 1963).

The prominent low pressure systems, called Aleutian Lows, make southeast Alaska an essentially stormy area, winter and summer. A normal storm track along the Aleutian Island chain, the Alaska Peninsula, and all the coastal area of the Gulf of Alaska exposes these areas to most of the storms crossing the north Pacific (Searby 1968). The Aleutian Lows are not the developmental areas for these cyclones, but a favorable channel through which to pass (Fitton 1930). The resultant nearly constant east-west zonal circulation dominates throughout autumn and winter and intermittently at other times of the year (Marcus 1964). At times Canadian or arctic high pressure systems spill over the Coast Mountains, bringing northerly winds, From these sources, especially the deep cyclonic depressions, there develops a pattern of windiness that has taken a toll of merchant and fishing vessels, has done considerable structural damage, and has made a mosaic of young even-aged stands following blowdowns of old-growth forests.

Nearly 40 percent of the large daily precipitation occurs in October, with only 1 percent in April, May, and June. The probable maximum 24-hour precipitation ranges from about 20 to 27.5 inches (Miller 1963).

One of the most distinctive climate-related features of southeast Alaska is its glaciation (fig. 3). According to Miller (1967), 43-year

Figure 3.--Mendenhall Glacier, near Juneau, Alaska.

cycles of glacial advance and retreat respond to the warming or cooling trends associated with sunspot activity. During maximum solar activity, the continental airmass warms and expands, forcing the maritime airmass seaward and raising the elevation at which there is snowfall. High-elevation glaciers expand and low-elevation glaciers shrink. With minimum solar activity, the continental airmass cools and contracts, the maritime airmass moves landward, lowering the elevation at which there is snowfall. High-elevation glaciers shrink and low-elevation glaciers expand. Past trends suggest that we are entering a period of cooling.

Daylight throughout the latitudes of southeast Alaska ranges from about 18-1/2 hours to as little as 7 hours. From 6 to 8 percent of the day is twilight and materially lengthens the day in terms of visibility so that useful daylight amounts to 8-1/2 to nearly 22 hours.

Climatic summaries are available in Searby (1968), and U.S. Weather Bureau (1962, 1965). Small scale maps of plotted climatic data were published by Johnson and Hartman (1969). More detailed summaries for certain stations and climatic elements were published by Watson et al. (1971) and Andersen (1955). Daily details for many stations are published monthly and annually by the Environmental Data Service of the. National Oceanic and Atmospheric Administration.

The tides of southeastern Alaska are an important consideration in planning log dumping and storage areas, construction of homes, roads, businesses, and recreational facilities,

The mean diurnal tidal range varies from less than 10 feet on the west coast of the archipelago to nearly 17 feet in inland passages. Spring tides, resulting from the combined effects of the moon and the sun, increase the range as much as 40 percent and the neap tides (opposite effect) reduce the range as much as 40 percent. For instance, in 1972 the greatest tidal range at Juneau was from -4.4 feet to 20.6 feet on November 21. The smallest range, 2.8 feet, was on February 8-9 with stages of 7.2 and 10 feet.

GEOLOGY AND SOILS

Southeast Alaska lies within the broad zone of active volcanism and other mountain building processes which rims the north Pacific basin. The region is characterized by deep valleys, steep slopes, and narrow intervalley ridges, Drainage patterns are coarse and strongly controlled by faulting and jointing of the bedrock, Extensive glaciation during the last ice age has modified these features to a large extent, creating characteristic U-shaped valleys, serrate ridges, horn peaks, and cirque basins so typical of recently deglaciated terrain. Glaciation (fig. 3) and mountain building processes are still active in the region today. Vigorous mountain glaciation is presently occurring in the Coast Mountains, and faulting and tectonic uplift have occurred west of Chatham Strait as recently as 1958 (Miller 1960).

Detailed mapping and interpretation of the geologic history of southeastern Alaska are still in beginning stages. Many of the available

data are of a reconnaissance nature and date back to the early part of the century. Detailed interpretation is also hampered by lack of rock exposures and an inadequate knowledge of the geologic record. An excellent analysis of the geologic history of southeast Alaska based on existing data has been prepared by Brew et al. (1966).

The following synopsis of the geologic history of southeast Alaska provides an appreciation for the dynamic nature of the landscape and a framework in which to consider the interaction of the various resources and the various management problems encountered in their use.

EARLY GEOLOGIC HISTORY

Gross topographic configuration of southeast Alaska is a product of (1) widespread deformation, metamorphism and intrusion of thick sequences of interbedded Paleozoic[1/] and Mesozoic[2/] sediments and volcanics and (2) major igneous intrusions at the end of the Mesozoic era (approximately 65 million years ago). The outcrop pattern (fig. 4) is dominated by three northwest-southeast trending belts of sedimentary and metamorphic rocks consisting of gray-green graywackes, conglomerates, and sandstones interbedded with black shales and slates (locally called argillite), and gray-green andesitic flow rocks. Locally, limestones and marbles dominate. The oldest rocks, of Paleozoic age, occupy the center belt, with younger Mesozoic rocks occupying the belts on either side and indicating a broad anticlinal structure which dominates the regional structural pattern.

Igneous rocks, predominantly quartz-diorite, diorite and granite, were intruded during a late Cretaceous-early Tertiary metamorphic period. The igneous intrusions dominate the Coast Mountains and occur in a belt trending northwest-southeast through Baranof and Chichagof Islands toward the St. Elias Mountains. The Coast Mountains constitute a portion of a major batholithic intrusive belt which extends along the entire north Pacific coast (Gabrielse and Wheeler 1961).

Metamorphism of the surrounding rocks is associated with all the igneous intrusions in the region. In addition, there are broad areas which have undergone varying dynamic metamorphism associated with regional folding and deformation. A belt of highly metamorphosed rocks, predominantly high-grade gneisses and schists (locally garnetiferous), extends the entire length of southeast Alaska adjacent to the Coast Range Batholith and was probably formed during intrusion of the batholithic mass. This is the "Wrangell-Revillagigedo belt of metamorphic rocks" first described by Buddington and Chapin (1929). A similar belt of metamorphic rocks makes up the "Wales Group" on southern Prince of Wales Island. A third area of extensive metamorphism includes all of Baranof Island and southwestern Chichagof Island, probably in large part related to intrusion of igneous masses in that area.

Northwest-southeast and north-south trending lineaments and faults of Cretaceous-Tertiary age are prominent features of the regional structural pattern in southeast Alaska (fig. 5). The north-trending Chatham Strait

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1/ 225 to 500 million years ago.
2/ 65 to 225 million years ago.

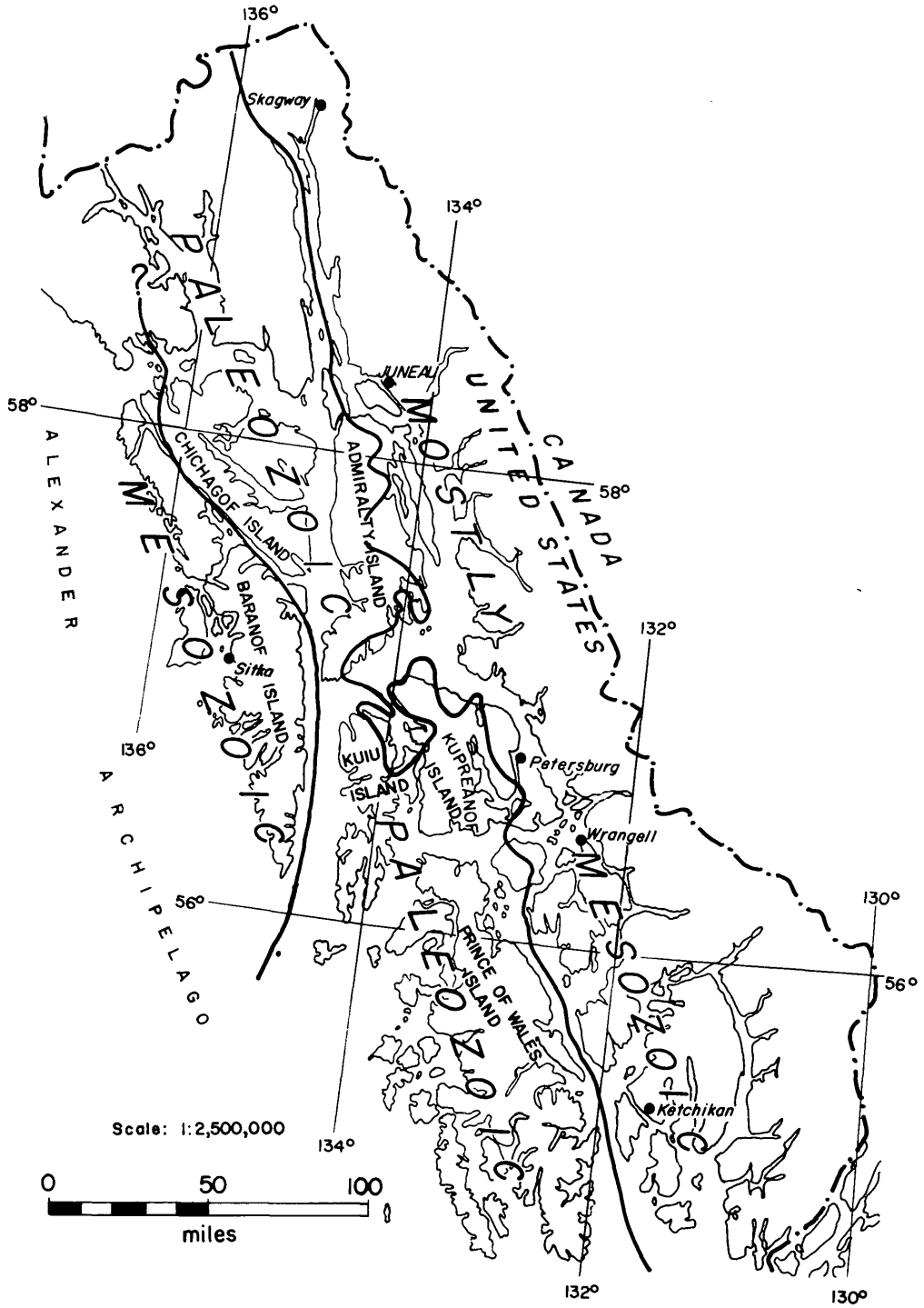

Figure 4.--Major outcrop belts of southeast Alaska (from Brew et al. 1966; used with permission of the publisher, The Canadian Institute of Mining and Metallurgy).

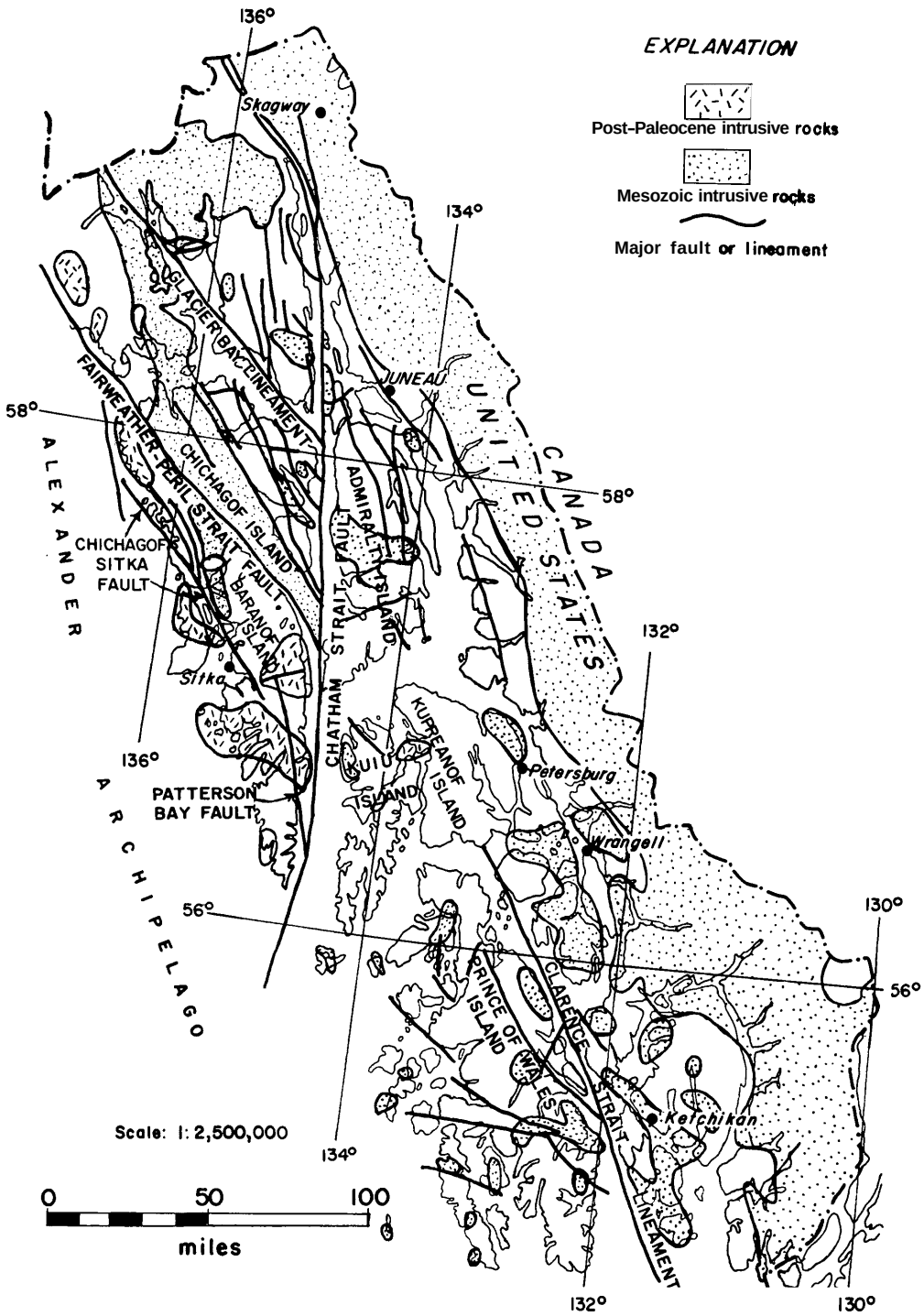

Figure 5.--Post-Paleozoic intrusions and major faults and lineaments of southeast Alaska (from Brew et al. 1966; used with permission of the publisher, The Canadian Institute of Mining and Metallurgy).

Fault dominates these features, extending through Chatham Strait and Lynn Canal for over 250 miles. Approximately 50 miles of offset have occurred along this faultline (Brew et al. 1966). The Fairweather Fault trends northwest-southeast along Peril Strait, Lisianski Inlet, and the western flank of the Fairweather Range and intersects the Chatham Strait Fault at the entrance to Peril Strait. Approximately 18 miles of offset have occurred along this fault. The Chichagof-Sitka-Patterson Bay Fault, trending northwest-southeast, is located along the west side of Baranof and Chichagof Islands. This fault also intersects the Chatham Strait Fault although movement has not yet been quantified or reported in the literature. Many other faults and lineaments exist in southeast Alaska but are difficult to interpret because of lack of detailed mapping and concealment of faulting evidence by fiords and channels.

Following this major period of folding, faulting, intrusion, and metamorphism, tectonic activity decreased in magnitude although local volcanic activity associated with uplift and erosion has continued. During the Tertiary period, such activity produced a thick sequence of sandstones, conglomerates, and andesitic volcanics which were deposited in the central part of southeastern Alaska. These are mainly exposed on Kuiu, Kupreanof, northern Prince of Wales, and southern Admiralty Islands and have remained relatively undeformed.

PLEISTOCENE GLACIATION

Weathering and erosion of the geologic surfaces produced by the late Cretaceous-early Tertiary period of folding, faulting, and metamorphism are primarily responsible for the broad topographic configuration of southeastern Alaska. Subsequent erosion and deposition by continental and alpine glaciers during the Pleistocene epoch (2 million to 10,000 years ago) and by alpine glaciation during post-Pleistocene (Holocene) time have modified this topographic configuration to what it is today.

Southeast Alaska undoubtedly underwent repeated continental glaciations during the Pleistocene epoch, with the continental ice mass in the interior of Canada flowing through the principal valley passes in the Coast Mountains: the Alsek, Taku, Whiting, Stikine, and Unuk Rivers. Unfortunately, evidence of these early Pleistocene glaciations has largely been masked by the later glacial expansions in the region. Almost all evidences of glacial erosion and deposition in southeastern Alaska thus far identified are directly related to the last major glacial advance of the Pleistocene, the Wisconsinan.

The highest levels of glaciation during the Wisconsinan extended from 2,000-3,000 feet in elevation on the outer islands of the Alexander Archipelago (Coulter et al. 1965, Sainsbury 1961) to 6,000 to 8,000 feet in elevation in the Coast Mountains (Miller 1964). This seaward gradient, coupled with sloping berm lines and lower correlative cirque floor elevations in the Alexander Archipelago (Swanston and Miller 1968), indicates an ice surface sloping to the west. The glacier advances during the Wisconsinan must have been via outlet glaciers through the Coast Mountains forming extensive valley ice tongues in the archipelago and leaving large low-level areas to be fed by glaciers from local mountain icecaps on the islands and along the mainland.

Although the overwhelming majority of southeast Alaska lands below 3,000 feet were occupied by ice during the Wisconsinan glaciation, several areas west of the Fairweather and St. Elias Mountains were not (Heusser 1960, Miller 1961, Goldthwait 1963); and there is evidence suggesting that one area on Prince of Wales Island may have escaped glaciation, at least during the last Wisconsinan ice advance (Harris 1965).

RECENT GEOLOGICAL ACTIVITY

A warming of the climate caused a general retreat of the late Wisconsinan ice sheet that occupied southeast Alaska, culminating in the "Thermal Maximum," 6,000 to 7,000 years ago when the mean annual temperature was about 1° warmer than today and precipitation was considerably less (Goldthwait 1966). Glaciers in southeastern Alaska were reduced to nearly their present size or smaller. At this time, rising sea levels, due to melting of the continental ice sheet, inundated many of the glacial valleys and deposited marine terraces at several different levels above the present tide line, A marine beach terrace at an elevation of about 50 feet occurs intermittently throughout the panhandle and may be related to an early postglacial sea level rise.

A slowly cooling trend 2,000 to 3,000 years ago caused many of the mainland glaciers to readvance following the "Thermal Maximum" although not synchronously nor to the same extent. The Glacier Bay ice sheet was probably the most pronounced of these glacial advances, obtaining a maximum thickness of 4,000 feet and extending to Icy Strait, This ice sheet began to retreat 190-270 years ago and has retreated some 70 miles in that time. Dendrochronological studies in the Juneau area have shown that the Taku, Mendenhall, Herbert, and Eagle Glaciers had reached a maximum advance around 1750 (Lawrence 1950). This advance is clearly marked by terminal moraines in front of the Herbert, Eagle, and Mendenhall Glaciers.

A general retreat of southeast Alaska glaciers from their maximum positions is presently occurring. This is not steady, however, and minor readvances of many glaciers have occurred or are occurring (e.g., the Taku, Brady, Lituya, and Hubbard Glaciers).

The northern part of southeastern Alaska is undergoing glacial rebound or readjustment of the land surface to the position it held before it was depressed by the weight of the ice. Rates of uplift range from about 4 centimeters (1.6 inches) per year at Glacier Bay to 2 centimeters (0.8 inch) per year at Juneau (Hicks and Shofnos 1965).

The Chatham Strait Fault and its associated faults to the west are part of the larger Denali-Queen Charlotte Fault zone, a presently active system of strike-slip faults extending along the north Pacific coast (Souther 1970) which almost certainly links up with the San Andreas Fault system in northern California. Its northern extension passes up the Chilkat River, over Chilkat Pass, and along the Shakwak Valley separating the St. Elias Mountains from the Yukon Plateau.

The region west of the Chatham Strait Fault is a zone of high seismic activity with a well-documented record of late Cenozoic to recent movement along the Fairweather and related faults (Page 1969), the most recent being the Lituya Bay earthquake of 1958 which produced a right lateral shift and

vertical uplift of 30 feet. In contrast, the region to the east of the Chatham Strait Fault has low seismic activity and has remained relatively stable.

The most recent major volcanic activity documented in southeastern Alaska occurred between 6,000 and 9,000 years ago and was associated with the eruption of Mount Edgecumbe on Kruzof Island, near Sitka, which deposited volcanic ash and lapilli as far east as Sitkoh Bay on Chichagof Island. More recent volcanic activity is evidenced by a basalt flow which passed down Lava Fork and partially dammed Blue River, a tributary to the Unuk River northeast of Ketchikan. This flow originated on the Canadian side of the Alaska-Canada boundary and is probably less than 120 years old. Active hot springs, indicating the presence of hot igneous rocks below the surface, occur at scattered locations throughout southeast Alaska. The best known hot springs are at Bell Island and Tenakee.

As a result of these geologic influences, valley walls are often greatly oversteepened, frequently above a stable angle for the soils on them, and subject to frequent natural debris avalanches and debris flows (fig. 6). Soils are youthful, shallow, poorly developed, and low in

Figure 6.--Debris avalanche in the Marten Creek valley, Alaska.

available nutrients due primarily to lack of extensive weathering of bedrock and glacial till deposits. Drainage density is low, and the angular drainage pattern is indicative of a youthful stage of development with maximum control exerted by bedrock structure, Few new stream tributary channels have been developed since deglaciation because of the coarse, permeable nature of the soils and the recent exposure of the land surface. Most existing drainages occupy preglacial channels controlled by faulting and jointing. Stream gradients vary widely and may range from 10 to 1,000 feet per mile. In large valleys, the tributary gradients decrease abruptly once the main valley floor is reached, and an agraded (depositional) condition with braided or meandering channels is frequently encountered in both the lower tributaries and the main stream.

MINERALS AND MINING

An epoch of intense mineralization closely followed intrusion of the Late Cretaceous-Early Tertiary batholithic rocks in southeastern Alaska. Veins of metal-bearing quartz and disseminated metal in the country rock lie along the contacts of the igneous intrusions throughout the region. Historically, the principal economic minerals have been gold and copper, but nickel, chromite, magnetite, uranium, and lead-zinc also occur and have been worked commercially. Some silver and platinum have also been produced as milling byproducts.

The most highly mineralized areas lie in a narrow strip of sharply folded paleozoic sediments adjacent to the Coast Range Batholith, in the country rock adjacent to intrusions along the west coast of Chichagof Island, and adjacent to intrusions on Kasaan Peninsula on Prince of Wales Island. Most mining activity has been concentrated in these highly mineralized areas, although many smaller mineralized zones have been identified and worked during the history of mining in the region. Some of the earliest discoveries were gold placers along streams leading from the coastal mountains, but principal production has come primarily from lode deposits. There has also been extensive quarrying of limestone and marble on Prince of Wales and Kosciusko Islands.

Probably the best known deposits in southeastern Alaska are the gold-quartz veins adjacent to the Coast Range Batholith, in the so-called "Juneau Gold Belt" extending some 175 miles between Windham Bay and Berners Bay. Within this belt, two of the most productive mines in southeast Alaska operated, the Alaska-Juneau and Treadwell Mines located respectively on the mainland and on Douglas Island near Juneau. Gold-quartz veins in the "Chichagof Gold Belt" were also important producers with most of the production coming from the Chichagof Mine near Klag Bay and the Hurst-Chichagof at Kimshan Cove, both on the west side of Chichagof Island.

For many years, copper was second only to gold in production in southeastern Alaska, coming primarily from the Mount Andrew, Mamie, Poorman and It Mines on Kasaan Peninsula; the Rush and Brown Mines near Karta Bay; and the Jumbo and Copper Mountain Mines near the head of Hetta Inlet, all on Prince of Wales Island.

Silver and lead have been produced primarily as byproducts of gold milling although the mines in the Hyder District were and still are primary silver producers. The principal source of lead was as a byproduct of the Alaska-Juneau Mine operation.

Platinum metals have also been produced as byproducts, most of the output coming from the copper mines of Kasaan Peninsula.

The output from all mines was shipped south to Canada and the United States for refining and smelting.

In general, mining in southeastern Alaska has been an on-again, off-again operation. The ores characteristically occur in discontinuous veins and lodes so that it is difficult to accurately predict production levels or to estimate reserves. Throughout the history of mining in the region, profits have been marginal and greatly dependent on the prevailing market price of minerals. The Chichagof mines have operated intermittently since they were first discovered. The Kasaan Peninsula mines achieved their greatest copper production because of high demand for that metal during the First World War; they declined steadily after that. Their last reported production was in 1938. The Alaska-Juneau (fig. 7) and the

Figure 7.--Alaska Juneau Mining Company mill at Juneau, Alaska.

Treadwell are the only mines that were able to maintain more or less continuous production for any length of time, largely because of low labor costs and the high volumes of ore they were able to handle. The Treadwell closed in 1917, after 30 years of operation, when an invasion of seawater filled most of the mine tunnels. The Alaska-Juneau was closed during the Second World War and never reopened.

During the midfifties a uranium-thorium deposit was discovered in the vicinity of Kendrick Bay on southern Prince of Wales Island. This deposit, centered at the Ross-Adams property on Bokan Mountain, was developed and operated for approximately 3 years (1955-58). It was closed down in 1958 due to difficulty in smelting the ore. It was reopened again in 1970 and the remaining commercial ore removed. Inlet Oil Company is currently operating a barite mine in Duncan Canal near Petersburg. The barite is shipped to Kenai where it is ground and bagged for drilling mud.

There were several commercial mining ventures active in southeast Alaska during the summer of 1971, but these are small and are not expected to operate for any length of time.[3/] There is a small lead-zinc-silver operation on George Inlet northeast of Ketchikan. El Paso Natural Gas has found a good lead-silver property near Hyder and has recently recorded a large group of claims near Boundary Lake east of Juneau. The Marconi Corporation is proposing to develop a taconite plant to process magnetite iron near Port Snettisham. Various companies are actively prospecting for copper on Kasaan Peninsula, and Newmont Mining is currently drilling for copper and nickel in Glacier Bay National Monument.

Complicated structure and large areas of igneous rock make much of the southeastern Alaska panhandle unfavorable for the occurrence of petroleum in commercial quantities. Miller (1959), however, defines three areas lying within the Tongass National Forest, in which it may be geologically possible to find petroleum: (a) Heceta Island area, (b) Keku Islets area, and (c) Gulf of Alaska between Cape Yakataga and Cape Spencer.

No verified oil finds have been made in the Heceta Island-Keku Islets areas, although there was an unverified report of an oil seep several miles inland from the head of Murder Cove on Admiralty Island.

Oil and gas seeps are abundant along the shore of the Gulf of Alaska, especially in the Yakataga and Malaspina Districts. In the Yakataga District, oil seeps occur at or near the faulted crest of the Sullivan Anticline, which lies near the coast. Large oil seeps also occur in the Samovar Hills at the north margins of the Malaspina Glacier, and oil seeps and films have been reported near Icy Bay, Lituya Bay, Yakutat Bay, and Cape Spencer.

Although mining is presently in a relatively dormant state, there is considerable potential for future impact on resource patterns if major revitalization of the mining industry occurs. The principal impact of mining activity on forest resource management has been and probably will continue to be related directly to the mineral access rights stipulations of the Federal mining laws. An excellent discussion of the broad impact of current law on public land management has been prepared by the Stanford

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3/ Wesley Moulton, Regional Mining Engineer, Region 10, personal communication.

Environmental Law Society (Condon and Jackman 1971) and should be pursued for a more detailed discussion. Under the provisions of the current law (Mining Law of 1872), mineral locators are able to explore for, occupy, and obtain patent to valuable mineral deposits on the public domain, including Forest Service lands, and to purchase, for a nominal price, the land on which these deposits are found. In addition, locators have the opportunity to patent up to 5 additional acres of nonmineral land for a millsite. On the basis of this law, the prospector has free access to and is unrestricted in his activities on forest land as long as he is diligently exploring for or mining mineral deposits. For all practical purposes, the activities of the prospector and hard rock miner lie outside any comprehensive land use plans and are not subject to regulation by the forest land manager. Thus, any land management policies implemented by the Forest Service in this area are continually subject to displacement by a mineral claimant.

Several other ramifications of the Mining Law of 1872 make forest land management particularly difficult in southeastern Alaska. There is no easy way to discover which Forest Service lands are subject to either valid or invalid mining claims. The law requires that the claim be recorded on the local land records but does not require notification of the Federal Government. It is also difficult *to* challenge or remove invalid or abandoned claims. According to Condon and Jackman (1971) the Federal Government can contest a claim only if it can prove actual abandonment or that no valid discovery has been made. It cannot contest a claim for failure to comply with State location requirements. This is a difficult and cumbersome process in that the Government must first show a prima facie case of invalidity before the burden of proof shifts to the claim holder.

These laws have recently undergone close scrutiny by the Public Land Law Review Commission and others,[4] and several recommendations have been made for basic changes and reforms of administrative policy providing Federal land managers with some positive control over entry onto the public domain. If such recommendations are enacted into law, the forest land manager may gain the power to balance other public land values against the need for a particular mining activity.

SOILS AND SOIL DEVELOPMENT

The major ice recession which occurred about 10,000 years ago was "time zero" for most soils of southeast Alaska. Compact glacial till, evidently formed from the great pressure of the ice on overridden (basal) till, is extensive up to about 1,500 feet in elevation in many U-shaped valleys.

4/ *One-third of the Nation's land*, report by the Public Land Law Review Commission, June 1970. 122 p.

U.S. Department of the Interior, "The Mining Law - An Antique in Need of Repeal," a recomnendation for repeal of the 1872 Mining Law, submitted to the Public Land Law Review Commission in January 1969.

Northcutt Ely assisted by Albert Chandler, *"Hard Rock" Mineral Policies on Federal Lands*, prepared for the Mining and Metallurgical Society of America, May 1969.

The existence of the compact glacial till in the landscape is difficult to determine; however, it occurs intermittently depending on the movement of past glaciers and the localized pressures exerted by the ice. Most mineral soils are derived primarily from ablation till, even those over bedrock. Till deposits become thinner at higher elevations, evidently due to the lesser volumes of ice to melt and deposit loads of till. Till deposits also tend to be thicker on south- and west-facing slopes than on north- and east-facing slopes.

Postglacial ash and pumice deposits are extensive on southeastern Revilla Island and the Kruzof-northern Baranof-southern Chichagof Islands area. Ash from Kruzof Island has been dated as about 9,000 years old. Soils formed in these volcanic ash materials are moderately well-developed Spodosols, many of them with a heavy iron concentration zone called a plastic horizon. They are forested, and their landscapes contain many natural landslide areas, presenting a variety of management problems.

Moderately well-developed soil profiles occur on the fine silt and clay sediments of the marine terraces which occur throughout southeast Alaska at various elevations up to 500 feet. They are forested with conifer vegetation and not easily identified in the landscape without spot checking.

Because of an overburden of glacial till, bedrock plays a lesser role in soil development. Rocky types vary greatly; there are extensive areas of granitic, metamorphic, volcanic, and calcareous rocks. Bedrock, except for some rocks of unusual mineralogy, has little influence on soil occurrence, except as it influences soil drainage and the distribution of alpine areas. Granitic rocks are generally more massive and resistant to glacial erosion than the other rock types; consequently, they often form the more extensive mountain systems with widespread alpine areas. They also tend to have relatively high proportions of very poorly drained (muskeg) soils. Marble and limestone areas, with their extensive fracturing and good subsurface drainage, often have very low proportions of poorly and very poorly drained soils, unless they are overlain by compact glacial till.

The five basic soil forming factors--time, climate, parent material, vegetation, and topography--all have influenced soil development in southeast Alaska, but climate appears dominant.

Temperature greatly influences the rate of organic matter decomposition on the forest floor and the degree of incorporation of organic carbons into the soil. Also, microbiological activity is an important factor in soil development and the availability of nutrients for plant use. Soil temperatures greatly influence biotic activity. When soil temperature reaches about 43" F., biotic activity slows drastically to almost nil. High rainfall, cool summer temperatures, a short growing season, and moderately low soil temperatures all contribute to the accumulation of organic material on the surface and in the soils of southeast Alaska. The organic mat which accumulates on the surface ranges from 6 to 10 inches thick. Soils which have developed are high in both organic carbon and iron and relatively low in clay content (Stephens 1969b). This is due in part to the influence of climate.

The average soil contains approximately 10 percent organic matter and 12 percent iron oxides, which strongly attract and hold water. This plus frequent and high rainfall keeps these soils fairly moist most of the time. Because of the high content of both iron and organic matter, plus the high rainfall, many of the soils in southeast Alaska have developed thixotrophic properties. They are commonly referred to as "quick." The soil structure breaks down under stress. The breakdown itself may be caused by one of several things such as agitation, shearing, or excess weight upon the soil material. Thixotrophy is a reversible gel-sol transformation, and the soil material will set back up after a rest.

The occurrence of forest vegetation on raw glacial till parent material varies, but generally Sitka alder with willow and cottonwood will dominate the site soon after the material is deposited. Observation of the plant succession in front of glaciers indicates that Sitka spruce gradually overtops the shrubs; with 100 years of vegetation establishment, a dense Sitka spruce forest will dominate the site (Stephens 1969a). Soil development starts with the establishment of the first plants. Organic matter, nitrogen, and other plant nutrients build up in the soil as the vegetative succession takes place. After about 75 years, soil development has proceeded to the point of a thin, bleached horizon apparent immediately below the surface organic layer.

In the first 10 to 60 years of soil development, nitrogen accumulates in the mineral forest floor system at an apparently steady rate of about 32 pounds per acre per year. After 60 years, there is a marked reduction in the rate of accumulation of nitrogen; but the process does continue as the soil develops. Organic carbon will follow a somewhat similar trend (Crocker and Dickson 1957). As mineral soils develop in southeast Alaska, a series of things happens. The soil reaction (pH) goes from alkaline (pH 8.0) to slightly acid (pH 5.0) within 30 to 50 years. There are also increases in organic carbon and nitrogen. Alder appears to be the main plant contributing to these nitrogen increases.

An absolute loss of nitrogen from mineral soil is associated with the elimination of alder and the emergence of the spruce forest (Crocker and Major 1955). However, most of this nitrogen may be retained within the wider vegetation-soil system, and little or none of it may be lost altogether.

With the passing of 200 to 250 years, a weakly developed soil profile called a Spodosol is formed. Spodosols (Podzols) are extensive in southeast Alaska. All mature mineral soils under timber have strongly developed spodic (Podzol B) horizons. The better drained Spodosols have remarkably similar properties regardless of the parent material (Stephens et al. 1970).

Precipitation in southeast Alaska exceeds calculated evapotranspiration throughout the year in most of the area. Mainly because of the Late Pleistocene glaciation, the landscape also has many depressions and extensive impermeable soil layers (commonly compact glacial till or water-laid glacial flour). As a result, there are extensive areas of organic soils. These soils are classified as Histosols, commonly called "muskegs" in southeast Alaska, and are found in a wide variety of landscape positions. They are found on nearly flat slopes and slopes of 20" to 22°.

These organic soils are saturated or nearly saturated with water most of the year. At the extreme, they may be only a mat, floating on water.

The muskegs of southeast Alaska vary in depth, composition and vegetative relations. The depth of organic soil material ranges from less than 2 feet to over 40 feet. They may be composed of sphagnum peat, sedge peat, or muck, usually with some component of wood.

Vegetation growing on a muskeg is related to the organic material present, which in turn is related to water table regime and movement. In addition to the open muskegs, a large acreage of wet organic soils supports forest vegetation (Stephens et al. 1970).

Organic soils in southeast Alaska include alpine organic soils, well-drained organic soils derived from forest litter over bedrock or gravel, and wet organic soils derived from various vegetative materials. The wet organic soils below the alpine can generally be placed into four groups: (1) poorly decomposed moss peat (Kogish Series), (2) moderately decomposed sedge peats (Kina Series), (3) poorly decomposed sedge peats (Staney Series), and (4) mucks over peats (Maybeso and Kaikli Series).

Of these four major kinds of wet organic soils, only those of the last group (Maybeso and Kaikli soils) support forest vegetation; they represent about 10 percent of the landscape. The others are muskeg, that is, the vegetation on them is dominated by sphagnum mosses or sedges or both, with low shrubs and forbs and only scattered trees. They represent about 14 percent of southeast Alaska's landscape.

The wet organic soils throughout southeast Alaska comprise about 24 percent of the landscape. Estimates derived from timber inventory of southeast Alaska indicate that about 36.2 percent of the area is included in alpine meadows, brushfields, rock, snow, and icefields. The remaining 39.8 percent is comprised of soils derived from glacial till and residual bedrock. This includes soil types which support conifers, alder brush, and natural grassland.

The thick organic mat which accumulates on the surface of these glacial tills and residual soils is a storehouse of plant nutrients. The depth of tree rooting is confined primarily to this organic mat and the upper 12 inches of mineral soil.

FOREST RESOURCES

VEGETATION TYPES

The forest of southeast Alaska is a segment of the continuous coastal, temperate rain forest extending along the Pacific rim from northern California to Cook Inlet in Alaska. Viewed from a passing ferry, the rugged mountainsides along the inside passage appear to be covered with unbroken conifer forests from the water to timberline. From the air, however, the forest zone is a mosaic of various densities, crown sizes, subtle colors, and interspersed openings. Most of the forest consists of old-growth stands undisturbed by man. Differences in external appearance are due to stand age, species composition, and tree vigor. Stands which

have remained undisturbed for centuries have a ragged texture because they include trees of various ages, sizes, and conditions, with many dead tops and snags. Stands which have been disturbed during the last century or two by windthrow, fire, or landslide have a more uniform appearance because they contain trees of more uniform age and size, with fewer snags and defective trees.

In the southern part of southeast Alaska, the forests are primarily western hemlock and Sitka spruce, with scattered western redcedar and Alaska-cedar. In the northern part, the percentage of hemlock increases somewhat and the cedars are less important. Western redcedar extends only to the northern shore of Frederick Sound, and Alaska-cedar is often found only as a small tree in swamps or muskegs. In the northern portion of the area, mountain hemlock becomes more prominent. Other commonly found species are red alder (along streams, on landslides, and on other highly disturbed areas), black cottonwood (in major mainland river valleys), and lodgepole pine (adjacent to muskegs and on other poorly drained sites). Less common species include subalpine fir and Pacific silver fir.

The best stands of timber generally are found near tidewater with stand heights, volume per acre, and quality diminishing progressively up the slope. The terrain is predominantly steep, rugged, and broken.

Interspersed with forest stands are openings, hidden from view of the water but prominent from the air. These are "muskegs" or bog plant communities growing on deep peat and dominated by sphagnum mosses, water-loving plants'such as sedges and rushes, and ericaceous shrubs. Tree growth is sparse within the muskegs and consists mostly of hemlock and lodgepole pine in scrub form. Muskegs provide suitable habitat for many plants with edible berries, give welcome scenic viewpoints for the foot traveler, and help to regulate streamflow.

Between the muskegs and dense forest are more open forest stands growing primarily on organic soils (Stephens 1969b). Tree growth is slow and tree form often poor in these stands. Alaska-cedar, mountain and western hemlock, lodgepole pine. and Sitka spruce are important species in this forest community. The open canopy allows sufficient light to reach the forest floor to support dense understory vegetation of blueberry, huckleberry, rusty menziesia, other tall shrubs, and numerous small vascular plants. These stands are very important for wildlife habitat.

Above timberline (generally 2,500 to 3,000 feet in elevation) the alpine zone is dominated by heaths, grasses, and other low plants. Plants such as deer cabbage cover wide areas and form excellent summer range for deer. Occasional trees occur, often with stunted or shrublike "krummholz" form, due to adverse growing conditions. The alpine area provides many fine recreational and esthetic opportunities,

A notable feature of southeast Alaska is the abundance of plant life. Except for steep cliffs, scarcely any area remains devoid of vegetation. Even rock, which in a drier climate would be bare, is soon colonized by mosses, small plants, shrubs, or trees.

Southeast Alaska's forests contain fewer tree species than do the coastal forests to the south, and species diversity decreases with

increasing latitude. Nine conifer species and 22 broadleaf species attain tree size. Of these, four species are sought for commercial harvest: western hemlock, Sitka spruce, western redcedar, and Alaska-cedar. Mountain hemlock is logged along with western hemlock when encountered in mixed stands. The wood is equal in all respects to western hemlock, and it is often difficult to tell the two species apart. Pacific silver fir and subalpine fir occur in limited areas and may be cut although neither species is sought out for harvest. Lodgepole pine is used locally for firewood and for Christmas trees but is seldom found in-dense commercial stands and rarely cut. Black cottonwood has been harvested occasionally and tested for use in dissolving pulp but is not being harvested today. Red alder is used locally for firewood, carving, and smoking fish. Alders are capable of fixing atmospheric nitrogen and so are valuable in improving soil fertility.

The forests contain many shrub species—Viereck and Little (1972) recognize 72 species as most important. Many of these shrubs are characteristic of the dry interior and appear in southeast Alaska only in the drier transition zones at the head of Lynn Canal and Portland Canal. At present, berries are the only shrub products gathered commercially, and then only on a limited scale. Berries are also used extensively by local residents.

WOOD INDUSTRIES

Before the white man came, southeast Alaska was inhabited by Tlingit and Haida Indians. These original residents developed a culture based on products from the sea and forest. They relied on the sea primarily for food and for travel between their widely spaced villages and hunting or fishing grounds, but their mastery of the sea was made possible by material from the forests. They hewed large canoes up to 60 feet in length, the best and largest made from western redcedar. Inferior or smaller ones were made from Sitka spruce or black cottonwood. Alaska-cedar provided paddles; and cedar bark, the sails and lines.

Canoes were usually made in the winter. A hole was cut at the base on on the windward side of a large standing tree and a fire built at this point. The fire was kept burning until the tree toppled. Canoes were then hewed to shape with an adze with the help of fire.

Houses were of cedar or spruce handsplit planks covering log frames, with a tiered wooden floor surrounding a central firepit. Houses were clustered in villages where many families lived during the winter. Cedar totem poles in front of the houses kept alive the memory of important historical events or legends.

Trees furnished most of the household, personal , and ceremonial articles needed. Bentwood boxes in a variety of sizes were used for storage of food and equipment. Dishes and other utensils were carved from alder, spruce, or cedar, as were ceremonial masks, drums, and rattles. Bows, spears, fishhooks, and numerous other weapons or tools were of wood. Baskets and hats were woven from split roots of Sitka spruce, and cedar bark provided mats, clothing, ropes, and baskets. Firewood was always in demand for cooking and heat, and for drying or smoking fish and meat.

The first demand for timber by white men came with Russian colonization. Under the direction of Alexander Baranof, a colony was founded at Yakutat in the last few years of the 18th century. Logs were needed for construction of a fort and dwellings as well as for firewood.

In 1799 the Russians attempted to establish a colony near the present site of Sitka. Logs were cut for building a fort, and lumber was sawed for building a boat. The venture was short-lived, however, and in 1802 the fort was destroyed by hostile Indians and the boat was burned while still on the ways.

The following year, Baranof ordered two boats to be built at Yakutat for use in recapturing Sitka, and in 1804 these two ships, the 100-ton *Yermak* and the 85-ton *Rostislaf* were completed and put in service (Bancroft 1886).

In 1804 Baranof led a punitive strike against the Sitkans and a new post was established at the present site of Sitka. This time the colony was successful. Logging began immediately to supply logs and lumber for construction of a fort and magazine, and for building a ship which was launched the following year.

A foundry was built, the only one on the Northwest coast for many years, and a supply of charcoal was needed. Stands of hemlock and spruce along Indian River were clearcut for charcoal, which was produced on the spot. Charcoal mounds may still be seen in this area, now within the Sitka National Monument. Some of the earliest studies of tree growth in Alaska were done in the young stand which came in following this early clearcutting.[5/]

The colony prospered, and new construction required a continuing supply of logs and lumber as well as a constant supply of firewood and charcoal. Shipbuilding was an important occupation at the new colony and continued until 1867 when Russian holdings were transferred to the United States. During much of this period, no other shipbuilding facility existed on the Northwest coast. Alaska-cedar was favored for hull construction because of its durability, and selective logging for cedar took place along tidewater as far distant as Peril Straits. It was reported later that Russians had exhausted the accessible supply of cedar near Sitka.

At first, lumber for the growing colony was hewn or sawn by hand, but waterpowered sawmills soon appeared. The first Alaskan sawmill is thought to have been built at Redoubt Bay near Sitka in 1833. It first operated by waterpower, then was converted to steampower in the 1850's. Lumber was sawn for export as well as for local use, and it is probable that a cargo of lumber carried to Chile in 1839 by Captain Etolin was sawn at this mill (DeArmond 1946).

Sometime before 1853, a second sawmill was built at Sawmill Creek about 5 miles from Sitka and a third at Sitka. About 3,000 board feet of lumber were produced daily by the Russian mills, for local use and export.

5/ R. F. Taylor. An investigation of tree growth on the Sitka charcoal mounds. Unpublished report on file at Forestry Sciences Laboratory, Juneau, 6 p., 1934.

Records show that 1umber was exported to Chi1e, Macao, and Canton. Sawdust was also used for packing ice which was cut at Swan Lake near Sitka for shipment to San Francisco during the California gold rush of the early 1850's.

Early Russian logging methods were primitive. Trees were cut with axe or saw, and logs were moved by jacks, levers, or pul leys, Most logging was done on a selective basis, and only high-quality trees of a size that could easily be handled were cut, except close to Sitka where several small areas were clearcut for firewood and charcoal.

After transfer of Alaska to the United States in 1867, use of local timber gradually increased as canneries and towns were built. Many pilings were used to build the canneries over the tideflats. Most logging was by handline and A frames in stands easily reached from protected shores. The areas logged were small, and in many cases only choice trees were taken. Many very large logs as well as small logs and poles were used in the construction of fishtraps,

During World War I, high-quality Sitka spruce lumber suddenly came into demand for construction of military aircraft. Some timber was cut for this purpose near Howkan late in the war, but the operation was plagued with problems. Only a small amount of lumber was exported, and the operation was generally unsuccessful. Altogether during the decade from 1910 to 1920, some 4,000 sales of timber totaling 420 million board feet of sawtimber and piling were made on the National Forest lands in Alaska (Greeley 1920).

Soon after the First World War the Forest Service began reconnaissance of the pulp timber resource and began efforts to attract the paper industry to southeast Alaska. Pulp operating units were laid out, inventories were made, and regional development of the pulp timber resources was planned (Smith 1921). Soon industry became interested, and a sale was made. In 1920 the Alaska Pulp and Paper Company was supplied with 100 million board feet of timber on Admiralty Island and the adjacent mainland, and mill construction began at Port Snettisham near Juneau. This mill operated for about 2 years but was forced to close because costs proved too high for profit.

In 1923, six sawmills were cutting lumber in large quantities for local use and export. Logs for these mills came from trees up to 225 feet tall and 8 feet in diameter growing in stands of pure spruce (Heintzleman 1923). Heintzleman, then assistant district forester with the Forest Service at Juneau, believed that the spruce lumber industry could not be expanded until extensive pulpwood logging operations were started and the many large isolated spruce trees growing with the smaller pulp timber became accessible. He described the forests as being primarily suited for pulp and paper but recognized a large potential for sawtimber production as well.

In 1926, legislation was enacted which gave the Department of Agriculture discretionary power over export of timber from Alaska. The Department's position was clarified in 1928 and remains generally in effect today in that primary manufacture of timber in Alaska is required so as to insure the development of a stable year-round industry.

Interest developed on the part of the pulp industry, and two pulp sales were made in 1927. Substantial initial development work was done, but neither venture advanced to the point where mill construction began. With the market collapse of 1929 and the following depression, plans were abandoned and both sales were cancelled by mutual consent in 1933. From this time until the beginning of World War 11, only sporadic interest in pulp development continued (Bruce 1960).

During World War 11, Sitka spruce lumber again came into demand for military aircraft. In response the Alaska Spruce Log Program was set up as an agency administered by the Forest Service in June of 1942, and the program continued into early 1944. Total output was 38.5 million board feet of high-grade spruce that was sent to the States and 46 million board feet of grade 3 spruce and hemlock which went to local mills.[6/]

Several sawmills continued to operate, cutting Sitka spruce and Alaska-cedar for local use and export. In 1953, a small plywood plant began production in Juneau. Sitka spruce plywood was produced and was well accepted. Large, high-quality logs were required, and some were rafted from as far away as Kosciusko Island, some 230 miles distant by water. The venture had financial difficulties, shut down in 1955, and burned to the ground 4 years later without reopening.

Efforts to establish a pulp industry were finally successful, and in 1947 preliminary award of a 50-year sale of 1.5 billion cubic feet (8.25 billion board feet) of timber from an allotment on Prince of Wales and Revillagigedo Islands went to the Ketchikan Pulp Company of Bellingham, Washington. Final terms of the sale contract were signed in July 1951. Construction of a pulpmill was completed at Ward Cove near Ketchikan in 1954. The mill was dedicated in July 1954 and represented the culmination of years of effort to bring the pulp industry to Alaska.

Within 3 years after opening of the Ketchikan Pulp Company mill, the Forest Service entered into three additional long-term agreements which provided for pulp development in Alaska (Bruce 1960).

In June 1954 the Forest Service made a preliminary award for a 50-year sale to Pacific Northern Timber Company of Wrangell for timber located in the vicinity of Petersburg and Wrangell. Terms of the contract called for building a sawmill by 1957 and a pulpmill by 1962 (Greeley 1954).

A sawmill was built, the first in Alaska designed for cutting hemlock. The company soon ran into difficulties and the mill closed. The sale was taken by the Alaska Wood Products Company, now affiliated with Alaska Pulp Company of Tokyo. Terms of the sale were modified several times, the mill redesigned, and at present the sale agreement is for a total of 693 million board feet of timber, with the only construction requirement being for a sawmill.[7/]

6/ Lawrence Rakestraw. History of the Alaska Region, U.S.F.S. Chapter VI. Manuscript on file, Regional Office, USDA Forest Service, Juneau.

7/ Pacific Northern Timber Company Contract No. A10fs-1283, dated 6/9/54, with modifications. On file, USDA Forest Service, Juneau.

In 1957 the Alaska Lumber and Pulp Company was awarded 50-year cutting rights to 5.25 billion board feet of timber' located on Baranof and Chichagof Islands.[8] This company opened a high-sulpha cellulose plant at Silver Bay near Sitka in 1959.

A third 50-year sale for timber on Admiralty Island and the mainland near Juneau and Yakutat was awarded to Georgia-Pacific Company in 1955, but the company did not go through with its plans to build a mill. A new sale of 8.75 billion board feet of timber in approximately the sane location was awarded to the St. Regis Company in 1965, the largest timber sale in Forest Service history (Lockhart 1966). The St. Regis Company later abandoned development plans, and in 1968 the sale was transferred to the U.S. Plywood-Champion Papers Co., Inc. In 1970 suit was filed by the Sierra Club and coplaintiffs to stop the sale (Adasiak 1971, Miller 1971), and the case is still in litigation.

To summarize the development of the present timber industry, use of the timber resource by the Indians and Russians was slight, and until nearly the turn of the century timber cutting was limited. With establishment of the Forest Reserves and administration by the U.S. Forest Service, continuing efforts were made to establish a sound economic base in Alaska through establishment of a permanent year-round pulp industry. The Forest Service directly supported and often led this effort because regional development was a generally unquestioned ideal.

The need for multiple use of forest land was recognized by leaders of the Forest Service long before the concept became law. Timber production was recognized as the dominant use of land capable of producing good timber growth, but not to the exclusion of other uses. For example, the need to protect fish spawning streams was recognized, and a limited ban on timber cutting along steamer lanes to avoid esthetic damage was imposed. However, only recently have interests other than the timber industry been strong enough to attract national attention, and demands for all forest resources have increased greatly. The general level of affluence has risen, and leisure time has increased to the point where many articulate people are now questioning previously accepted economic values. The result is that now the Forest Service is no longer in the position of trying to establish a timber industry but is increasingly in the position of acting as arbitrator between many factions which demand ever greater use of the forest resources.

FISH AND WILDLIFE

The abundant and easily accessible salmon runs of southeast Alaska were a major factor in shaping the settlement patterns as well as the cultural activities of the aboriginal peoples of this area, Most of the many Indian villages were located on or near good salmon-producing systems, and salmon made up the bulk of the food supply. Other fish (e.g., halibut and eulachon) and game (e.g., deer and mountain goat) also were used, but much less than the salmon. The dense forests made game rather difficult to obtain in the quantities necessary for a year-round subsistence, In

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[8] **Timber Sale Contract No. 12-11-010-1545, Alaska Lumber and Pulp Co., Inc., 1/25/56. On file, USDA Forest Service, Juneau.**

contrast, the annual spawning runs of salmon were easily harvested in a short period of time in the quantities necessary to sustain the natives until the next year and a new salmon run,

The abundance and ease of obtaining salmon during their spawning migrations had another major influence on the aboriginal peoples of southeast Alaska. A few days of effort in catching and preserving the fish (generally by drying or smoking which does not appreciably decrease the food value) left considerable leisure time for the people to develop their arts and crafts to a degree greatly superior to that of the interior tribes who found it necessary to devote much more time and effort to obtaining food (Cooley 1963). The methods which these early peoples used to catch fish were not much different from those used today--traps, weirs, nets, and hook and line.

Many of these early village sites are still occupied today, e.g., Yakutat, Klukwan, Hoonah, Angoon, Sitka, Kake, Wrangell, and Klawak, and fishing is still a way of life but more as a commercial venture than for subsistence.

Game was used by these early peoples both for food and for clothing. In addition, skins of fur bearers such as the sea otter and ermine were used for decoration of clothing and ceremonial objects. The Chilkat Indians used the hair of the mountain goat to make blankets.

In general, however, before the influence of the white man, the use of fish and game resources by aboriginal peoples was primarily for subsistence. Some minor trading of meat and skins took place between tribes, but wildlife supplies were generally unaffected by this limited use.

Discovery and exploration of southeast Alaska by Russians and Americans took place in the middle of the 18th century. Sea otter pelts were soon found to be a much-sought article, particularly in Chinese markets, and the trade for and hunting of sea otter was a major occupation of early mercenaries. By the early part of the 19th century the once abundant sea otters had been all but eliminated from southeast Alaskan waters. Other furs and skins were traded to the white companies, but to much less extent than the sea otter.

In 1878 the first salmon canneries were built in southeast Alaska, and the exploitation of this resource increased rapidly. By 1889 at least 36 canneries were in operation in southeast Alaska. Nineteen of these had been built and put into operation during 1888-89 (Federal Field Committee 1968). The 1890 census stated that fishing operations were located at nearly every point that afforded a commercially profitable supply of salmon. Any means known was utilized to harvest the runs, including barricades at the mouths of the streams,

During the early part of the 20th century, the intense commercial fishing of salmon continued (fig. 8). The Pacific coast became the base of the largest salmon industry in the world, and Alaska was the chief source of fish. Conservation practices on the part of the salmon-canning industry did not share equal weight with the economic issues of the moment, and by the 1940's the fishery began a downward trend which continued for the next two decades. Other fish of importance in southeast Alaska are herring, halibut, sablefish, and shellfish of several kinds.

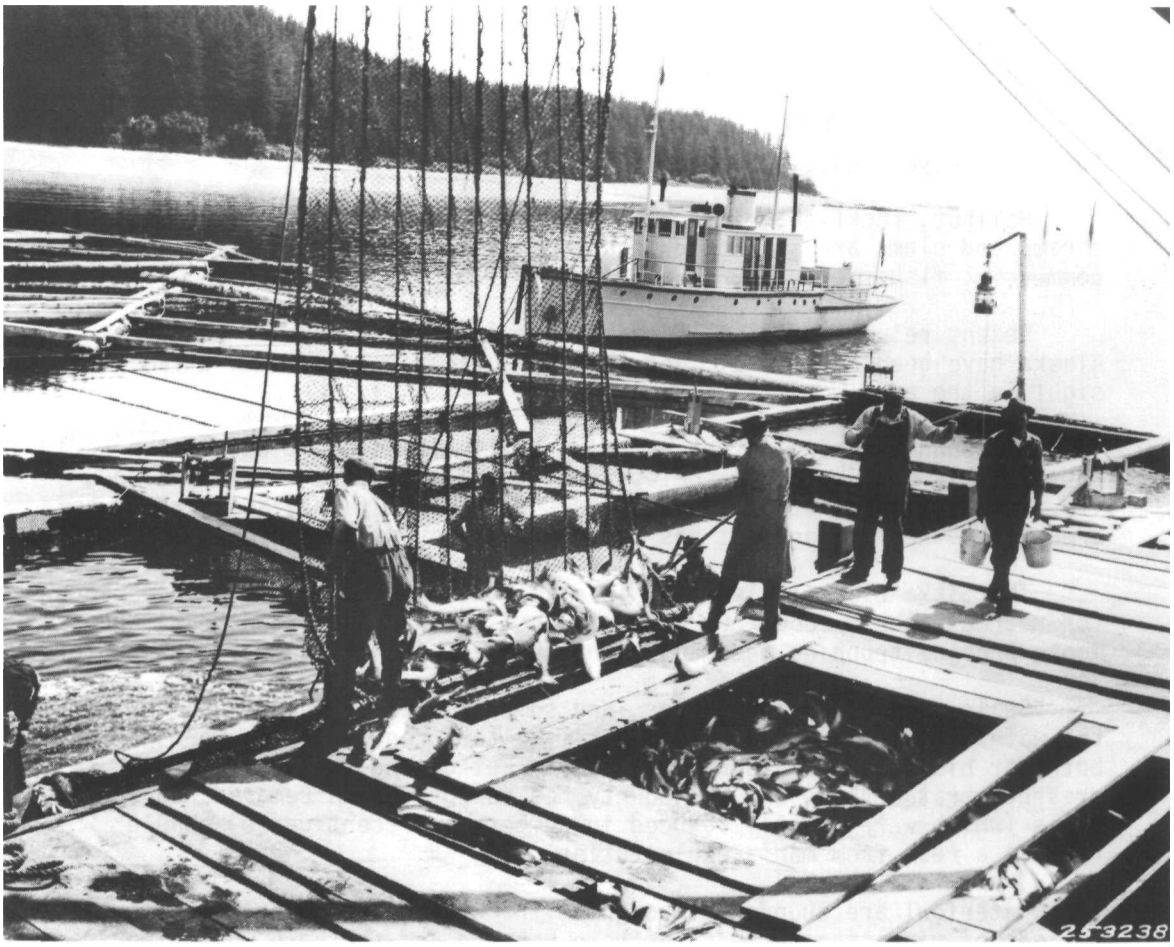

Figure 8.-- Brailing salmon from a floating fish trap in southeast Alaska.

Before World War II, the fur trade still occupied an important position in the economy of the region. Mink, marten, beaver, and otter were regularly trapped, primarily by the indigenous peoples but also by resident whites such as fishermen and others seasonally employed. This fur trapping continued despite fluctuations of market values (Rogers 1960).

The use of other wildlife has become one of recreation and subsistence during the last few decades. The Sitka black-tailed deer provides the major meat supply of many indigenous families. Recreational hunting has assumed a greater importance in southeast Alaska in the past few decades. Nonresident hunters do not often seek deer in their quests for trophies but concentrate on brown bears and, to less extent, mountain goats and moose. Recreational fishing is likewise assuming greater importance in southeast Alaska. Cutthroat and rainbow or steelhead trout are sought in the many lakes and streams of the mainland and the island archipelago. Salt-water fishing for chinook (king) and coho (silver) salmon attracts many residents and nonresidents alike. And many residents enjoy the shellfish--crabs and clams in particular.

Today, the fish and wildlife resources of southeast Alaska are represented by the same species which were present when the area was discovered and first explored.

The five species of Pacific salmon found are: pink (humpback), chum (dog), sockeye (red), chinook (king), and coho (silver).

Halibut, rockfish, king crab, dungeness crab, and several varieties of shrimp and clams are still much sought by local residents, as well as by commercial fishermen.

Recent reintroductions of sea otters into the waters of southeast Alaska have been successful, and this fur bearer may again be a familiar sight in the area.

Although trapping is not as major a livelihood as it was in the early part of this century, nevertheless some fur bearers are still utilized, i.e., mink, marten, otter, and beaver. Wolves are fairly abundant in some areas, and their management has become a controversial issue in some cases.

The Sitka black-tailed deer is still the major big-game species sought for recreation and food; but mountain goats, black and brown bear, and moose provide trophies and meat to nonresident as well as resident hunters.

Seals, sea lions, porpoises, and some species of whales are common to the waters of southeast Alaska. Until quite recently, seals were harvested both for hides and for bounties. The market demand for sealskins is presently rather low, and the bounty has recently been removed, so the seals (which were greatly reduced in numbers in recent years) should receive a rest from man's exploitation.

Waterfowl are abundant throughout the area, particularly during the periods of migration between northern nesting and southern wintering areas. Hunters enjoy fine shooting in many bays and tidal flats.

Blue grouse and ptarmigan furnish sport and "pot meat" throughout the fall and winter months.

Besides a rich and diversified sea bird population, southeast Alaska enjoys an abundance of bald eagles, a symbol of the wildness of the area.

In summary then, the fish and wildlife resources of southeast Alaska have gone through four distinct phases of utilization (Federal Field Committee 1968): (1) the aboriginal phase--oriented primarily toward marine resources, easily harvested, with negligible drain on productivity; (2) the exploration and colonization phase--the heavy hunting of sea otter, to the point of extinction in southeast Alaska; (3) the commercial fishery phase—from 1878 when the first salmon canneries were built to the dramatic exploitation and depletion of the salmon resource; and (4) the recent developmental phase--hunting and fishing for recreational interests have become very important, although commercial fishing and subsistence hunting still continue.

Southeastern Alaska still supports many valuable fish and wildlife resources, but conservation measures are increasingly important.

WATER

Its abundance in several forms shows that water is a dominant environmental factor in southeast Alaska. Precipitation is heavy to supply much runoff in streams of all sizes. This streamflow is the freshwater habitat for a valuable commercial and recreational fishery. The habitat productivity is due in considerable measure to favorable temperatures that result from the preponderance of cloudy weather and cool air temperatures.

Moisture is rarely a limiting factor for plant growth—the western hemlock-Sitka spruce forests are often referred to as "rain forests," and forest management is free of "dry site" problems, Muskegs, interspersed in the rain forest at lower and midelevations, are a common feature of the landscape from sea level to ridgetops.

Glaciers and icefields are prominent along the mainland. Erosion by water and ice has sculptured a rugged mountain scene of unrivaled beauty.

Drainage of the mainland heads mostly in the glaciers and snowfields of the Coast and St. Elias Mountains, It is generally westward except at the northern end of the region where drainage is also southward to Lynn Canal and Glacier Bay. The Alsek, Taku, and Stikine Rivers receive a considerable part of their flow from glaciers and the west slope drainage of the St. Elias and Coast Mountains, but they arise in the plateaus of British Columbia. The Chilkat, Skagway, Speel, Whiting, Unuk, Chickamin, and Salmon Rivers also rise in the snowfields and glaciers of the mountain ranges and their extreme headwaters reach into Canada. The drainage slopes of the mainland are steep, rocky, and deeply incised by glaciation so that there are many small drainage basins adjacent to the tidal inlets and bays that indent the coastline. Some of these smaller streams have glaciers at their headwaters, and many have lakes along their courses.

The islands of the Alexander Archipelago drain mainly to the east and west directly into tidal waters. The westerly slopes draining toward the ocean are more gradual than the drainage slopes toward the mainland so that generally the streams flowing westward are longer.

The largest stream on the islands is Hasselborg River with a drainage area of 107 square miles on Admiralty Island. It heads in lakes at an elevation of 247 feet, flows westward 6 miles, and empties into Mitchell Bay. Other large streams are the Medvetcha and Maksoutof Rivers, both of which drain westward on Baranof Island.

Runoff from lower elevation basins is about 60-100 inches annually; from intermediate to higher elevation basins of the islands and mainland, the runoff is roughly 150-200 inches.

The extreme runoff in the year 1970 was 396 inches from Sashin Creek, near Little Port Walter on Baranof Island, where the sea level precipitation was 265 inches for the period. This is an example of the common southeast Alaska situation in which basin runoff exceeds sea level precipitation. Elevation-precipitation relationships should significantly affect runoff. However, techniques for estimating runoff are of limited reliability because precipitation patterns and relationships are poorly understood (Childers 1970, p. 36).

Glaciers are a unique form of the water resource, and one that is highly significant along the mainland. Glaciers and icefields occupy about 2,200 square miles of the highlands (Field 1958).

Glaciers regulate streamflow. Runoffs from glacier-free basins in the Juneau area peak at about 13 and 14 percent of the year's runoff in May and June in response to snowmelt and again at approximately 14 percent in September due to rain. Summer flows are quite uniform, with about 12-percent level of runoff maintained for July, August, and October.

Streamflows from streams with glacier systems in their basins in the Juneau area peak at about 23 and 24 percent of the water year runoff in July and August, primarily in response to snow and ice melting. Snowmelt also contributes to the 15-percent runoff in June; rain probably is a factor in the 20-percent runoff amount for September. The higher elevations and consequent lower temperatures of glacierized watersheds cause a rapid drop in runoff beginning in October and a low base flow in December through April. The low flow probably is also related to the bare rock and coarse mantle materials common at the upper elevations,

Water parameters of particular interest in southeast Alaska are stream temperature, sedimentation, and streambed stability. Their importance is mainly as the freshwater habitat for fish. Excessive water temperatures, or even a change in the temperature regime, can affect not only fish survival but also food production and the timing of migrations of young fish to the sea. Sediment may enter stream gravels and affect fish egg and fry development by reducing intragravel water flow which results in low dissolved oxygen levels and high concentrations of metabolic wastes. Streambed stability is an important factor since bedload movement at high streamflows can destroy eggs and fry.

Stream temperatures vary throughout southeast Alaska but are generally lower than temperatures of streams at lower latitudes. This reflects the preponderance of the overcast skies and cool air temperatures characteristic of southeast Alaska's maritime climate.

Besides "glacial flour" in streams heading in glaciers, large amounts of sediment result from mass wastage and other valley and slope development processes, especially bank cutting. Slope disturbance incident to road construction is a major manmade sediment source.

Most, but not all, streambeds are unstable whether they are the short, steep watercourses of the mainland or the lower gradient streams of the islands. This is a consequence of the high streamflow response to rainstorms. The depth of such instability and the movement of streambed gravels depends on gravel size and type and stream energy,

RECREATION AND ESTHETICS

The dramatic increase in recreational and esthetic uses of the southeast Alaska outdoors demonstrates their growing importance. As a factor in the southeast Alaska resources setting they can be emphasized by reiterating a part of the most recent Alaska Outdoor Recreation Plan (State of Alaska 1970):

> Few places in the Western world offer the richness and variety of outdoor recreation resources available in Alaska.... Thus, Alaska has important assets to preserve and, unlike many other parts of the world, the opportunity to do so and to extend the recreational benefits of its natural resources to growing numbers of both residents and visitors.
>
> Rarely is a nation afforded a second opportunity to plan for the recreational use of its natural resources before commercial exploitation imposes severe constraints. Alaska, however, provides such an opportunity, and perhaps this nation's last chance to prove that compatible development of natural resources for both recreational and commercial purposes is possible, ... Alaska is in a strong position to provide the nation and the world with a place of repose, away from the hurry and pressure of life in the cities, where one may enjoy the splendor of some of the world's most spectacular scenery, and view wildlife in its natural habitat.

This is interpreted here as a strong plea to recognize the long-term importance of the natural scenic landscape before its values are depleted by industrial ventures, most of which are ephemeral in comparison. The recreation resource is expected to emerge as Alaska's greatest asset.

What is said about the recreation resource of the State as a whole is applicable to an even greater extent in southeast Alaska where some unique.scenic and recreational resources are found.

Land management must respond to changing needs manifest in the shifting patterns of public demand on forests and related resources.

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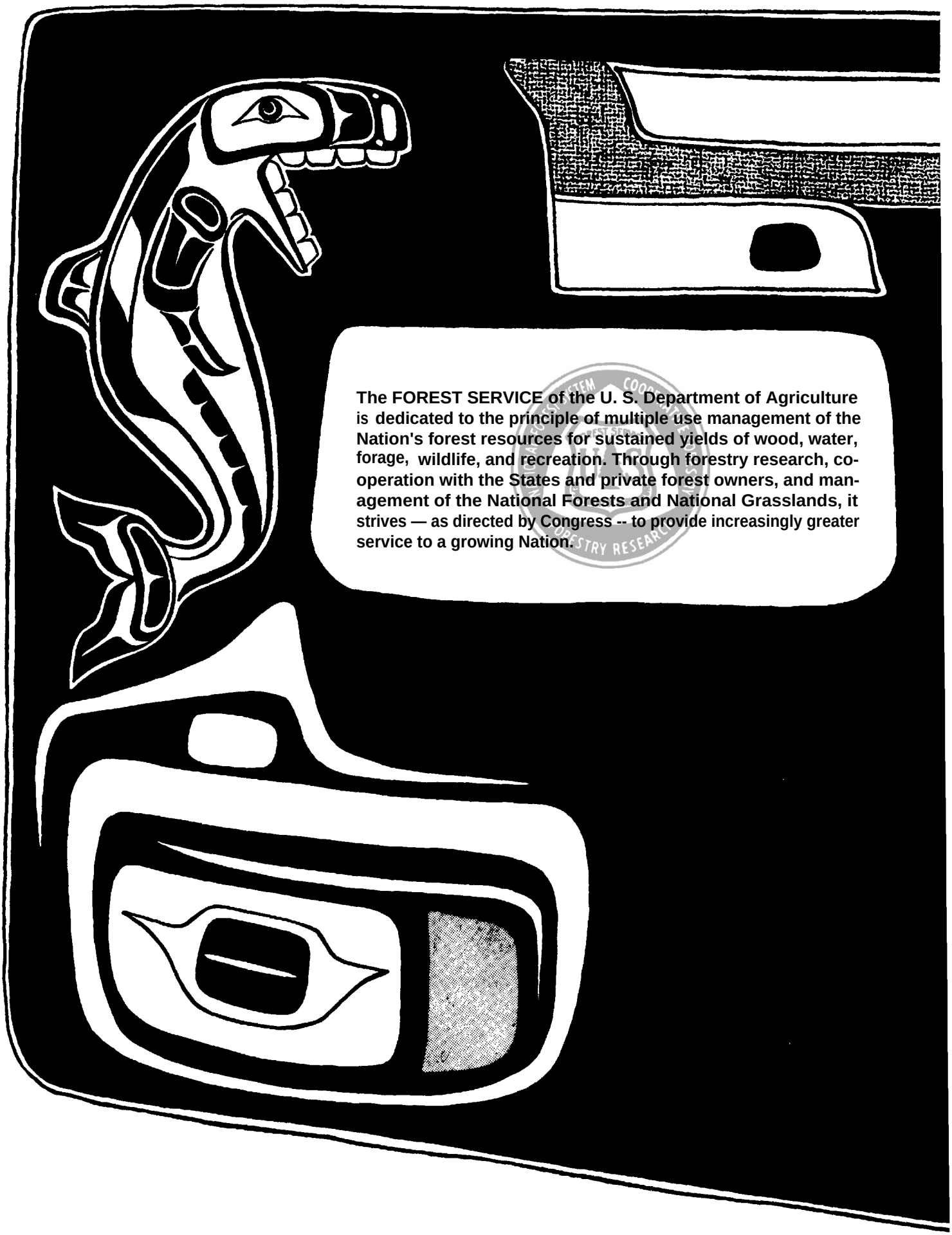

The FOREST SERVICE of the U. S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress -- to provide increasingly greater service to a growing Nation.