ALASKA LEGISLATURE COMMITTEE FILES 1985-1986 8072

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With some limited exceptions, no timber harvest related measures have been developed or implemented, since enactment of ANILCA or adoption of TLMP, that have the demonstrated ability to mitigate long-term wildlife habitat losses. Although measures to protect fish habitat have been more successfully implemented, many are currently proposed for revision to reduce logging costs and may result in reduction of fish habitat protection. Identification of high-value fish and wildlife areas has often occurred during timber sale planning, but protection of the areas through retention[2] as undisturbed habitat has not occurred on the majority of the TNF where timber harvesting is being scheduled. Despite TLMP commitments to long-term retention for fish and wildlife habitat, project planning has usually failed to provide consideration of long-term retention when making available a specific volume of timber for harvest.

Outside of Congressionally designated Wilderness areas, the key decisions that have the most far reaching implications on the extent and rate of adverse impacts are: (1) the annual harvest target, (2) the emphasis on harvest of high-volume timber stands out of proportion to their occurrence on the TNF (both in TLMP and in a recent decision

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[2]The concept of wildlife habitat retention on the Tongass National Forest was first discussed in the 1977 Southeast Alaska Area Guide which required Wildlife Habitat Management units (WHMU) to be developed by an interdisciplinary team (IDT) for all land use proposals. These WHMU would include the identification of "areas retained in natural conditions" (Forest Service. 1977. Southeast Alaska Area Guide. Alaska Region, Juneau. 280 pp.)

Permanent retention of old-growth habitat was the major wildlife habitat mitigation measure discussed in TLMP and incorporated into the TLMP harvest schedule (Forest Service. 1979. Tongass Land Management Plan Final Environmental Impact Statement, Part 1. Alaska Region, Series No. R10-57, Juneau.) About 273,000 acres of operable commercial forest land (CFL) in LUD III and IV areas were excluded from timber harvest scheduling in the development of TLMP harvest calculations in order to protect visual quality and fish and wildlife habitat (Forest Service, 1979, Forest Service. 1984. Tongass Land Managmenet Plan Evaluation Report. Alaska Region, Admin. Doc. No. 139, Juneau. 166 pp.) The amount equals about 30 percent of the operable CFL in LUDs III and 13 percent in LUDs IV (Forest Service 1979). Specific retention percentiles were developed for bear, eagle, moose, goat, upland bird, furbearer, wolf, and waterbird habitat (Forest Service 1979, 1984).

to exceed the ratios specified in TLMP for the first decade), and (3) accelerated rates of pre-roading of permanent roads in areas where timber harvest is not imminent. TLMP assumptions concerning portions of the commercial forest land base available or reserved from harvest and the implementation of extended rotations usually have not been considered in project or Management Area Analysis (MAA) planning which may alter the ability of the TNF to sustain the TLMP timber harvest without significantly greater logging of high-value fish and wildlife areas. The most significant procedural failings are the (1) lack of long-term (life-of-the-rotation) planning, and (2) lack of cumulative impact analysis on both the long-term and management area basis.

The fish and wildlife resources of both wilderness and nonwilderness portions of the Tongass are vital to commercial fishing and guiding industries and contribute to support industries and the suitability of the region for a growing tourist industry. Many residents of the region depend heavily on the resources for food and recreation, with dependence on fish and deer that is particularly high in the many small communities. Long-term reductions in opportunities to harvest or enjoy fish and wildlife will occur in areas subject to timber harvesting as a result of that timber harvest and associated development. Where habitat losses are significant, yields may likely be reduced in some areas of the Tongass to levels below which harvest of certain species can be sustained. The State is very concerned that it will not be able to manage fish and wildlife on a sustained yield basis, and that these resources may not be available for maximum use consistent with the public interest. Moreover the State is concerned that it will not be able to "manage, protect, maintain, improve, and extend the fish, game, and aquatic resources of the state" as required by statute.

The State of Alaska depends upon the expertise of DFG regarding the relationships between timber harvest and habitat management and believes that the conclusions drawn in the DFG report (see footnote on page 15) must be adequately considered and dealt with as the report becomes finalized.

nb85092702cle

BILL SHEFFIELD
GOVERNOR

STATE OF ALASKA
OFFICE OF THE GOVERNOR
JUNEAU

April 18, 1986

The Honorable Richard E. Lyng
Secretary
Department of Agriculture
Room 200-A
Fourteenth Street and
Independence Avenue, SW
Washington, DC 20250

Dear Mr. Secretary:

Congratulations on your recent appointment as Secretary of Agriculture. I am sure that the current farm crisis is demanding much of your attention, as is responding to the new constraints of deficit reduction legislation. In Alaska, we, too, are coping with fiscal constraints which are imposed by a major drop in the state's oil revenues.

I would like to acquaint you with some issues which concern many Alaskans. As you know, your Department recently submitted a report to Congress on the status of the Tongass National Forest in southeast Alaska. The report, which is required by Section 706(b) of the Alaska National Interest Lands Conservation Act (ANILCA), includes a section contributed by the State of Alaska that disagrees substantially with some of the conclusions reached by your agency. Unfortunately, the report's executive summary, which was submitted to Congress in advance of the full report, does not acknowledge the disagreement. A copy of the state's contribution is enclosed for your information. It contains more than two dozen recommendations to Congress and the Forest Service, many of which deal with the use of ANILCA Section 705 funding or inadequate implementation of existing Forest Service directives to protect fish and wildlife habitat. I encourage you to examine these recommendations. Efforts in Alaska to resolve the disagreement have been largely unsuccessful. I am writing to express my interest in making another attempt at resolving these issues administratively before Congress completes its review of your report. Below, I briefly describe the background of this problem and identify the issues upon which I believe we should focus.

BACKGROUND

In the southeast region of our state, the timber industry is in a depressed and weakened condition. Many Alaskans who have been employed for years in harvesting and processing trees from the Tongass National Forest are out of work, and mills have been shut down or are operating at reduced capacity.

Southeast Alaska's timber industry became established largely as a result of Federal government efforts beginning more than 40 years ago. With the passage of ANILCA in 1980, Congress set aside nearly 5.4 million acres of the Tongass Forest as national monuments and wilderness areas. In recognition of the preexisting public uses of the Tongass and the dependency of southeast Alaska residents on many resources of the forest, Congress also authorized a unique funding provision in Section 705 of ANILCA.

The Secretary of the Treasury is authorized and directed by Congress to make available to the Secretary of Agriculture at least $40 million annually, or as much as the Secretary of Agriculture finds is necessary, to maintain the Tongass Forest timber supply at a prescribed rate for the dependent industry. Congress's objectives in Section 705 were to maintain employment in the dependent timber industry of southeast Alaska at pre-ANILCA levels, while ensuring that other resource values and public uses would be protected on nonwilderness land in accordance with Federal law and the Tongass Land Management Plan (TLMP).

CONGRESSIONAL OBJECTIVES UNMET

Timber Industry Employment - It is the State of Alaska's view that the congressionally sanctioned employment objective has not been achieved, even though the Forest Service seems to believe that it has met its obligations under Section 705 by making available an average of 450 million board feet of timber per year. If the employment objective is to be achieved, the timber which the Forest Service supplies to the dependent industry must be economically feasible for the purchaser to harvest. It does little good to make timber available which no one can afford to purchase. Such timber is not available in an economic sense and does not contribute to maintaining employment in the timber industry as Congress intended. Unquestionably, adverse market conditions have had a depressing effect upon the industry which depends on Tongass National Forest timber. However, the framers of ANILCA understood, based in part on the Forest Service's TLMP, that such market fluctuations could be expected and that offsetting public investments in the Tongass Forest would be necessary to counter these cyclic events.

One of the most effective and appropriate means of countering current market conditions would be to use ANILCA funding to pay for necessary timber access roads. When constructed, these roads become the property of the Federal government and are available for future uses. Under prevailing depressed markets, purchasers are not being compensated for their construction of access roads required by the timber sale contracts. The State of Alaska believes that ANILCA funds should pay for needed timber access roads through Forest Service contracted construction or through equitable compensation to timber purchasers for construction costs which they reasonably incur. This will bring much relief to the timber industry.

By not adequately funding those measures which would achieve congressional objectives, the Forest Service and the Department of Agriculture are contributing to the demise of the timber industry as it existed prior to ANILCA and to the detriment of other values and uses of the Tongass Forest.

Protection of Other Resource Values and Public Uses - The fish and wildlife species which inhabit the Tongass National Forest, or utilize waters within or flowing from the forest, are managed by the State of Alaska. As a consequence, federal management of the Tongass National Forest, as it affects the habitats of these state-managed resources, is a matter of direct concern to the state and its residents. The potential for adverse impacts from timber harvesting and associated activities is usually greatest on those portions of the Tongass Forest outside of designated wilderness areas which possess commercial timber values. It is from these areas, by reason of proximity to communities, that the majority of fish and wildlife harvesting occurs. While some habitat impact is unavoidable in pursuing timber harvest objectives, this impact must be consistent with the habitat protection provided for by TLMP, applicable law, and, where appropriate, relevant standards of the Alaska Coastal Management Program. The state believes that the Forest Service, by not properly implementing Section 705 and TLMP, may be jeopardizing the wildlife and fisheries resources in the Tongass Forest which the state manages.

The state's major concerns for the fish and wildlife resources of the Tongass Forest include: (1) the impacts of logging-related alteration of old-growth forest habitats on wildlife, (2) the degree to which habitat protection measures have been implemented by the Forest Service, (3) the effectiveness of those measures which have been implemented, and (4) the resulting effects of timber harvesting on commercial, sport, and subsistence users of the fish and wildlife resources of the forest. The recommendations presented in the enclosure are intended to ensure that these concerns are adequately addressed.

We support Forest Service measures to reduce logging costs as a means of improving the economics of timber harvesting. Cost-saving measures implemented thus far have not accelerated adverse impacts on fish and wildlife, but some recent Forest Service proposals may increase these impacts to an unacceptable level. The economics of timber harvesting should not be further enhanced by risking such adverse impacts but rather should be accomplished through the use of ANILCA funds as intended by Congress.

THE NEED TO FULLY IMPLEMENT SECTION 705 OF ANILCA

If the solution which Congress devised to accommodate competing demands in the Tongass Forest has shortcomings, we can never know the full nature or extent of such shortcomings until you fully utilize the funding provisions of Section 705. Congress enacted these provisions to achieve its multiple objectives in the Tongass National Forest.

The primary national interest in the timber program of the Forest Service in southeast Alaska was, and remains, the establishment and maintenance of year-round employment and community stability. This was to be accomplished within the context of the Forest Service's multiple-use mandate and the continued use and protection of other resource values of the Tongass Forest in accordance with applicable laws and TLMP. Congressional objectives for the Tongass were so important that an unprecedented method was created to ensure their achievement. If it is necessary to reallocate Federal funds to accomplish these objectives, we believe that you have both the authority and the obligation to do so.

I would appreciate your views on these important matters prior to the commencement of congressional oversight hearings which may be scheduled next month. Thank you for your consideration of the state's position.

Sincerely,

Bill Sheffield

Bill Sheffield
Governor

Enclosure

cc: Senator Ted Stevens
Senator Frank Murkowski
Senator James McClure
Congressman Don Young
Congressman Morris Udall
Assistant Secretary Peter Myers
Department of Agriculture
Deputy Assistant Secretary Douglas MacCleery
Department of Agriculture
Associate Director Randall Davis
Office of Management and Budget
Regional Forester Michael Barton
Department of Agriculture
Attorney General Hal Brown
Department of Law
Commissioner Don Collinsworth
Department of Fish and Game
Commissioner Richard Knapp
Department of Transportation
and Public Facilities
Commissioner Loren Lounsbury
Department of Commerce and
Economic Development
Commissioner Bill Ross
Department of Environmental
Conservation
Commissioner Esther Wunnicke
Department of Natural Resources
Mr. John Katz
Office of the Governor
Mr. James Clark
Robertson, Monagle and Eastaugh
Mr. Bart Koehler
Southeast Alaska Conservation Council
Mr. Robert Loescher
Sealaska Corporation
Mr. Jack Cadigan
United Fishermen of Alaska
Mr. Gordon Williams
Southeast Alaska Regional Fish
and Game Council

State of Alaska
Cochairmen, Resource Committee
Representatives:
Richard Shultz,
Aldelheid Herrmann
Juneau, AK 99802

April 25, 1986

Re: HRJ 75

Honorable Representatives:

I submit this letter in reference to HRJ 75 which is soon to be considered by the House Resource Committee. I represent myself and fellow residents of Southeast Alaska.

Line 14: I believe the word "mandated" is incorrect and misleading. The chief of the US Forest Service has testified in Congressional Hearings that Section 705 of ANILCA "certainly does not mandate a harvest." US Congressman James Weaver has testified that ANILCA does not say that the Forest Service must provide 450 billion board feet per decade, only that the money will be made available when the the harvest is up to that level on the Tongass. Therefore the word "suggested" would be better suited than "mandated."

Line 16: As an Alaskan resident and US taxpayer, I do not support the expenditure of $40 million (or more) of tax dollars for subsidizing an industry which is controlled by foreign interest and is driving out smaller local competition. This is especially true in times of extreme Federal deficit, supposedly austere government budgets at all levels, and non-interference by the government with the workings of the free enterprise market. I strongly urge our Representatves not to support the Tongass Timber Supply.

Lines 23-25: I support the resolution for hearings on the subject to be held within the State of Alaska but suggest additional language to encourage a hearing to be held in Southeast Alaska which will be most affected.

Thank you for your consideration in this matter.

Respectively yours,

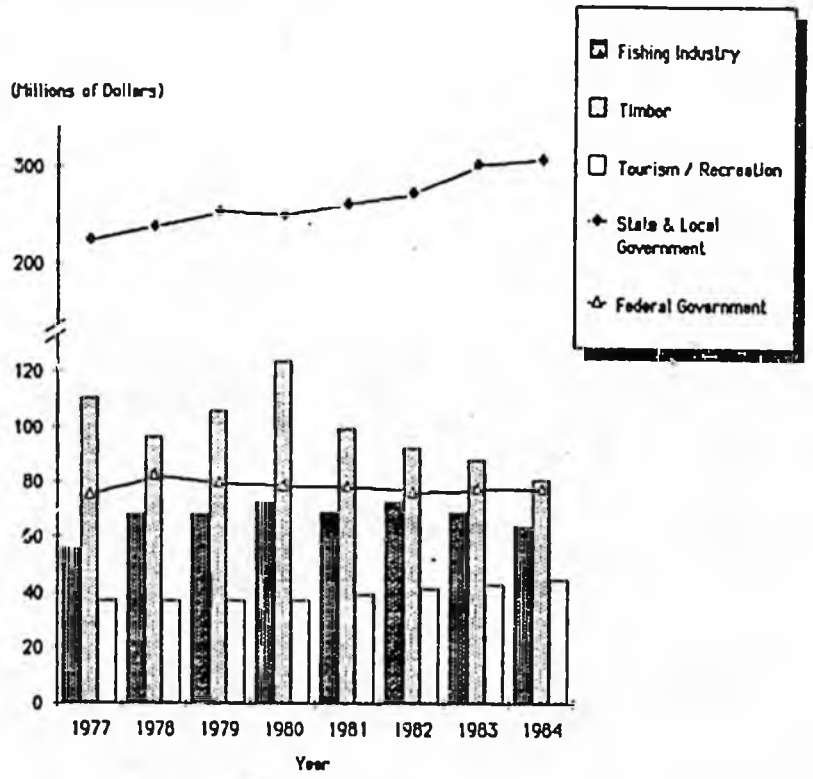
Don Williamson

Don Williamson
PO Box 211328
Auke Bay, AK 99821

cc: House Resource Committee Members

Figure 2.2

Direct Earnings[a] by Sector[b] in Southeast Alaska, 1977–84



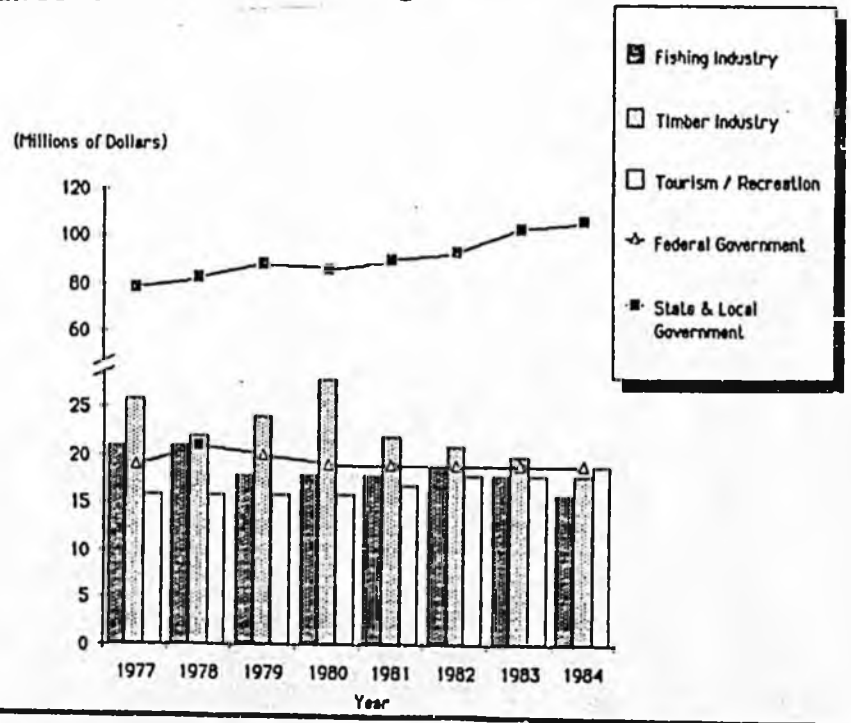
[a]All earnings have been converted to 1985 dollars using the GNP Implicit Price Deflator for first quarter, 1985.

[b]Timber industry includes forestry consulting, logging, sawmills and pulpmills. Fishing industry includes commercial harvesting and seafood processing. Tourism/Recreation includes a composite of visitor-related industries. Government includes State/local and Federal administration and enterprises. Earnings from fish harvesting are estimated at between 40 and 57 percent of the annual gross receipts to fishermen. See: *The Alaska Fishing Industry: An Overview of State Expenditures and Economic Benefits,* Alaska State Legislature: House Research Agency Report No. 81-4, January, 1982, for a discussion of the problems of estimating harvest earnings.

Source: Direct levels are from historical data from the Alaska Department of Labor and simulations using a Forest Service input-output model, IPASS.

Figure 2.4

Associated Indirect and Induced Earnings[a] in Southeast Alaska, 1977–84

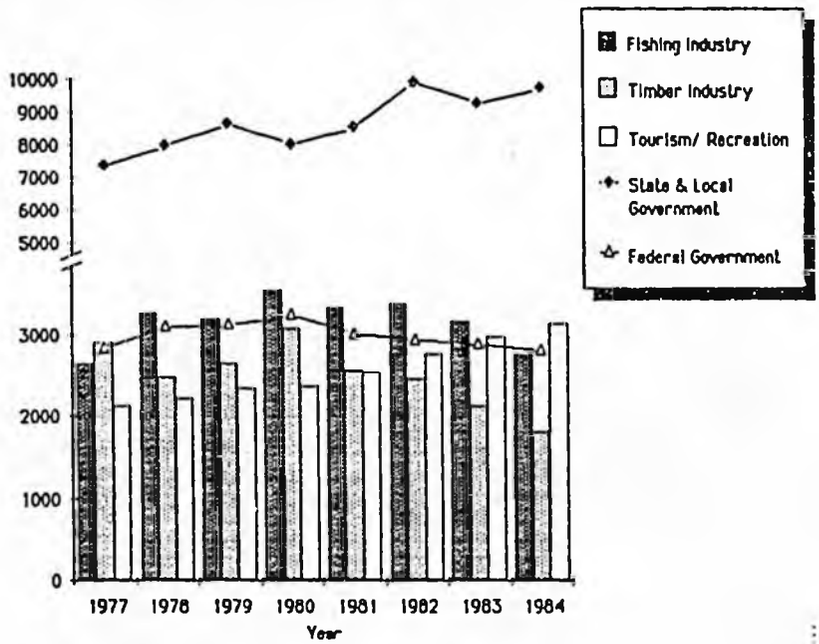


[a]All earnings have been converted to 1985 dollars using the GNP Implicit Price Deflator for first quarter, 1985.

Source: Associated indirect and induced earnings are estimated from IPASS.

Figure 2.1

Direct Job Numbers[a] by Sector[b] in Southeast Alaska, 1977–84



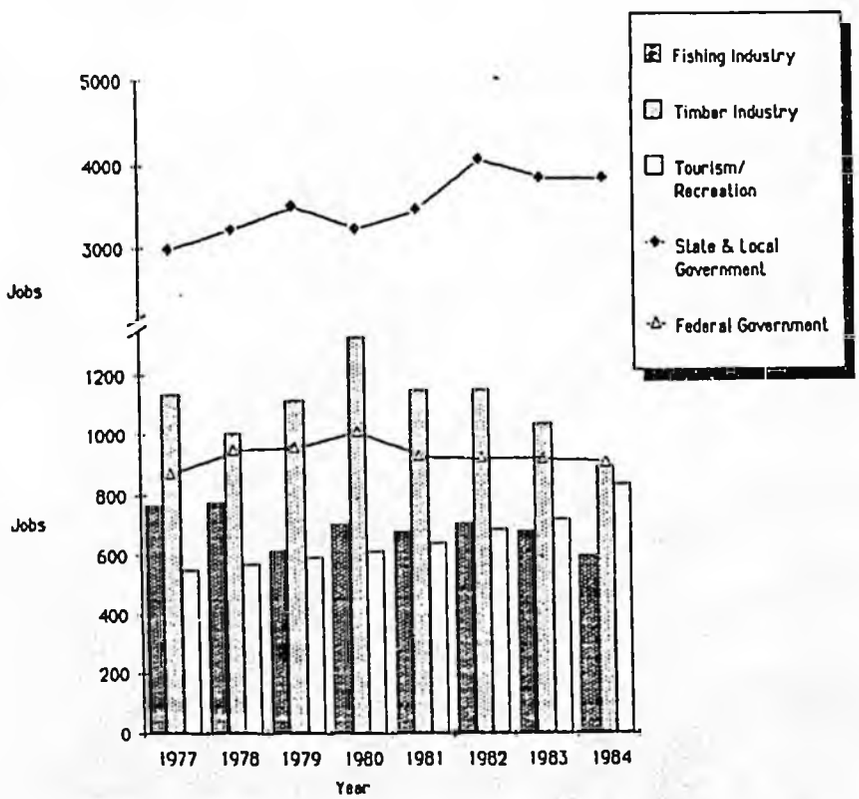
[a]Since job numbers do not reflect differences in full-time and part-time employment, it is important to supplement this information with the earnings data in Figure 2.2 before making sector comparisons.

[b]Timber industry includes forestry consulting, logging, sawmills, and pulpmills. Fishing industry includes commercial harvesting and seafood processing, but not recreational fishing due to lack of information. Tourism/Recreation includes a composite of visitor-related industries. Government includes State/local and Federal administration and enterprises.

Source: Direct levels are from historical data from the Alaska Department of Labor and simulations using a Forest Service input-output model, IPASS.

Figure 2.3

Associated Indirect and Induced Employment[a] in Southeast Alaska, 1977–84



[a]Job number information should be supplemented with the earnings data in Figure 2.4 before making sector comparisons.

Source: All associated indirect and induced job numbers are estimated from IPASS.

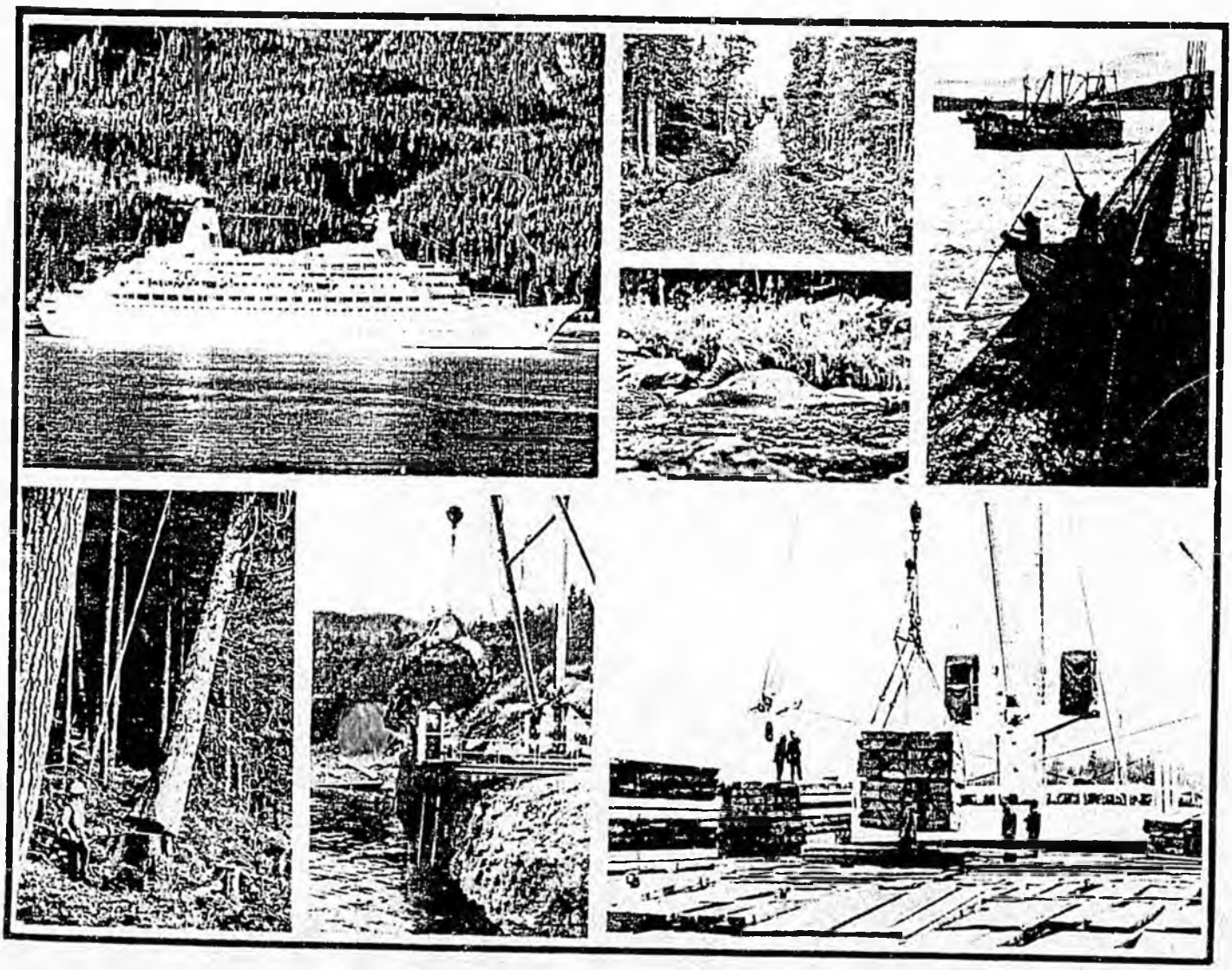
United States
Department of
Agriculture

Forest Service

Alaska Region
Admin. Doc.
Number 153

Status of the Tongass National Forest

1985 Report



LOGGING IN SOUTHEAST ALASKA AND ITS RELATIONSHIP TO WILDLIFE, FISHERIES, AND ECONOMICS

Territorial Sportsmen, Inc.
P. O. Box 761
Juneau, Alaska 99802
February 1985

Prepared by

The Wildlife and Fisheries/Logging Committee
of the Territorial Sportsmen with
contributions from outside specialists

Wildlife and Fisheries/Logging Committee

Jack Lentfer, Chairman
Greg Cook
Ed Gustafson
Christian Knoeller
Max Lewis
Sid Morgan
Don Schmiege

Contributers

Vern Beier
Steve Elliott
Mark Kirchhoff
Matt Kirchhoff
John Schoen
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Territorial Sportsmen, Inc.

P. O. Box 761

Juneau, Alaska 99801

February 12, 1985

To Whom It May Concern:

This report, Logging in Southeast Alaska and its Relationship to Wildlife, Fisheries, and Economics, by the Territorial Sportsmen, Inc. is the culmination of many man-hours and man-months of intense efforts by members of our organization and cooperating agencies and individuals. The report presents some of the most pertinent information related to the existing controversial fish and wildlife/logging issue in Alaska.

The Territorial Sportsmen, Inc. is one of the oldest, if not the oldest, conservation and sportsmen organization in Alaska. The Territorial Sportsmen is a Juneau based organization which is dedicated to the conservation and wise use of Alaska's resources. Because of its constitutional structure and its purpose, it is primarily concerned with the proper management of Alaska's renewable resources--particularly its fish and wildlife resources. In this arena we feel we have a responsibility to assure our membership and the general public that these resources and the public users are properly represented as public policies and decisions affecting their welfare are developed.

The purpose of this report is to present current information to interested policy makers and the general public. The Territorial Sportsmen have essentially synthesized and summarized pertinent information available from all the agencies and other private sources. We have not provided any new information gathered exclusively by our organization. On the other hand, we have provided independent and collaborated interpretations of the data. Hopefully, this type of presentation can be used to provide a forum for developing positive solutions, for providing support for necessary research, for prompting the resource managing agencies and corporations into affirmative actions, and for assisting the general public in assessing resource trade-off values.

The Board of Directors of the Territorial Sportsmen realize clearly the perceptions that can be associated with the release of a report of this type. This is especially true in light of the growing frictions between the polarized groups forming around the Southeastern logging/environmental issues. Because of these perceptions, we feel it is necessary to clearly state the position of the Territorial Sportsmen. By this

process we hope to keep open channels of positive dialogue with all interested parties and nopefully participate in developing positive solutions. For the record, the Board of Directors wish to emphasize that the Territorial Sportsmen:

1. Support logging in Southeast Alaska which is compatible with the maintenance of fish and wildlife values. The intent of this report is not to shut down the logging industry in Southeast Alaska. The intent is to blend fish and wildlife values with the economic values of the industry. It is fair to expect that there will be differences on exactly when, where and how logging will occur. Most importantly, it is our intent to make sure the other resource values are also adequately considered and the public is fully aware of the value trade-offs.

2. Support fish, wildlife and silvicultural research programs. Most task force reports and other related studies point out the need for more information about certain fish and wildlife and their habitat and about silvicultural practices in the southeastern rain forest.

3. Support research to develop enhancement and mitigation measures for fish and wildlife affected by timber harvesting. With improved technology and an expanded data base it is possible that aggressive enhancement or mitigation programs may significantly alleviate some of the value losses associated with the present logging program. Enhancement and mitigation programs that have been demonstrated to be effective should be implemented.

4. Support continued efforts toward population modeling effects of timber harvesting on fish and wildlife populations. At present, it is extremely difficult for the general public to relate to the value trade-offs associated with specific logging proposals, especially when relating these with past activities. Population modeling can be a valuable tool to aid both managers and the general public in understanding the effects, both positive and negative, of different management practices, and relate them to the economics of logging.

5. Support the U.S. Forest Service planning processes. We recognize and support the planning process being implemented by the U.S. Forest Service. Continued emphasis by the Service on public participation has provided a mechanism for input. Since planning is most effective if the public is fully informed and involved, it is our intent to participate positively in that process.

6. Support general recommendations provided in the Technical Committee Report. In July 1982 a multi-organizational Technical Committee was appointed to review the issues relating to wildlife and timber management in Southeast Alaska. A report from this committee was released in 1983. The conclusions and recommendations, although general in nature, are sound and are supported by the Territorial Sportsmen.

7. Support development of fish and wildlife population goals and objectives. The state of the arts associated with conducting some fish and wildlife population censuses within the forested areas of Southeast Alaska is rudimentary at best. Improved fish and wildlife assessment procedures must be developed and tied to habitat requirements for each species. We recognize that until these procedures are fully developed, other less precise modeling and assessment techniques will have to be utilized to establish and evaluate species population goals. Eventually, these goals and objectives must come from an informed general public.

Since it is the goal of the Territorial Sportsmen to provide the most accurate information possible, it is anticipated that this report will be up-dated. Certainly, any errors will be corrected and new information included when appropriate.

The Territorial Sportsmen are committed to continue working closely with the various task forces, committees and resource managing agencies concerned with the fish-wildlife/logging issues. It is anticipated that specific recommendations will be developed to accompany this report. Others will be prepared and submitted through each stage of the planning and review process now in place for management of the Tongass Forest.

For more information please contact:

Mr. Jack Lentfer, Chairman
Fish-Wildlife/Logging Committee
Territorial Sportsmen, Inc.
P. O. Box 761
Juneau, Alaska 99802

or

Mr. Ron Somerville
President
Territorial Sportsmen, Inc.
P. O. Box 761
Juneau, Alaska 99802

Approved by the Territorial Sportsmen, Inc. Board of Directors on December 11, 1984.

Sincerely,

Ronald Somerville R.S.

Ronald Somerville, President
Territorial Sportsmen, Inc.

LOGGING IN SOUTHEAST ALASKA AND ITS RELATIONSHIP TO WILDLIFE, FISHERIES, AND ECONOMICS

SUMMARY

The present forest management practice throughout Southeast Alaska of clearcut logging on a rotational basis of generally 100-115 years is permanently converting old-growth, uneven-aged forests with high wildlife values to second-growth, even-aged stands of much less value to those wildlife species dependent on old-growth habitat. Logging may also adversely affect fish spawning and rearing habitat and shell fish esturine habitat, although measures can be taken to minimize impacts. More research is needed to determine long-term effects of timber harvest on fisheries.

Despite the large size of Southeast Alaska's Tongass National Forest (16.9 million acres), only a small portion (4 percent) is considered to have commercially important timber (more than 30,000 board feet per acre). Such commercial timber areas, often near tidewater at low elevations, or along valley bottoms of major river drainages, provide critical habitat for fish and wildlife. It is on this small, but important, component of the Tongass Forest that the wildlife and fisheries/logging debate centers.

As of 1978 an estimated 317,000 acres of Tongass Forest timberland had been logged. Between 1956 and 1981, areas which were logged averaged slightly less than 50,000 board feet per acre (net inventory volume). This logging is believed to have reduced the extent of the highest-volume class (more than 50,000 board feet per acre) on the forest by half. Current plans call for logging half of what is left of this highest-volume class forestwide within the next 40 years.

Clearcutting is the method of logging in Southeast Alaska because it is the most cost efficient and for silvicultural reasons. The planned rotation period for most areas is 100-115 years, i.e., areas will be cut again after 100-115 years. The common pattern is three entries into a drainage system, with second and third entries at about one-third and two-thirds of the 100 to 115-year rotation period. The highest-volume timber is normally cut on the first entry. Revegetation after cutting is natural growth unaided by replanting. After cutting, approximately 300 years are required for forestland to regain old-growth characteristics. Cutting on a rotational basis of approximately 100 years therefore permanently eliminates old-growth forest.

Clearcutting old-growth forest in Southeast Alaska will reduce the carrying capacity of winter range for Sitka blacktailed deer. High-volume, old-growth hemlock-spruce stands are preferred deer habitat during winters of heavy snowfall. Past timber harvest

has concentrated in high-volume stands and future harvest is scheduled to do the same, thereby affecting deer more than acreage figures alone would suggest. Present knowledge suggests that deer numbers in many popular hunting areas will be reduced 60-80 percent by the end of the first rotation period. Deer are hunted more than any other animal in Southeast Alaska, and reduction of carrying capacity will have major impacts on recreational and subsistence hunting. Other wildlife species that could be adversely affected by logging, road-building, and associated activities are brown bear, black bear, mountain goat, moose, marten, mink, river otter, bald eagle, Vancouver Canada goose, and a number of other bird species that overwinter or nest primarily in old-growth forest.

Commercial and recreational fishing are extremely important activities in Southeast Alaska that can be affected by logging. All five species of Pacific salmon, rainbow and cutthroat trout, and Dolly Varden char use freshwater streams for spawning and rearing. Logging can affect spawning and rearing by introducing debris, suspended sediment, and deposited sediment and by changing water temperature, amount of dissolved oxygen, and streamflow. It is especially important that uncut buffer strips be left along streams and that roads be laid out and constructed so as to have minimum impact on streams.

In addition to the impact of clearcutting itself, log dumping and rafting can affect shellfish, i.e., crabs and clams. Bark accumulating on the ocean bottom reduces populations of marine benthic organisms. Water storage of logs results in release of leachates which increases oxygen demand and thereby affects marine organisms. Actual and potential dumping and rafting sites comprise a small portion of the waters of Southeast Alaska, but sites generally are important because of high biological productivity.

Guiding, an important commercial activity in Southeast Alaska, occurs for a number of recreational activities including hunting, fishing, marine cruising, kayaking, rafting, photography, aerial sight-seeing, and ice field traveling. Clearcut areas are not esthetically pleasing for such activities. As more areas are cut, guiding will be concentrated in uncut areas, with the potential to create overcrowding and more human interaction, both undesirable from a guiding and recreational standpoint. Brown bear hunting is one of the most important forms of guiding. Logging has already disturbed enough brown bear areas that guides themselves now believe it necessary to reduce by more than one half the number of persons eligible to guide on Admiralty, Baranof, and Chichagof Islands.

The Alaska Department of Fish and Game has identified 70 drainages in the Tongass Forest with high fish and wildlife values and

recommended deferral of logging and road building until the Tongass Land Management Plan is revised in 1989. In spite of this recommendation, road building has been carried out in some of these critical habitat drainages. Forest Service representatives state that the Forest Service will analyze these recommended deferrals during preparation of the Tongass Land Management Plan Update to be completed by April 1, 1985.

Federal legislation generally provides for adequate protection for fish and wildlife on national forests. However, the managing agency, the U.S. Forest Service, has much discretion in determining management emphasis and how different values of the forest will be utilized. In Southeast Alaska the emphasis is on timber management. The Alaska Lands Act makes 4.5 billion board feet of Tongass Forest timber available to industry per decade. Recent findings suggest this level of timber harvest, if sustained, will have severe long-term impacts on wildlife and thereby on recreational and subsistence use. The Alaska Lands Act also states that utilization of public lands is to cause the least adverse impact possible on subsistence users.

Native corporations and the State of Alaska each manage approximately 3 percent of the land in Southeast Alaska. Fish and wildlife managers would like State laws and regulations strengthened to better protect fish and wildlife on these private and state lands.

The timber industry in Southeast Alaska has been dominated since the 1950s by two major companies which have long-term contracts for timber from the Tongass Forest. The timber industry is highly subsidized by the Federal government. Most forest products from the Tongass are sold overseas. The National Forest Management Act calls for revision of long-term contracts to make them consistent with guidelines and standards of the Act. Violations of the Sherman Antitrust Act, providing false information to the government in violation of contracts, and defrauding the government of more than 75 million dollars by the two long-term contract holders are other reasons for considering contract revisions.

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LOGGING IN SOUTHEAST ALASKA AND ITS RELATIONSHIP TO WILDLIFE, FISHERIES, AND ECONOMICS

INTRODUCTION

The Territorial Sportsmen of Juneau, Alaska, wish to become involved in programs and decisions affecting management of lands in Southeast Alaska. Of particular interest is the relationship of logging to fish and wildlife populations and habitat. This report has been prepared so that the members of the Territorial Sportsmen can be better informed. The report will also be used to inform others and to provide information and guidelines for the Territorial Sportsmen to evaluate and make recommendations on timber management plans and activities.

A committee composed of Greg Cook, Ed Gustafson, Christian Knoeller, Jack Lentfer, Max Lewis, Sid Morgan, and Don Schmiege was named to prepare the report. The committee asked certain outside specialists to assist with report preparation. Committee members and others and the portions of the report they have been involved with include: Tongass Forest land types--Matt Kirchhoff; Tongass Forest logging--Matt Kirchoff; Tongass Forest management guidelines--Greg Cook and Jack Lentfer; State of Alaska forest-land--Jack Lentfer and Greg Cook; wildlife--John Schoen and Matt Kirchhoff; fisheries--Greg Thomason and Steve Elliott; guiding--Vern Beier; economics of Tongass Forest logging--Jack Lentfer, Mark Kirchhoff, and Christian Knoeller. Jack Lentfer was responsible for the final synthesis and Christian Knoeller for technical editing.

Draft copies of this report with requests for comments were sent to the U.S. Forest Service, the Alaska Department of Fish and Game, the Alaska Department of Natural Resources, and Sealaska Native Regional Corporation. Draft copies were also sent to representatives of the two major Southeast Alaska timber companies, Louisiana Pacific-Ketchikan and Alaska Lumber and Pulp, along with invitations to comment at a meeting of the Board of Directors of the Territorial Sportsmen. Responses were received from the Forest Service and Alaska Departments of Natural Resources and Fish and Game, and the report was modified to reflect comments which would improve accuracy and comprehensiveness.

The Board of Directors of the Territorial Sportsmen adopted the report in December 1984.

Major land managers in Southeast Alaska are the U.S. Forest Service, the National Park Service, Native corporations, and the State of Alaska. National Park Service lands cannot be logged,

and discussion of their management will not be included in this report. The U.S. Forest Service, with 94 percent of the land in Southeast Alaska exclusive of Park Service land, is by far the largest land manager (Table 1).

Table 1. Land management in Southeast Alaska, exclusive of Glacier Bay National Park and Preserve.

	Acres	Percent
U.S. Forest Service	16,900,000	93.8
State of Alaska	482,000	2.7
Native Corporations	630,000[1/]	3.5

[1/] Native corporations are still selecting land, and this figure is the amount which will be owned after final selection.

TONGASS NATIONAL FOREST

Land Types

A diverse array of land forms and forest types comprise the 16.9 million acre Tongass National Forest. The following information is from the Tongass land type inventory in the Tongass Land Management Plan (U.S. Forest Service 1979). Nearly 40 percent of the Tongass Forest is not forested, but is composed of treeless alpine meadows, muskegs, rock, and glacial ice. An additional 29 percent of the Tongass Forest is classified as "noncommercial forestland," defined as forestland having less than 8,000 board feet of lumber per acre (Harris and Farr 1974:14). Noncommercial forestland is also defined as land not capable of producing 20 cubic feet of growth per acre per year (M.A. Barton, Regional Forester, Tongass National Forest, pers. comm. 8/20/84).

Included in noncommercial forestland are poorly drained sites, borders of muskegs, and subalpine areas where tree growth is sparse or stunted. Western and mountain hemlock, red and yellow cedar, and lodgepole pine dominate these relatively unproductive sites. The remainder of the Tongass, roughly one-third, is considered as "commercial quality forestland," capable of producing from 8,000 to over 100,000 board feet of lumber per acre.

As this volume-per-acre range suggests, a great variety of forest types occur within commercial forestland and represent ecologically distinct habitats having different values to different wildlife species at different times of the year. For inventory purposes, commercial forestland is classified into four categories based on the stand timber volume. The first category includes stands having 8,000-20,000 board feet per acre. These "low-volume" areas are relatively open, sometimes brushy, and often found on wet, poorly drained sites. Low-volume stands are common on the Tongass, accounting for half of all commercial forestland.

Medium-volume stands (20,000-30,000 board feet per acre) are characterized by larger, more densely stocked trees, and comprise about 36 percent of the total commercial forestland on the Tongass.

Higher-volume stands, by comparison, are rare. The 30,000-50,000 board-foot-per-acre category accounts for 12 percent of the commercial forestland, and the highest-volume stands, those with more than 50,000 board feet per acre, account for 2 percent of the commercial forestland on the Tongass (Figure 1). These higher-volume stands, referred to as "commercially important forestland" in a report co-authored by the Forest Service (Smith et al. 1983), contain the most valuable trees in the forest.

Such stands are typically found along toe slopes of hillsides, bordering major stream or river systems, or on flat benches along the beach; they are normally associated with deep, well drained, mineral soils. Like all old growth, these stands include trees of all ages and sizes; however, dominant trees may exceed 200 feet in height, 8 feet in diameter, and 800 years in age. A single tree that size yields more board feet than an entire acre of low-volume forestland.

Despite the seemingly boundless expanse of land on the Tongass, most is either non-forested, noncommercial forest, or low-volume forest. Only a little more than 4 percent of the total land base is high-volume important forestland (more than 30,000 board feet per acre), and less than 1 percent of the total land base is in the highest volume class containing more than 50,000 board feet per acre (U.S. Forest Service 1979).

Logging

The Tongass National Forest has a long history of industrial logging, dating back to 1833 when the first Alaskan sawmill was built at Redoubt Bay near Sitka (Harris et al. 1974). Most early logging was selective, with cutting concentrated on large, high quality, individual trees. Use of local timber gradually increased during the early 1900s as canneries and towns were built. Altogether during the decade 1910 to 1920, 420 million board feet of saw timber and piling were cut on national forest lands in Alaska. By 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 (Heintzlman 1923). By 1930, most of the premium stands of timber easily reached from protected shores had been logged, and increasing emphasis was being placed on developing a pulpwood industry to utilize the smaller timber.

With the award of an 8.25 billion board foot timber sale in 1951 to Ketchikan Pulp Company of Ketchikan, a 693 million board foot sale to Alaska Wood Products Company in Wrangell (affiliated with Alaska Pulp Company in Tokyo), and a 5.25 billion board foot sale in 1957 to Alaska Lumber and Pulp Company in Sitka, large scale industrial logging had finally arrived in Southeast Alaska (Harris et al. 1974). In an effort to encourage establishment of a stable, regional economy, the Forest Service granted these companies 50-year cutting rights. (Board feet are commonly used as the measure of timber to be cut under terms of the long-term contracts. Deputy Regional Forester M.A. Barton in a letter dated July 20, 1984, states that cubic feet, not board feet, were used in these contracts.)

For 25 years, prior to final approval of the Tongass Land Management Plan in 1979, loggers operated in a much less regulated

environment than they find themselves in today. Forestland offering the greatest return on investment, usually the lower elevation, high-volume sites, were logged first. Clearcuts were large and wood utilization standards lax. High-volume stands of timber located near protected coastlines or along broad valley bottoms were highly prized and actively sought by the timber industry. From 1956 through 1972 the average volume removed from inventory by cutting was in excess of 50,000 board feet per acre (Scribner inventory volume, Hutchison and LaBau 1975). From 1972 through 1981 the inventory volume removed by cutting averaged over 48,000 board feet per acre (J. Standerwick, Timber Staff Officer, Tongass National Forest, pers. comm. 4/15/83). These statistics take on even greater significance when the rarity of high volume stands is considered (Figure 1).

The Tongass Land Management Plan (TLMP), finalized in 1979, allocated individual drainages of the Tongass Forest to one of four land use designations, or LUDs. LUDs I and II are wilderness and roadless areas where commercial logging may not occur. LUD III lands are for multiple use including logging. LUD IV lands are for intensive resource use and development with emphasis on commodity or market resources; logging is the most concentrated here. Table 2 summarizes the TLMP allocation of commercial forestland among LUDs and by volume classes. It is evident that the drainages with the highest volume classes were generally allocated for commodity resource development. LUDs III and IV, where logging may occur, contain more than twice as many acres of the two highest volume classes (more than 30,000 board feet per acre) as LUDs I and II where logging does not occur. LUDs III and IV contain about six times more of the highest volume class (more than 50,000 board feet per acre) than LUDs I and II.

Today, over 317,000 acres (6.3 percent of commercial forestland) in the Tongass have been cut and are in a regenerative status. (Unpublished data on file, U.S.F.S., Regional Office, Timber Management, Juneau.) From 1980 to 1989, U.S. Forest Service plans call for an average of 17,100 acres to be cut annually on the Tongass (Smith et al. 1983). The number of acres cut will increase to approximately 22,000 acres per year late in the 100-115 year rotation period as increasing emphasis is placed on harvesting in low-volume stands. Although the rotation period for most cutting areas is 100-115 years, 244,000 acres are scheduled for cutting over a 120-200 year extended rotation for visual management and other resource needs.

The Forest Service has no record of the number of acres of high-volume timber logged to date. A conservative estimate that one-third of the acres cut to date were in the highest volume class leads to the conclusion that we are left today with less than half of the original high-volume forestland (50,000 board feet per acre and above) that existed prior to the start of large scale industrial logging in Southeast Alaska.

TONGASS NATIONAL FOREST
LAND TYPES

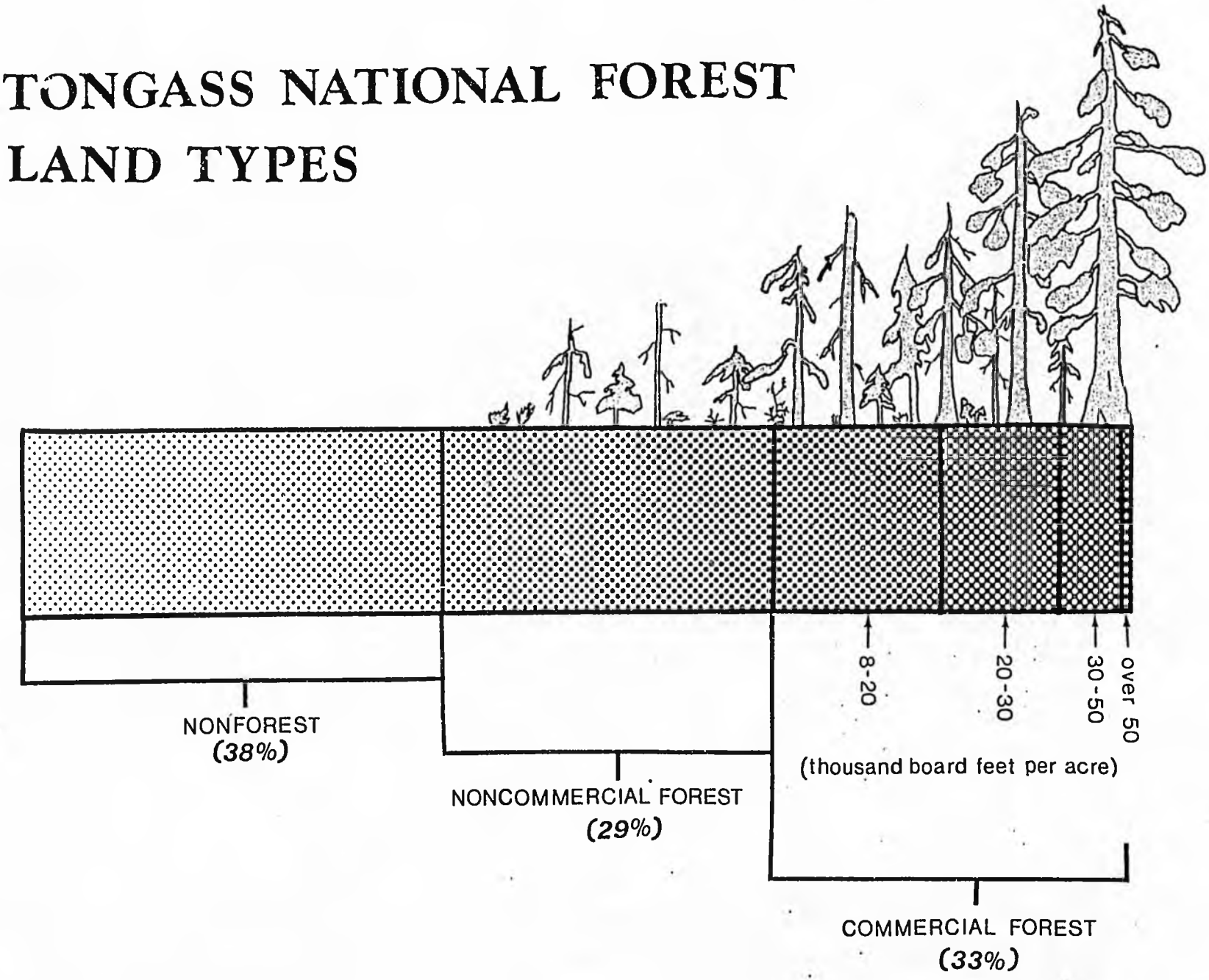

Figure 1.

Table 2. Tongass National Forest commercial forestland acreage by land use designation and volume class.[1]

Volume Class (thousand bd.ft./A)	I		II		III		IV	
	Acres	%	Acres	%	Acres	%	Acres	%
Already logged	37,981	2.6	31,187	7.9	82,253	7.4	166,769	8.4
8-20	719,442	49.3	248,496	52.6	529,124	47.3	862,197	45.2
20-30	528,403	36.2	151,577	32.1	365,375	32.7	673,675	33.7
30-50	162,765	11.2	30,736	6.5	119,902	10.7	233,249	11.7
More than 50	10,842	0.7	3,552	0.8	21,697	1.9	61,836	3.1

[1]From data on file, U.S. Forest Service, Regional Office, Juneau, 1980.

The Tongass Land Management Plan will cause the timber industry to operate increasingly in lower-volume stands. This reflects increased emphasis on resource protection (e.g., retention of valuable high-volume wildlife habitat and wilderness areas) and the present rarity of remaining high-volume stands. In the short term, however, economic realities dictate that high-volume stands will continue to be heavily harvested. Within the next 40 years, less than half of the total high-volume forest (50,000 board feet per acre) standing today in the Tongass will remain. (Unpublished data on file, U.S.F.S. Regional Office, Timber Management, Juneau, and Figure 2.)

In order to plan on sources of timber for cutting throughout the first rotation period, generally 100-115 years, the Forest Service has scheduled the amount of cutting within management units (value comparison units or VCUs) throughout the forest. A number of VCUs on the mainland in the vicinity of Juneau, on northern Admiralty Island, and on western Chichagof Island are listed to give examples of what has been cut and is scheduled for cutting during the first rotation period (Table 3). Deer habitat will be altered significantly, and an estimate of the percentage of deer remaining in each VCU after the first rotation period is also included in Table 3.

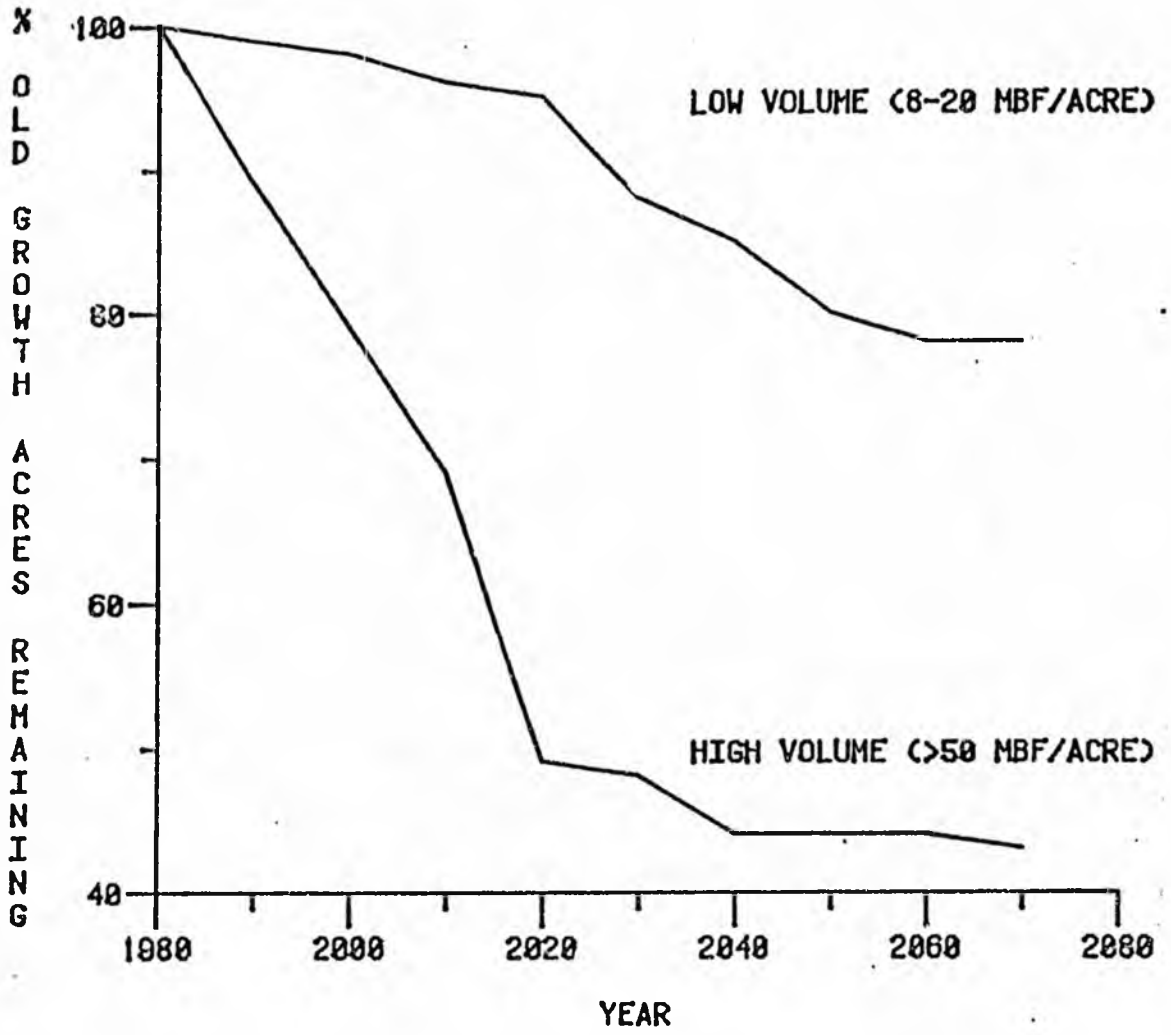

Figure 2. OLD GROWTH DEPLETION SCHEDULED 1980-2080

Table 3. Percentages of total commercial forestland (more than 8,000 board feet per acre) which have been cut and are scheduled for cutting during the first rotation period (generally 100-115 years) and percent deer remaining after first rotation period on selected VCUs in Southeast Alaska.[1]

VCU	Percent CFL Already Harvested	Percent CFL Scheduled For Harvest	Percent Deer Remaining After 100-115 Years
Echo Cove	0.0	43.5	30.7
Taku Harbor	1.1	50.1	35.3
Gilbert Bay	0.0	56.7	41.4
Windham Bay	0.0	68.6	41.9
Hobart Bay	0.0	75.8	28.3
Port Houghton	0.0	93.7	25.6
William Henry Bay	0.0	49.6	77.2
Barlow Cove	2.0	48.3	59.7
Funter Bay	0.0	50.2	38.2
Hawk Inlet	5.1	78.6	12.4
Lone Mountain	0.0	61.9	26.1
Fowler Creek	1.7	76.0	11.9
Young Bay	0.0	48.4	37.3
Eagle Peak	0.0	60.5	23.1
False Bay	0.0	83.3	15.9
Kennel Creek	4.7	63.6	16.1
Pavlof River	4.4	73.4	21.9
Tenakee Springs	2.4	66.7	17.5
Crab Bay	5.9	67.0	31.7
Kadashan	1.1	64.1	23.8
Corner Bay	21.9	66.7	22.0
Sitkoh Bay	11.3	70.0	24.2

[1]From Rideout, et al. 1984 and Schoen et al. 1985.

Aside from the demonstrated value of high-volume timber stands for deer in winter (see discussion elsewhere in this report and literature cited), these rare stands have value as ecological communities in their own right. The esthetic value of a grove of 200-foot spruce trees, centuries in the making, cannot be easily weighed against the value of the trees as lumber or pulp. While a relatively small percentage of the Tongass Forest overall will be changed by logging, under present plans, an already relatively rare forest type, high-volume old growth, will be reduced even further.

Management Guidelines

A number of laws pertain to resource management for federal and state public lands. Those most important for Southeast Alaska are summarized here. Cook (1984) provides a more detailed description of laws and their interpretation.

The Multiple Use-Sustained Yield Act of 1960 requires that National Forests be administered on a sustained-yield basis for outdoor recreation, range, timber, watershed, and wildlife and fish purposes. Several court decisions relating to the Multiple-Use Sustained Yield Act have resulted in the interpretation that the Forest Service has almost unlimited discretion in determining how much emphasis each of these multiple use values will receive (Cook 1984). In actual practice, the emphasis in Southeast Alaska has always been on timber.

The Alaska Native Claims Settlement Act of 1971 authorizes Southeast Alaska Native corporations to select land in the Tongass National Forest for private ownership. When selection is complete the regional corporation, Sealaska, and 12 village corporations will own an estimated 630,000 acres.

The Coastal Zone Management Act of 1972 requires that private landowners as well as state and federal agencies undertaking development projects in the coastal zone of a state ensure that they meet applicable provisions of the state's approved coastal management program.

The National Forest Management Act of 1976 (NFMA) comes closer than any other federal law to providing explicit and enforceable standards relating to fish and wildlife habitat protection on National Forest lands. The Act requires that management activities be done in a manner that provides for diversity of plant and animal communities. NFMA requires that if clearcutting occurs, it must be carried out in a manner consistent with the protection of soil, watershed, fish, wildlife, recreation, and esthetic resources, and the regeneration of the timber resource. NFMA directs the Secretary of Agriculture to revise the 50-year timber sales contracts in Alaska to make them consistent with the guidelines and standards provided by the Act.

Legislative history of the NFMA provides more insight on the intent of Congress. The Senate Report states that timber production and sale are important, but not the sole objective of management planning, and that the other resources of the forests, including wildlife and fish habitat, water, air, esthetics, and wilderness, must be improved and protected. The Senate Committee also believed widespread cutting of mature trees to be incompatible with management of the national forests, where decisions must be based on the numerous public values of the forest, in

addition to economic returns. The Committee was concerned that significant damage was still occurring to fish and wildlife habitat, particularly in Alaska. They thought the Forest Service should make greater use of the expertise of state fish and wildlife agencies, the Fish and Wildlife Service, and the National Marine Fisheries Service.

The committee report on NFMA stated that clearcutting and other harvest systems resulting in even-aged stands had greater adverse ecological impact than uneven-aged management. The decision to use even-aged management systems should not be based solely on economic benefits, i.e., dollar return. Rather, the committee wrote that the full scope of environmental effects (natural, economic, and social) should be evaluated and even-aged systems used only when they best meet forest management objectives for the individual management plan.

Regulations implementing the NFMA were adopted by the U.S. Forest Service in 1979 and significantly amended in 1982. One summary commented that the regulations abound with phrases and adverbs designed to provide escape hatches from otherwise strict requirements (Coggins and Ward 1981). The definition of multiple use does call for harmonious and coordinated management of the various resources without impairment of the productivity of the land. Sustained yield is defined in the regulations as "the achievement and maintenance in perpetuity of a high level annual or regular periodic output of the various renewable resources of the National Forest System without impairing land productivity."

The NFMA regulations require a detailed approach to resource management planning. A key aspect is the interdisciplinary team (IDT), which integrates biological, physical, economic, and social science disciplines. After public participation in the process, the IDT drafts management plans which identify and recommend alternatives for achieving management objectives. The Regional Forester has final authority for selection of a management plan.

NFMA regulations state that fish and wildlife shall be managed to maintain viable populations of existing native vertebrate species. For planning purposes, a viable population is defined as one which has the estimated numbers and distribution of reproductive individuals to ensure that it will continue to exist and be well distributed in the planning area. In order to ensure that viable populations will be maintained, habitat must be provided to support at least a minimum number of reproductive individuals, and that habitat must be well distributed so that those individuals can interact with others in the planning area.

Regulations also require selection of management indicator species chosen so that population changes of indicator species will indicate effects of management activities. The management indicator

species categories should contain animals that are commonly hunted, fished, and trapped. The IDT is directed to estimate the effects of changes in vegetation type, timber age classes, community composition, rotation age, and year-long suitability of habitat related to mobility of management indicator species. Where appropriate, the IDT recommends measures to mitigate adverse effects. Population trends of the management indicator species are monitored and relationships to habitat changes determined by the IDT. This monitoring is done to whatever extent possible in cooperation with state fish and wildlife agencies.

Another NFMA regulation requires that planning alternatives be stated and evaluated in terms of the amount and quality of habitat as well as animal population trends of the management indicator species.

NFMA also requires forestland management plans. This resulted in the Tongass Land Management Plan (TLMP) for Southeast Alaska. TLMP is a 10-year allocation plan whereby various portions of the forest are to be managed to achieve a set of goals and objectives. The forest was divided by drainages into value comparison units (VCUs) which were allocated to four major land use designations (LUDs). LUDs I and II, where timber harvesting is not permitted, contain approximately 8.1 million acres, of which 2.1 million acres are classified as commercial forestland. LUDs III and IV, where cutting will occur, contain about 6.9 million acres, of which 3.1 million acres are commercial forestland. In general, except for portions of Admiralty Island, areas with the highest value timber lands are classified as LUDs III and IV. Many of the high value LUD III and IV timber areas also have high wildlife values.

In the preparation of TLMP, fisheries and wildlife task forces were established to rate VCUs for fisheries and wildlife values. A shortcoming of the wildlife rating system recognized by some task force members was that one criterion, the number of species in an area, was weighted too heavily and that importance of individual species was not given enough consideration (Bob Wood, ADF&G, pers. comm.). The Wildlife Task Force also recommended retention figures, or the amount of timber that it considered an absolute minimum to be left uncut for wildlife. As an example, for deer the Wildlife Task Force recommended that 50 percent of existing old-growth commercial forestland be retained as intermediate range and that 90 percent of beach fringe commercial forestland be retained as critical range (U.S. Forest Service 1978). The Wildlife Task Force also stated, ". . .that, if the Task Force's retention factors are reasonably valid, there will be a continuing trend toward lowering wildlife habitat quality in areas where logging and other similar developments take place."

Task force recommendations went to an interdisciplinary team (IDT) which then drafted TLMP. The Alaska Department of Fish and Game wildlife specialist on the IDT was not in agreement with the IDT recommended alternative because too much timber would be removed, thereby impacting wildlife habitat too severely. Even so, the IDT recommended alternative did contain retention factors, or areas to be left uncut for wildlife and related values. These were reduced by the Alaska Regional Forester in the version of TLMP that was finally adopted. TLMP provides for an average annual allowable harvest of not less than 450 million board feet of timber or 17,000-18,000 acres a year. This is based on the industry's scaled volume and is equivalent to approximately 550 million board feet inventory volume.

The Alaska Department of Fish and Game commented on TLMP when it was in draft form (R. O. Skoog, Commissioner, ADF&G, Memorandum, 8/4/78). One concern of the Department was that wildlife habitat ratings on which TLMP is based often did not reflect true values. Ratings were based primarily on the number of species present rather than the importance of individual species or the value of areas to users. This resulted in some islands with relatively few species but with high wildlife values receiving lower wildlife ratings than mainland areas of less wildlife value that were rated high because they had more species.

Another Department of Fish and Game comment on TLMP (R. O. Skoog, Commissioner, ADF&G, Memorandum 8/4/78) was that the economics of timber harvest as it affects guiding, trapping, and viewing of wildlife should be analyzed along with the economics related to timber industry jobs. To attain a balanced resource allocation, the Department of Fish and Game recommended that a certain alternative (D) or another modified alternative (C) be adopted for the final version of TLMP. Alternative (C) was similar to the alternative recommended by the IDT that prepared TLMP. Both alternatives were rejected for the final TLMP, and a more intensive timber harvest plan was adopted.

Since TLMP was adopted, the Alaska Department of Fish and Game has identified 70 Class 1 VCUs, mainly in LUDs III and IV, that have high fish and wildlife values, and requested that road building and cutting be deferred until TLMP is revised in 1989 (Matthews and McKnight 1982). This is based not only on the yet unanswered questions concerning the effects of logging on fish populations and all old-growth-dependent wildlife but also on the already well documented effects of timber harvest on certain old-growth-dependent wildlife species (D. Kelso, Deputy Commissioner, ADF&G, pers. comm. 7/19/84). This State recommendation has not been accepted by the U.S. Forest Service, and roads have been built in Blind Slough and Kadashan, both Class 1 VCUs. A Forest Service representative states that Department of Fish and Game recommendations will be considered for the Tongass Land Management Plan Update scheduled for completion by April 1, 1985.

TLMP was adopted in March 1979 for a 10-year period. After 5 years, the Forest Service has prepared an Evaluation Report (U.S. Forest Service 1984) to provide a basis for updating and improving TLMP, aid in preparing a Tongass Forest status report for Congress as required by the Alaska National Interest Lands Conservation Act, and document how original TLMP management direction has been implemented to date. The report may also provide insight about what should be addressed when TLMP is revised in 1989.

The Alaska Chapter of the Wildlife Society requested revisions in the 1981-86 Timber Sale Operating Plan prepared under TLMP guidelines (Mickelson 1980). One of the reasons for requesting a revision was that the timber sale was not in compliance with plant and animal diversity requirements of NFMA. The Forest Service rejected the Wildlife Society's appeal even though the Forest Service did agree that diversity is not reviewed in TLMP with the specificity required by the NFMA current regulations and requires improvement (Peterson 1980, p. 9).

NFMA regulations were adopted in March 1979, 6 months after TLMP was adopted. Lack of NFMA regulations may be considered by some as justification for TLMP not being consistent with NFMA. Nonetheless, the intent of the NFMA statute is clear, and it would seem reasonable that TLMP conform to this intent. Also, it would seem that NFMA draft regulations could have served as guidelines for TLMP. The TLMP revision scheduled for 1989 is intended to remedy discrepancies between TLMP and NFMA (M.A. Barton, Tongass National Forest Regional Forester, pers. comm. 8/20/84).

The Alaska Regional Guide is a policy document also required by NFMA, and was adopted in December 1983. It encompasses the guidelines previously in the Southeast Area Guide. One of the guidelines addresses desirable levels of wildlife. The Regional Guide states "Desirable levels of wildlife will be determined primarily by the Alaska Department of Fish And Game, and wildlife habitat will be determined primarily by the Forest Service . . ." Hoopes (1982) states that "The Alaska Department of Fish and Game policy on 'desired' levels is clear: maintenance of maximum numbers of fish and wildlife that can be supported by the existing habitat in an ecologically sound manner." Hoopes (1982) further discusses desired levels and states, "Selected levels will reflect public demand for the resource, but which segment of the public is to be considered? As a National resource, levels should reflect the demands of people nationwide, not just local or regional users. Public demand for wildlife is not static and will quite probably increase in the future. Public demand includes both consumptive and nonconsumptive uses of wildlife. While consumptive use can be quantified, how will nonconsumptive uses be evaluated? Wildlife use is not readily translated into demand or desired levels. What levels are desirable to ensure a reasonable opportunity exists to view or harvest wildlife? To most users, not enough wildlife exists even now."

Another statute that affects forest management in Southeast Alaska is the Alaska National Interest Lands Conservation Act of 1980 (ANILCA). This Act makes $40 million available to the Secretary of Agriculture annually, or as much as the Secretary finds is necessary, to maintain the timber supply from the Tongass National Forest to dependent industry at a rate of 4.5 billion board feet per decade. It is important to note that ANILCA does not mandate an actual harvest of this amount of timber, but that the Forest Service must make the timber available to industry. If stands are not economically attractive, and industry chooses not to harvest them, that situation would not violate the law so long as the Forest Service had made reasonable efforts to make the timber available.

Statements of Congressional intent amplify on these points. Representative Udall (Congressional Record 11/12/80, p. 10542) made the following statements. "In keeping with existing National Forest Act provisions, this [Section 705] is not a mandate to produce a specific cut level regardless of the findings of future land use plans, demand for National Forest timber, or the cost to the taxpayer. . . No more national forest timber should be supplied than can be sold at fair market value."

Representative Udall also addressed the purpose of the $40 million appropriation. He stated it is the intent of Congress "to maximize protection to environmentally sensitive areas, particularly those with high fish and wildlife values." He also stated "Our intent is to encourage retention of old-growth forests for multiple use considerations rather than reduce old-growth retention in order to lower costs. The funding provided by Section 705 is to enable the Forest Service to adhere to the land use allocations of the [Tongass Land Management] plan and in the process, to protect the non-economic values embodied in the plan."

Another provision of ANILCA requires that the Secretary of Agriculture report to Congress every 2 years, beginning in 1985, on a variety of issues, including measures instituted by the Forest Service to protect fish and wildlife.

The subsistence provisions of ANILCA also affect management of the Tongass Forest. ANILCA states that utilization of public lands in Alaska is to cause the least adverse impact possible on rural residents who depend on subsistence uses of such lands. Before making resource use decisions, the head of the responsible federal agency must evaluate the effect of the decision on subsistence uses and needs, and consider using other lands and alternatives. He must also determine that reasonable steps will be taken to minimize adverse impacts on subsistence resources and uses caused by such resource use decisions. Judicial enforcement of the subsistence priority is provided for in ANILCA, with an expedited hearing in federal District Court as the forum.

The $40 million annual appropriation authorized by ANILCA may not necessarily have to be spent directly on timber production and possibly could be spent on wildlife and fisheries projects. The Office of General Counsel, Department of Agriculture (C. W. Brizee, 1/30/81), states that a request for such funds for a program not related to timber production is defensible if the Secretary can justify the program to sustain the desired timber harvest level.

The Forest Service's own administrative manual also influences Tongass Forest management. Many day-to-day policies, including those affecting fish and wildlife, are found in the U.S. Forest Service Manual. The manual states that where other resource activities or uses are proposed that affect fish or wildlife habitat objectives, habitat shall be examined, multi-resource prescriptions prepared, and the consequences of alternatives evaluated and displayed. Where opportunity exists to improve the capability for fish and wildlife, it should be included in the multi-resource prescription.

The Forest Service has recently initiated a second-growth management program and states, "Although this program is just being implemented and it will be many years before the effectiveness of some of the wildlife treatments can be completely evaluated, this program constitutes a significant effort by the Forest Service to address concerns associated with second-growth. . ." (M.A. Barton, Regional Forester, Tongass National Forest, pers. comm. 8/20/84).

The major treatment for wildlife in the second-growth management program is thinning of second-growth stands. Alaback and Tappeiner (1984) studied response of understory vegetation to thinning in Southeast Alaska. Looking at a range of stand ages, site classes, and thinning regimes, they found that "(after thinning) herbs and mosses decreased their relative contribution to understory biomass, and in many cases actually decreased productivity. . . Understory shrubs and herbs on precommercially thinned stands (20-30 years old) were the least responsive to thinning. On most plots, tree seedlings increased productivity at the expense of herbs and shrubs . . . Although the understory biomass accumulation of some stands following thinning was highly significant, it was less than that measured in several old-growth stands . . . Several measurements at 5-10 year intervals will be necessary to assess how understory vegetation will change in response to thinning over the course of a complete timber rotation . . . The short-term results of thinning experiments suggests that thinning may have some potential for increasing the overall productivity of understory vegetation in second-growth stands in Southeast Alaska. How significant thinning may be to improving deer winter range will depend on how quickly forest overstory canopies close after thinning, what influence a secondary Tsuga canopy created by heavy thinning will have on the understory, and the nutritional requirements of deer and other wildlife."

STATE OF ALASKA FORESTLAND

The State of Alaska owns approximately 482,000 acres in Southeast Alaska, of which about 400,000 acres are in the Haines-Skagway area. Nearly all state forestlands are in the Haines area and comprise 229,000 acres, of which 94,000 are timbered. Inoperable logging conditions and land classifications which preclude logging reduce the amount of operable forest land to 59,000 acres.

An estimated 12,000 acres have been logged to date in the Haines area, and the current cutting rate is 200-500 acres per year. The total uncut commercial old-growth forest in the Haines area is estimated to be over 67,000 acres; the estimate of old-growth forest remaining at the end of 100 years is 32,000 acres.

The following discussion on management guidelines for state lands is from Cook (1984). Natural resource management, including forest management, has a basis in the Alaska constitution, which states that forests and other replenishable resources shall be utilized, developed, and maintained on the sustained-yield basis, subject to preference among beneficial uses.

Alaska's constitution also states that wherever occurring in the natural state, fish and wildlife and waters are reserved to the people for common use. This and various court decisions argue for a public trust doctrine applying to fisheries and wildlife. On this basis, the State would be obligated to provide protection to fisheries and wildlife relative to logging and other activities with the potential for harming them.

Two statutes can also be interpreted to impose trust responsibilities on the State. The Land Policy Act mandates that resource requirements of future generations shall be considered and requires the Commissioner of the Department of Natural Resources to consider present and potential resource users.

The Alaska Forest Resources and Practices Act requires that renewable forest resources be administered to best provide for present needs and preserve future options of the people of Alaska. Renewable forest resources include, of course, fish and wildlife. The Forest Practices Act gives guidelines for managing forest resources on state lands. These include multiple-use and sustained-yield principles. Activities causing prolonged or substantial damage to renewable resources or the capability of the land or water to produce renewable resources are prohibited. The Act is administered by the Department of Natural Resources. A 14-member Board of Forestry appointed by the governor reviews regulations before they are adopted by the Commissioner of the Department of Natural Resources.

The adequacy of protection of non-timber resources provided by the Forest Practices Act was addressed in a recent survey by the State Division of Forestry (Table 4). This would indicate that the Act is not as protective of fish and wildlife as desirable.

PRIVATE FORESTLAND

Nearly all privately-owned forestland in Southeast Alaska has or will be selected by Native corporations from the Tongass National Forest under provisions of the Alaska Native Claims Settlement Act of 1971 (ANCSA). The Native regional corporation, Sealaska, and the 12 village corporations have thus far selected about 575,000 acres. When selection is complete, they will own an estimated 630,000 acres (330,000 acres by Sealaska and 300,000 acres by village corporations). A primary use of the lands will be timber harvest from an estimated base of 11-14 billion board feet of timber. Through July 1, 1981, Sealaska had selected approximately 195,000 acres, of which 74 percent is commercial forestland, 11 percent is noncommercial forest, and 14 percent is non-forestland (Sealaska 1982). Native corporations have logged about 61,000 acres to date, and intend to log 13,300 acres in 1984 (J. Sturgeon, State Forester, pers. comm. 3/22/84).

While provisions had originally been made legislatively to regulate management of private timberlands, those mandates have not been carried out and have since expired. Section 22-k of ANCSA states that lands selected by Native Corporations from the Tongass Forest shall be managed for 12 years on a sustained-yield and environmentally sound basis no less stringent than similar management provisions for adjacent National Forest lands. This provision, highly desirable from a wildlife and fisheries habitat protection standpoint, was not enforced by the U.S. Bureau of Land Management, the agency that eventually acquired responsibility for enforcement. The end of the 12-year period since passage of ANCSA was reached in December 1983, and landowners and overseeing agencies interpreted this as the end of regulation under Section 22-k. A lawsuit (Angoon v. Marsh), claiming that the date of conveyance of lands rather than enactment date of ANCSA should be the start of the 12-year 22-k regulatory period, is still pending, however.

Table 4. Responses (%) to questionnaire on State Forest Practices Act regarding amount of non-timber resource protection provided and overall effect.[1/]

Amount of Protection to Non-Timber Resources	Respondents		
	Industry	ADF&G[2/] ADEC	DNR[2/] Foresters
Too Much	40	0	22
Right Amount	60	0	55
Not Enough	0	100	23
Overall Effect			
Positive	68	60	75
Negative	0	0	0
Both	24	0	25
Neutral	8	40	0

[1/] Survey by Division of Forestry, Alaska Department of Natural Resources (J. Sturgeon, State Forester, Pers. Comm., 3/22/84).

[2/] ADF&G - Alaska Department of Fish and Game
ADEC - Alaska Department of Environmental Conservation
DNR - Alaska Department of Natural Resources

When regulation of Native lands under Section 22-k expired, regulation of forest practices came under state statute, the Alaska Forest Resources and Practices Act of 1979. This Act regulates forest practices on both state and private lands, but with different criteria. Provisions applying to state and municipal forest lands, but from which private forestlands are exempt are: management based on multiple use and sustained yield (other than for timber) principles which best provide for present needs and preserve future options; any system of allocating predominant uses or values to a unit of land to reflect the resources and values of that unit; timber harvesting limited to areas where natural or artificial reforestation will provide a sustained yield of merchantable timber; productivity of land and water with respect to natural resources not to be impaired; and, where economically practicable, allowance may be made for scenic quality in or adjacent to areas important for tourism and recreation. Regulations to implement the State Forest Practices Act do protect streams and provide for soil stabilization on private as well as on state lands. Nevertheless, the Act and regulations provide much less fish and wildlife habitat protection on private lands than on state and municipal lands (Table 4).

WILDLIFE

Relatively little research has occurred on wildlife-forest relationships in southeast Alaska and for many species, habitat relationships are still largely unknown. Accounts which follow summarize current knowledge for those species which have been studied.

Deer

For more than a decade, research on Sitka black-tailed deer in Southeast Alaska has shown that clearcutting old-growth forest will reduce the carrying capacity of deer winter range (Leopold and Barrett 1972, Bloom 1978, Barrett 1979, Schoen and Wallmo 1979, Wallmo and Schoen 1980, Schoen et al. 1981, 1984, Alaback 1982, Rose 1982, Kessler 1982, Kirchhoff et al. 1983, Hanley et al. 1983). These and other studies document the value of old growth as important winter deer habitat. Although climatic conditions vary in Southeast Alaska, findings of a number of workers (referenced above) in northern Southeast Alaska are corroborated by Rose (1982) who worked in the more moderate climate of southern Southeast Alaska. Still further to the south, other investigators have described the importance of old growth to deer on Vancouver Island, British Columbia (Gates 1968, Jones 1975, Weger 1977, Bunnell 1979, Hebert 1979, Harestad 1979), the Olympic National Forest in coastal Washington (Taber and Raedeke 1980), and northwestern Montana (Mundinger 1984).

In Southeast Alaska, deer populations are generally limited by winter weather and the quality and quantity of the winter range. (An exception may be a few small islands where summer range is limiting.) Old growth provides deer with abundant food and shelter from deep snow. Second-growth forests are poor deer habitat in Alaska throughout the year because of the lack of forage plants. These forests will make up approximately 75 to 80 percent of the managed forests under a 100-year rotation. Clearcuts provide abundant forage for only the first 15 to 20 years of the rotation period. A further complication is that during periods with snow accumulation greater than a few inches, the most valuable forage for deer (herbaceous species such as bunchberry, trailing raspberry, and gold thread) are inaccessible in open clearcuts. Additionally, recent evidence suggests that the quality of the forage plants found in clearcuts is lower than quality of the same plants in old-growth forest (Billings and Wheeler 1979, Schoen and Kirchhoff 1984).

All old growth is not the same, however. High-volume hemlock-spruce stands are preferred by deer during winters with heavy snowfall, while low-volume and noncommercial stands are avoided, as are high-volume spruce riparian stands (Schoen and Kirchhoff 1983). The high-volume stands with larger trees and canopies

intercept more snow than do lower-volume and noncommercial stands, resulting in lower snow depths and more available deer forage. In addition, bunchberry (a highly preferred forage plant) is significantly higher in nutritional quality in high-volume stands compared to low-volume stands (Schoen and Kirchhoff 1984, Flynn ADF&G unpublished data). Past timber harvesting has concentrated in the highest-volume stands, and future plans also project a disproportionate harvest in the higher-volume stands. The result will be a greater impact on deer than acreage figures alone may suggest.

There is an immediate management need for information relating old-growth harvest to deer populations in Southeast Alaska. The Alaska Department of Fish and Game has addressed this need by developing a model which predicts population changes in Sitka black-tailed deer as a result of logging in Southeast Alaska (Schoen et al. 1985). The model is based on habitat preference of radio-collared deer at Hawk Inlet, Admiralty Island, measured under low and high snowfall conditions. The model offers managers a systematic technique for evaluating timber management alternatives and their potential long term effects on deer populations. Alaska Department of Fish and Game and U.S. Forest Service biologists have also been developing a Southeast Alaska Multi Resource Model (SAMM, Fight et al. in prep.) which describes the interactions between timber management, hydrology, fisheries, and deer in selected watersheds on the Tongass. Developed primarily as an aid to research, this conceptual model may be adapted for management application in the future.

Wolves are a predator on deer in some areas and may keep populations depressed in years following severe winters and population die-offs (Olsen 1979). The Alaska Department of Fish and Game started a long-term study of wolf/deer-habitat relationships in southern Southeast Alaska in 1984.

Brown Bear

Historically the brown/grizzly bear was widely distributed in North America from central Mexico to northern Canada and Alaska, and from the Mississippi River to the Pacific Coast (Hall and Kelson 1959). Its distribution today is greatly reduced, with populations restricted to northwestern Canada, Alaska, and a few scattered wilderness enclaves in Montana, Idaho, and Wyoming. Alaska has the last major population of brown/grizzly bears in the United States.

Brown bears are indigenous to Southeast Alaska where they occur on the islands north of Frederick Sound and the mainland. Management concerns include hunting, effects of disturbance from increased human activities associated with development and recreation, and habitat alteration resulting from clearcut logging and

mining activities. An effect of habitat alteration of special concern is the greatly reduced vegetative understory in regrowth stands; brown bears are omniverous, and understory vegetation forms a significant part of their diet. Anadromous fish are another important food, and any reduction in fish runs that might result from mining or logging is also of concern.

The effects of removing old-growth forest on brown bear populations in Southeast Alaska are unknown. Johnson (1980) stated, "Development of an extensive logging industry has perhaps the greatest impact on bear management in Southeast Alaska . . . one known impact which is primarily a management problem but at the same time contributes significantly to the kill, is the rather large number of bears destroyed in logging and support camps. This kill may approach 10 percent of the reported legal kill."

In Montana, Mace (1983) reported grizzly bears avoided or moved out of recently logged areas. Craighead (1977) and Jonkel (1977) suggested that human induced mortality associated with logging may be the major contribution to grizzly bear declines. In British Columbia, Russell (1974) indicated that coastal brown bear populations were incompatible with intensive forestry. Smith (1978) suggested that other factors, in addition to habitat alteration, may be contributing to declines in brown bear populations in this area. Archibald (1981), also in British Columbia, suggested that development in coastal mainland forests appears to result in declining brown bear populations.

Although much research has been conducted on northern and interior brown/grizzly bear populations, comparatively less work has been done in forested, coastal brown bear habitat. As development, including forestry and mining, increases in the coastal forests of British Columbia and Alaska, more information will be necessary to maintain current brown bear population levels.

The Alaska Department of Fish and Game began brown bear research in Southeast Alaska in the fall of 1981. Major objectives are to determine seasonal distribution and habitat preference, home range, den site characteristics, and reproductive rates. Current research is being conducted in Tenakee Inlet on Chichagof Island and Hawk Inlet on Admiralty Island (Schoen 1982, Schoen and Beier 1983). There is an historically demonstrated incompatibility between brown/grizzly bears and man. As Craighead et al. (1982) stated, "Space and solitude are essential for maintaining grizzly bears in perpetuity . . . Research and management efforts throughout North America should focus on the largest wilderness areas of prime bear habitat." Construction of roads with their inevitable increase in human activity and development will substantially increase the number of bear-human conflicts.

Three types of human-related bear mortality occur: legal harvest, illegal take, and take in defense of life and property. Legal harvest can be managed, but as major road systems proliferate in Southeast Alaska as a result of logging, the Alaska Board of Game will need to consider more restrictive harvest regimes. One possibility is a permit system with numbers of permits allocated by drainage. Illegal take and defense of life and property incidents cannot be effectively controlled and will increase as logging brings about development of formerly unroaded wild country.

Black Bear

Black bears occur on the mainland of Southeast Alaska and on the islands south of Frederick Sound. Black bears have generally not been studied or managed intensively in Southeast Alaska. The only major study was by Erickson (1982) who investigated the denning characteristics of black bears on Mitkof Island. He found that bears utilize clearcuts in summer, but den in large trees or hollow logs--available only in old-growth stands. Black bears do occur in high densities in some areas of Southeast Alaska where logging has occurred. Studies are needed to relate bear populations to successional stages following logging. More specifically, are these high bear populations associated with the dense understory and abundant plant food species immediately following clearcutting, and how are populations affected during the next successional stage when the understory is shaded out by even-aged, densely spaced second growth?

Lindzey and Meslow's (1977a) study on the Washington coast found that, "physical disturbance and loss of habitat due to timber harvest between 1952 and 1968 may have caused bears to leave the island or increased mortality and perhaps reduced productivity of those that remained." Additionally, Lindzey and Meslow (1977b) reported that plant species preferred as forage by black bears declined by 85 percent as cuts progressed from 6-11 to 40+ years of age. Bears used 40+ year-old regrowth significantly less than expected, given its availability. In western Washington, Poelker and Hartwell (1973) surmised that black bear damage to conifer regeneration at 20-40 years of age was related to food shortage in those stands.

The potential adverse impacts of logging are not restricted to forage requirements. Johnson and Pelton (1981) analyzed the selection and availability of den sites in the Great Smokey Mountains and concluded that remnant old-growth stands were important denning habitat, particularly for females and young bears. Use of tree cavities for denning was also reported by Polker and Hartwell (1973) and Lindzey and Meslow (1976) in Washington and by Erickson et al. (1982) and Miller and McAllister (1982) in south coastal Alaska.

Although li ·le research has been done on black bear/forest relationships i Southeast Alaska, it is important to look at long term (over _ 100-year rotation) effects of habitat changes for black bears. It seems logical to predict that large scale conversion of productive old-growth forests to relatively sterile second growth over most of the rotational period will result in declines in black bear populations.

Mountain Goat

Mountain goats are indigenous to the Southeast Alaska mainland, have been successfully introduced to Baranof Island, and were introduced to Revillagigedo Island in 1983. Although mountain goats are not considered animals of the forest, in Southeast Alaska, many goats winter in old-growth forest habitat (Schoen and Kirchhoff 1982, Smith 1983, Fox 1983). In some areas goats occur in commercial forestland that may be clearcut. In other areas, it is unlikely that clearcut logging will pose a direct threat to forested goat habitat because such steep areas are currently classified as unharvestable and the timber is of marginal economic value. However, as harvest methods change (e.g., helicopter logging) conflicts in these areas may develop. There is evidence of substantial goat use in small "islands" of steep old-growth forests. Extensive logging between "islands" of preferred goat habitat could create barriers to dispersal. Smith and Raedeke (1982) discuss the problems of timber development in forested goat habitat on the Cleveland Peninsula and the possibility of increased mortality and eventual elimination of the population, as a result of logging and road-building.

Although logging may not result in widespread habitat degredation as is the case for deer, the indirect impacts on goat populations during and following logging may be substantial. Improved access into many drainages has the potential for concentrating legal hunting, poaching, and disturbance. These problems are not restricted to timber activities but could also result from mining, hydroelectric projects, and other development.

Moose

Moose are found in scattered populations in Southeast Alaska primarily in the major mainland river drainages. Moose are considered a successional species which generally benefits from fire and logging. The major moose research in Southeast Alaska has been conducted in Thomas Bay (Doerr 1983), the Chilkat River (Hundertmark et al. 1983), and the Stikine River (Craighead et al. 1984). These studies revealed that moose use old-growth forests extensively during periods of deep snow. During snow-free and mild snow periods, clearcuts were also utilized. Moose are probably less impacted by clearcutting than are deer because they can utlize woody browse and travel through deeper snow better

than deer. However, the closed canopy stands of second growth which replace clearcuts 20-30 years following logging are very poor moose habitat, and populations could be expected to decline if second-growth forests become abundant.

Wolf

Wolves are distributed throughout the mainland and southern islands of Southeast Alaska. They do not occur on Admiralty, Baranof, or Chichagof Islands. Little information is available on wolf biology or their habitat relationships. The Alaska Department of Fish and Game started a long term study of wolf/deer-habitat relationships in southern Southeast Alaska in 1984.

Deer are a major prey species of wolves in the southern archipelago. Following the severe winters of 1968-69 and 1970-71, deer numbers declined sharply. Wolf predation appears to have kept deer at low levels during the succeeding mild years (Olsen 1979). It is suspected that during heavy snow winters, when deer are forced to old-growth timber surrounded by clearcuts, wolf predation may be focused on old-growth retention areas. If deer do prove to be the primary prey, timber cutting which reduces deer populations can be expected to also adversely affect wolves.

Furbearers

The principle furbearers associated with old-growth forest habitats are beaver, marten, mink, and river otter.

Marten, of all furbearers, are probably most closely associated with, and dependent on old-growth forest (Marshall 1951, DeVos 1952). Marten are found naturally in Southeast Alaska along the mainland and on Admiralty, Kuiu, Kupreanof, and Revillagigedo Islands, and were stocked in 1934 on Prince of Wales, Baranof, and Chichagof Islands (Meehan 1974). Small mammals, especially voles, are a mainstay of the marten's diet (Koehler and Hornocker 1977), although they feed opportunistically on other available food (Lensink et al. 1955). In Southeast Alaska, red squirrels may be a particularly important food item. Other foods include grouse, other birds and their eggs, frogs, fish, insects, carrion, and berries (Seton 1929). Although local knowledge of habitat requirements is somewhat lacking, studies in Canada (referenced by Meehan 1974) and in Maine (Soutiere 1979) suggest that clearcut logging will reduce marten numbers.

Beaver are normally associated with "hardwoods" (e.g., alder, aspen, birch, willow, cottonwood) which they feed on, and accordingly are more common on the mainland than on the islands of Southeast Alaska. The animals are usually found in the valleys of slow-moving streams where there is little timber (Meehan 1974).

Since alder is a common component of early successionial vegetation development, beaver forage should be increased temporarily following logging (Meehan 1974).

Mink are perhaps Southeast Alaska's most abundant and commonly seen furbearer, spending summer along streams and in upland muskegs, and wintering in a narrow beach fringe zone. For den sites, mink prefer rocky, fairly steep beaches (but not bluffs), and are scarce along slightly sloping beaches where there is little cover at low tide (Harbo 1958). According to Harbo (1958) invertebrates, including blue mussels, clams, sea urchins, and dungeness crabs, make up the bulk of the mink's diet. Log storage and pulpmill effluents may be potential threats to these foods (Meehan 1974). Habitat loss of beach fringe timber due to clearcutting and associated blowdown is also a potential threat.

River otter are believed to be primarily inhabitants of beach and streamside habitats, although reports are common of otter 1/4 mile or more inland, especially in winter. Otter feed primarily on fish and shellfish, and may occasionally take swimming birds. Log storage and pulpmill effluents may affect these food sources (Meehan 1974). Decreased denning activity in beach fringe areas associated with clearcuts (Larson 1983) suggests logging may have a deleterious local impact on otter populations.

Bald Eagle

The bald eagle, once widely distributed throughout North America, is today considered common only in Alaska. The greatest concentrations of these birds are found in the coastal forests of Southeast Alaska. Aerial surveys indicate a stable population of between 7,000 and 7,500 birds in Southeast Alaska (Hodges et al. 1979). Eagles nest in the most mature trees, usually within several hundred feet of the open shoreline; on Admiralty Island, 85-90 percent of the nests were in old-growth Sitka spruce (Robards and King 1966, unpublished report). Second growth is not used for nesting if there are any remains of virgin stands in the vicinity (Meehan 1974).

Timber harvesting has been identified as a major factor in the elimination of suitable nesting habitat (Braun et al. 1975) and winter perching sites (Stalmaster and Newman 1978) in the Pacific Northwest. Management policies recently set forth (TLMP 1979) in Southeast Alaska call for retention of buffer areas around known nest trees and retention of beach fringe timber to protect nesting habitats.

Canada Goose

The Vancouver Canada goose nests in a generally solitary fashion throughout its range, which extends from Cross Sound and Lynn

Canal south to Dixon Entrance, on both the mainland and the islands of the Alexander Archipelago (Hansen 1962). This subspecies of Canada goose also winters mainly in Southeast Alaska, with estimates of the total population approaching 50,000 birds (Meehan 1974). Intertidal and estuarine areas throughout Southeast Alaska are a very important part of the year-round habitat, with sedge meadows, grass flats, muskegs, beaver ponds, and shallow lakes providing important feeding and brood rearing areas at certain times of the year (Meehan 1974). More recently, Lebeda and Ratti (1983) reported the importance of old-growth timber as vital nesting, feeding, molting, and brood rearing habitat. Lebeda and Ratti (1983) speculate that predation pressure by crows, ravens, bald eagles, mink, and otter has selected against individuals using traditional open habitats and favored birds using dense forest zones away from the beach fringe. Potential threats to Canada geese are log storage sites in estuarine areas and clearcut logging of certain old-growth stands, particularly lower-volume classes in proximity to extensive muskegs or estuarine habitats.

Marbled Murrelet

The marbled murrelet is the most abundant small seabird in many coastal localities, with numbers in Southeast Alaska estimated at 250,000. Its nesting requirements, however, are largely unknown with only nine nests recorded until recently throughout its range (northern California to Prince William Sound). These limited nesting records, along with its general distribution which coincides with remaining old growth, suggests this species may be adversely affected by logging. The Pacific Seabird Group passed a resolution in December 1982 citing the potential conflict between logging and murrelet habitat and urging additional research. The Alaska Department of Fish and Game studied murrelet nesting on Baranof Island in 1983-84.

Other Birds

Birds which commonly overwinter in old-growth forest include the hairy woodpecker, chestnut-backed chickadee, golden crowned kinglet, winter wren, brown creeper, pine siskin, and red crossbill. These, and other less common winter residents use old growth both for feeding and roosting in winter. Roosting birds require cavities, usually in dead, decaying snags, which are relatively abundant in old-growth forest. Some birds are seed eaters and others are insectivores, gleaning their food from the bark of trees. Old-growth forests produce both an abundance of seeds and well developed bark substrates for these foraging activities. Ongoing research on the habitat requirements of wintering birds in Southeast Alaska (Hughes, ADF&G, pers. comm.) suggest that high-volume stands of old growth are ecologically distinct from

other stands, and support a characteristic avifauna. Loss of snags, and disproportionate harvesting on rare high-volume stands are the greatest threats posed to some species of birds wintering in Southeast Alaska.

FISHERIES

Much of what follows has been taken directly from "The Forest Ecosystem of Southeast Alaska - 3. Fish Habitats" (Meehan 1974).

Finfish (salmon, trout, etc.)

Fish and timber are the two most important natural resources in Southeast Alaska at the present time. Salmonids (Pacific salmon, trout, and char) often spend most of their freshwater life in streams that flow through forested watersheds. In the glacier-formed, U-shaped valleys common in Southeast Alaska, much of the best timber is found in the valley bottoms in close association with salmon and trout streams. This makes timber harvesting a more difficult problem, because timber harvesting can affect streams.

Two major freshwater habitat types are important to salmonids, i.e., spawning areas and nursery or rearing areas. In some cases a reach of stream may serve as both spawning and rearing habitat, but more often rearing areas are located some distance away from the major spawning riffles. Pink and chum salmon utilize spawning habitat; but after fry emerge from the gravel beds, they migrate to sea almost immediately, so that freshwater rearing areas are not significant factors in their life cycle. On the other hand, the remaining salmon species (coho, chinook, and sockeye), the trouts (rainbow and cutthroat), and the char (Dolly Varden) spend from a few months to 3 or 4 years in fresh water before migrating to sea; in some cases they spend their entire life in fresh water. To these species the rearing areas are often more important than spawning habitat (although both can be critical), since the amount and quality of "living room" is generally the factor which limits their production.

The primary function of spawning gravels is to provide an environment suitable for the development of the eggs and alevins up to the time of hatching and emergence. The rearing areas must provide conditions suitable for the growth and survival of the young fish. Because of these different requirements, the two habitat types may be quite dissimilar. The spawning environment must (1) contain sufficient quantities of suitable gravel, (2) provide sufficient surface and intragravel water flow to assure adequate flow of oxygen to, and removal, of metabolic wastes from the developing embryos, (3) maintain temperatures which assure proper

rate of development and time of emergence of the eggs and fry, and (4) be free of sediment in quantities which would inhibit development of embryos due to oxygen depletion and would physically inhibit or prevent emergence of fry.

The rearing environment must provide the food, living space, cover, and water quality necessary for good growth and survival of fish populations. The spawning reaches are generally characterized by series of riffles and pools, where the flowing surface water can be oxygenated, and where bottom contours favor the interchange of surface and intragravel waters. The rearing habitat, on the other hand, is often slow-moving water, rich in plant and invertebrate animal life, and ranges from small streams and tributaries, through sloughs, side channels, and shore areas of major streams and rivers, to ponds and lakes of varying size.

Consideration for fish habitat in Southeast Alaska during timber harvesting was, in the past, often directed only toward the larger spawning streams. Today, the great importance of the smaller rearing areas is being more fully recognized, and these areas are now beginning to receive the attention which they warrant. Small streams are generally more dramatically affected by changes than are larger streams and rivers.

Sediment (both suspended and deposited), water temperature, dissolved oxygen, streamflow, and debris are the factors associated with logging practices which can affect the habitat of anadromous and resident fish populations. These factors often are interrelated, and the total cumulative effects may be greater than the sum of their individual effects.

Sedimentation--Sedimentation caused by destruction of streambanks, slope erosion, erosion of roads, or debris avalanches can alter the gravel composition of streams. Road construction is generally recognized as a major cause of logging related sedimentation (Burns 1972, Gibbons and Salo 1973). Increases in sand and silt in spawning gravels can reduce oxygen delivery and metabolic waste removal needed by developing salmon embryos and cause decreased survival, premature emergence, or smaller size of emergent fry (Cooper 1965, Reiser and Bjornn 1979). Sediment in spawning gravels also inhibits emergence by entombing alevins (Koski 1966) and may reduce the average size of emergent fry because only smaller individuals can emerge from sediment impacted gravels (Tappel and Bjornn 1983). Gravel permeability is the best when gravel contains less than 5 percent sand and silt by volume (McNeil and Ahnell 1964).

Sedimentation can also affect rearing species by reducing the stream's capacity to produce food organisms (Phillips 1971) and by reducing habitat for juvenile fish (Bjornn et al. 1977). Sigler et al. (1983) reported that juvenile salmonids grew slower

and had greater rates of emigration from experimental streams when subjected to turbid water conditions and Crouse (1981) demonstrated that coho production declined when large cobble substrates which they used for shelter were covered by sediment.

Sediment can affect adults also. Migrating king salmon will choose clear water tributaries in preference to streams that are turbid (Smith 1940), and adults will often refuse to move when suspended sediment exceeds 4,000 milligrams/liter. Adult trout will cease feeding and move closer to cover when turbidity exceeds 35 milligrams per liter (Bachman 1959). Bachman (1984) showed that adult brown trout decrease rates of feeding during turbid conditions.

Temperature--Removal of the forest canopy increases sunlight penetration and can increase water temperature (Brown 1970) and thereby increase mortality of spawning fish (Reiser and Bjornn 1979). In Alaska, Meehan (1970) found increases in stream temperature resulting from clearcutting but noted that increases did not reach levels lethal to salmonids. However, temperatures greater than about 13-15° C., although not lethal, can cause decreased growth rates and lower rearing densities (Rieser and Bjornn 1979). In British Columbia, Hartman et al. (1982) found that winter water temperatures increased after clearcutting, accelerating the rate of development of incubating alevins and causing fry to emerge from the gravel earlier in the year. Early emergence often occurs at a time of spring floods, and many fry are swept out to sea. Fry that escape floods enjoy a longer growing season and may attain a greater size by the end of their first year (Scrivner and Anderson 1984). Tyler and Gibbons (1973) and Sheridan and Bloom (1975) also reported on effects of forest canopy removal on stream temperature. Within limits, temperature increases in small streams as a result of removing streamside vegetation can be predicted. In some situations a slight warming of stream water might initially enhance fish production, but the cumulative downstream effects of temperature increases in upstream tributaries must be considered.

Logging related increases in temperature have popularly been criticized as a source of mortality in spawning pink salmon. However, Murphy (1983 unpublished) reported that summer die-offs of pink salmon in clearcuts is more related to low stream flows and low tides which trap and concentrate spawners, thereby creating anoxic conditions and rapid mortality.

Streamflow--Streamflow usually increases following logging due to decreased evapotranspiration and interception of water. Chamberlin (1982) lists examples showing annual increases in runoff 20-40 percent greater than pre-logging levels. Additionally, increased peak flows may occur and appear to be related to the amount of roads in the harvested watershed (Moring 1975)

It is not known if timber harvest alone (through evapotranspiration decrease) can increase peak flows significantly (Chamberlin 1982). However, much greater flow increases may be caused by rain-on-snow events or when heavy rainfall coincides with rapid snowmelt. Although Harr (1980) found no direct data linking these events with destructive peak flows, considerable circumstantial evidence suggests that harvesting in coastal British Columbia may have contributed to deteriorating aquatic habitat in a region where rain-on-snow events are common (Chamberlin 1982).

Evidence now shows that flooding, even within normal limits, has a dramatic impact on rearing salmonids and may be the single most important factor in determining annual abundance. Mason (1976) found that winter floods can rapidly reduce summer populations and Tschaplinski and Hartman (1983) found that numbers of juvenile coho salmon were depleted after floods. Also since fish choose foraging sites based upon their size and local velocity conditions (Bachman 1984), both higher minimum flows and higher peak flows may limit the number of usable foraging sites and thus reduce the population density.

Long term changes in streamflow may have greater impact on fisheries by limiting annual recruitment. Murphy (1983) concluded the following about streamflow following logging after studying a 1981 fish kill of pink and chum salmon spawning in Porcupine Creek on Etolin Island, Southeast Alaska: "In the short term, less than 20 years, streams in clearcuts may have increased minimum water flow because water that would have been transpired by the forest becomes runoff. For example, in western Oregon, cutting 80 percent of the trees in one watershed increased minimum streamflow by 85 percent (Rothacher 1970). Thus, fish kills may occur less frequently in recently logged watersheds than in similar forested watersheds if temperatures do not increase too much. However, in rapidly growing, second-growth stands (stands more than 20 years old), transpiration may be greater and streamflow less than in old-growth stands (Berndt and Swank 1970, Myren and Ellis in press). In the long term, logging could reduce minimum summer streamflow and exacerbate salmon kills." In summary, peak water flows in logged drainages may be increased, decreased, or remain unchanged after logging.

Water Quality: Nutrients--When watersheds are clearcut, nutrient cycling is interrupted. Trees are a major source of uptake of minerals, and their harvest can increase the nutrient input into streams, but only for short periods. Streams that are limited in a particular nutrient may experience major increases in algal production if temperature, flow and light conditions permit (Chamberlin 1982).

Large Organic Debris--Excessive log jams and large debris may limit fish production in some streams by blocking spawning fish passage. Moderate amounts of logs and large debris provide rearing and resting pools for juvenile salmon, trout, and char.

Franklin et al. (1981) reported the following about in-stream logs: "Logs are critical to maintenance of physical and biological stability in headwater streams. Debris dams create stepped stream profiles that dissipate energy otherwise used for transporting sediment and lateral-cutting and downcutting of stream channels. Such dams, with their associated plunge pools and beds of trapped gravels and fine sediments, provide a range of habitats needed to maintain a full array of stream and stream margin organisms. Logs are an important source of energy in streams, and the bulk of the nitrogen supply of a stream comes from woody debris."

Stream Habitat--Clearcutting affects stream habitat and limits the abundance of rearing salmonids. Clearcut reaches of stream have fewer undercut banks, fewer pools, more riffle area, and less organic debris than undistrubed sections of stream (Murphy and Koski 1984 unpublished). Habitat reduction is presumably caused by crossstream yarding of logs which can destabilize or remove instream debris, and collapse undercut areas. Overzealous stream cleaning of logging residue after harvest also appears to be a major factor in reducing instream wood debris.

Large organic debris (LOD) such as root boles, logs, and accumulated or matted branches are important components of juvenile salmonid habitat in coastal streams and may regulate annual production and smolt yield. Fallen or windthrown trees are incorporated into stream channels where the hydralic action of water plunging over or moving around LOD scours out pools. Fish use these quiet areas to conserve energy and venture out to capture passing food items. The number of these foraging sites or refuge sites determines the density of juveniles (Bachman 1984).

LOD may be more important during winter. With decreasing water temperature, swimming performance declines, and fish seek shelter from floods by moving to deeper water and to recesses provided by LOD (Bustard 1975). Studies of winter habitat by Heifetz et al. (in press) found that fish used only that habitat during the winter that had LOD. Mason (1976) demonstrated that regardless of the size of the summer population of fish, the annual production in the form of smolt was directly related to the amount of winter habitat available.

Of great concern to fishery managers are the long-term (more than 40 years) effects on habitat. Swanson et al. (1974) suggested that large organic debris gradually disappears when the source of recruitment is removed and does not return to former levels until

100 years after cutting. Sedell and Triska (1976) indicate that 300 or more years may be required for levels of large oraganic debris to recover. Based on work by Murphy and Koski (1984 unpublished) and Elliott (unpublished), long-term loss of LOD could result in a 30-50 percent decrease in the abundance of rearing coho.

The Stream-Forest Interface: Managing the Riparian Zone--The riparian zone and stream ecosystem are closely linked: events that occur in the riparian zone can directly affect the status of the stream. The riparian zone provides nutrients and organic material that is utilized by a wide diversity of stream invertebrates. Large organic debris stabilizes stream channels, forms pools, undercuts banks, and provides concealment for juvenile salmonids. Tree canopies provide shade during the summer that limits high stream temperatures. There is also evidence that the timber canopy provides an insulative layer and can help moderate the effects of low winter temperatures. Riparian zones act as buffer or "filter" against sediment and debris.

Clearcutting to stream banks disturbs the relationship between riparian and stream ecosystems, and changes could be expressed in terms of salmonid production. Tschaplinski and Hartman (1983) found that logging to the streambank and leaving no buffer zone was detrimental to juvenile coho salmon. Culp and Davis (1983) concluded that buffer strips at least 10 meters wide are necessary to maintain normal levels of organic input and benthic detritus in coastal streams. They stated that all logging, including selective logging, must be prohibited in this zone.

In Southeast Alaska, Murphy and Koski (unpublished) reported that streams in clearcuts had more fry than streams in old growth, but streams with buffer strips, where trees were not removed, had more fry than either streams in clearcuts or in old growth. Murphy and Koski (unpublished) stated that clearcuts had the highest levels of algae and invertebrate biomass and greatest density of fry indicating that logging had caused increased productivity. Streams with buffer strips provide optimum habitat for fry and may benefit from increased productivity resulting from clearcutting upstream.

But within clearcut streams increased production of fry is nullified by established levels of winter habitat (Mason 1976), and since clearcuts have less LOD than undisturbed streams, the winter mortality would be expected to be greater. Buffer zones, on the other hand, optimize and in some cases can maximize the winter carrying capacity by providing more LOD and should capitalize on increased production in clearcuts. However, more research is needed on the links between clearcut production and smolt production before sound guidelines for LOD management can be developed.

In the interim, buffer zones are considered to be the most effective and reliable solution to the LOD problem and meet all criteria for maintaining the habitat requirements of salmonids.

Many of the factors which have been discussed in this report are difficult to measure because natural variation can often be greater than the variation caused by man. For example, if severe storms occur during the measurement period, small changes in suspended sediment concentration or streamflow as a result of roadbuilding or logging might go undetected. Natural variations in stream temperature are also a potential problem in identifying temperature changes resulting from man's activities.

In summary, man's activities in a watershed can adversely affect fish habitat. These activities (logging, road construction, etc.) can be compatible with the production of salmonid fishes only if adequate consideration is given to the aquatic environment during both planning and operational stages. Protection of fish-producing waters in conjunction with land use treatments is a responsibility which land managers must never overlook. Fishery biologists must help determine the type of protection necessary for each stream system, and foresters must plan timber harvest in that system to assure that the necessary protection is afforded.

Research Needs--Much is known in a general way about the effects of man's activities on fish habitat in Southeast Alaska. There is still need, however, to more precisely define cause and effect relationships between logging and fish habitat and populations. Continuing research is needed on relationships between logging activities and stream sedimentation, water temperature, and large organic debris in streams. Changes in these aspects of habitat must then be related to survival of eggs and the various age classes of young salmonids, growth rates of salmonids, invertebrate production, and time of smolt migration to sea. Research must also focus on long-term effects. It is the concensus of investigators that increases in stream productivity associated with logging will not be permanent and that a long-term loss of debris-formed habitat will cause a decline in coho abundance. Data are not yet available however. Until these aspects are more thoroughly investigated, the Alaska Department of Fish and Game and others are requesting that logging and road construction in the most productive fish-producing watersheds such as Kadashan in Tenakee Inlet be deferred.

Shellfish (crabs, clams, etc.)

During log dumping and rafting processes, bark is knocked from logs and sinks to the bottom, often in large quantities. This accumulation can greatly increase oxygen demand, resulting in

reduced populations of marine benthic organisms, (such as crabs, and other shellfish), and can also smother the bottom so thoroughly that repopulation by benthic forms is prevented.

Observations at several dump sites in Southeast Alaska showed that significant accumulations of organic debris may persist for long periods of time (Ellis 1970). Marine animals, including crabs and clams, were very scarce in some areas compared with nearby areas without log dump sites. In general, the impact of these log facilities depends on several conditions including the type and age of the facility and the characteristics of the water (depth, influence of tidal currents, etc.).

Water storage of logs also results in a release of soluble organic compounds (leachates) which further increases the oxygen demand in the storage area. Length of storage, species of logs stored, and various estuarine conditions all influence the effects on marine communities. Much remains to be learned about the effects of water-based log handling in Southeast Alaska. The economic as well as biological considerations involved in rafting and towing versus barging, for example, need to be determined. In general, any method which reduces the amount of bark and other log debris accumulating on the bottom is preferred.

Economic Contribution

Fisheries resources contribute substantially to the economic welfare of Southeast Alaska. Data from 1980 for finfish and shellfish show their ex-vessel value to the fishermen to be $66.5 million and their primary wholesale value to be $196.9 million (Table 4). The estimated value for sport fish angling in 1979 utilizing fish produced on the Tongass Forest was $3.7 million (Sullivan and Sheridan undated).

GUIDING

Guiding is a multi-faceted industry directly affected by forest management in Southeast Alaska. Guiding occurs for a number of activities, including hunting, fishing, marine cruising, kayaking, rafting, photography, aerial sight-seeing, and ice field travel. All are enhanced by an esthetically pleasing environment and without crowding and interaction with other people. Forest management affects guiding in that clearcut areas are generally considered to detract esthetically. Consequently, as more areas are clearcut, guiding tends to concentrate in undisturbed areas, with the potential to create overcrowding and increased human interaction.

Since big game guiding has a longer history and is more closely regulated than other types of guiding and since more information is available, it will be considered in more detail in this report. Big game guiding has been conducted in Southeast Alaska since the 1890's. It has continued as a viable industry since then, and guides today believe their long existence in Southeast Alaska entitles them to recognition when land management plans are considered.

Brown bears are the major species guided for in Southeast Alaska. Black bears and mountain goats are also guided for, and a very limited amount of guiding occurs for deer. Twenty-two Master and Registered Guides are licensed and actively guide in Southeast Alaska (Game Management Units 1-5). Most hire two or more Assistant Guides and other seasonal help.

State regulations require that hunters who are not residents of Alaska contract with a licensed guide for brown bear hunting. This, and the fact that many non-residents do not have the knowledge and equipment to hunt alone, results in most guided hunters being non-residents. The income brought into the state by non-residents is "outside" money and may add more to the overall state economy than money that is merely recirculated by resident hunters.

A recent survey (Beier 1984) estimates the revenue generated in the state annually by guided hunters. An average brown bear hunt lasts about 12 days and costs about $600 per day for guide fees. The total number of nonresident guided brown bear hunters averages about 70 per year (56 successful and an additional 20 percent unsuccessful). This totals $504,000 in guiding fees, $6,300 in hunting and sport fishing licenses, and $17,500 in brown bear tag fees for a total annual direct expenditure for guided brown bear hunting of $527,800. Air travel costs, taxidermy fees, and incidental expenditures are in addition. When expenditures for guided black bear and goat hunts are added to brown bear hunt expenditures, it is estimated that the Southeast Alaska guiding industry brings between $750,000 and $1,000,000 into the state each year.

Income from non-resident hunting licenses and big game tag sales is especially important as a source of revenue for the State Division of Game. For 1983, statewide non-resident hunting license and big game tag sales totalled nearly $2 million, in contrast to resident hunting license and big game tag fees which totalled $850,000. Hunting license and big game tag fees directly support Game Division programs and are especially important because they are the main source of matching funds for revenue from the Federal Aid in Wildlife Restoration Program ($1 from license sales can be matched with $3 from the Federal Aid Program).

Guides have consistently been on record that clearcutting is not compatible with guided hunting, especially for brown bears. A survey of guides conducted by Beier (1984), an experienced Assistant Guide for Southeast Alaska, spelled out the impact of logging on the guiding profession. Twenty Master and Registered Guides were sent questionnaires, and ten responded. All but one listed hunt esthetics as an extremely desirable aspect of guiding and said that clearcutting greatly decreased the esthetic appeal of an area. All respondants stated that they did not hunt in areas that had been or were being logged. Reasons given were esthetics and reduced bear populations in logged areas. Most guides listed a number of bays where they no longer guided because the bays had been logged.

At present, 13 guides have joint exclusive guiding use of Game Management Unit 4, Admiralty, Baranof, and Chichagof Islands. This unit follows the Alaska Peninsula and Kodiak Island game management units in number of brown bears produced. Because of logging and roading in Unit 4 and resulting reduction in hunting areas and numbers of bears, guides believe that the 13 guides licensed for Unit 4 should be reduced to six or less. The state Guide Board is presently working on a plan for such a reduction and criteria for new guide eligibility under a six guide limit. In effect, timber cutting activity to date, which is only a fraction of what is planned, has already threatened to severely reduce guiding in Southeast Alaska.

ECONOMICS OF TONGASS FOREST LOGGING

The history and economics of timber industry operations in Southeast Alaska are particularly significant for upcoming policy decisions. The 50-year contracts governing current logging in the Tongass have been questioned, and the prudence and legality of re-negotiating these agreements may, to a large extent, be determined by the history of resource and fiscal management by the timber companies concerned. The economic procedures for timber sale and harvest--vital to understanding the viability of the industry in Southeast Alaska--constitutes the remainder of the report. Timber sales in the Tongass, as in national forests throughout the nation, are conducted by the Federal Department of Agriculture through the auspices of the Forest Service. A complex system of setting timber prices, deducting harvest costs including roadbuilding, and lowering sale prices retroactively through rate "redeterminations," go to preserve industry profits while in effect providing a government subsidy. Forest Service figures for Alaska for 1983 show each dollar spent by the government for timber sales returned 2 cents in timber sales receipts (Emerson et al. 1984). Examining below-cost timber sales and the portion of industry expenses underwritten in this fashion by

public monies aids in interpreting the actual, long-term contribution by the timber industry to the area economy, especially given any uncertainty of continued funding support from the federal government.

The Economic Beneficiaries of Logging in Southeast Alaska

Two pulp producers, Alaska Lumber and Pulp (ALP) and Louisiana Pacific-Ketchikan (LPK), exercise predominant control over logging operations in Southeast Alaska, and presently employ approximately 2,000 workers (Alaska Department of Labor, pers. comm. 1984). Some work is seasonal and results in payment of unemployment benefits by the State of Alaska. In 1983, the State paid unemployment benefits of $4,004,594 to lumber, wood product, and pulp workers. A significant portion of timber industry workers are not Alaska residents; of the $4 million in unemployment benefits paid by the State to forest products workers in 1983, more than one-third was paid out-of-state (Alaska Department of Labor, pers. comm. 1983).

Among the other direct beneficiaries of logging in the Tongass--namely the primary consumers of sawtimber and pulp produced--are the Japanese. Virtually all the sawtimber taken from the Tongass Forest is currently being marketed overseas, while only a scant amount is being used locally. In addition to the sawtimber, Japan purchases ALP's entire production of pulp. Pulp produced by LPK is also marketed internationally through the "spot market," whereby nearly 50 percent is shipped to the Middle East (J. Mehrkens, U.S.F.S. economist, Juneau, pers. comm. 2/1/84).

Timber Sales and Pricing

The regional office of the U.S. Forest Service is charged with conducting Tongass timber sales. An admittedly complex system of setting timber prices, deducting harvest costs including road-building, and lowering sale prices retroactively through rate "redeterminations," ensure industry profits while in effect providing a large government subsidy. Details of the workings and abuses of the pricing system follow.

The purchase price paid by the timber industry for timber harvested from national forest land is calculated as a "stumpage fee." Stumpage fees paid to the U.S. government for Tongass timber are determined by subtracting industry production costs, including an allowance for profit and risk, from anticipated final product prices. Production costs deducted from the purchase price include numerous expenses, including a substantial sum for the construction of roads for transporting timber from cutting sites to the mill.

When production costs are high, as is the case of virtually all Tongass sales, the U.S. Forest Service absorbs a loss so as to ensure the profit of the timber corporations. A 1983 study reported that the Forest Service spent more than $375 million from 1970 to 1982 to make Tongass Forest timber available, while charging loggers less than $63 million (Wolf cited in Barlow 1983). Emerson et al. (1984) reported that for timber sales in Alaska in 1983, the Forest Service received only 2 cents back for every dollar it spent to make timber available for harvest.

Although such "below-cost sales," as they are termed, are currently legal under federal regulations, debate has begun in congressional committee (U.S. Congress 1983) as well as in several national publications as to the economic prudence of the practice. Since loss to the Forest Service on timber sales in Alaska is especially high as compared to other states (Emerson et al. 1984), the timber industry in this state is vulnerable to any redefinition of the Forest Service pricing system which would eliminate currently allowable losses.

Roadbuilding costs, as previously mentioned, are currently deducted by timber corporations from the price paid for the trees purchased in national forests. Yet this deduction alone is not enough to make logging economically feasible in the Tongass. The Alaska Lands Act guaranteed an additional $40 million annually--or as much as needed--to keep the timber industry "stable" in Southeast Alaska. This money can be used for "pre-roading," that is constructing access roads before sales to technologically marginal and low-volume timber stands and to LUD III drainages managed for biological and esthetic considerations as well as timber yield. Pre-road money can be used in both independent or short-term sale areas and in long-term sale areas.

Further Reductions of Timber Prices

Stumpage rates, the price paid to the government for timber cut from public lands, are redetermined for the two 50-year contracts every 5 years. In addition, these long-term contracts qualify for special "emergency rate redetermination" by which the selling price can be dropped retroactively for a period of up to 5 years so as to ensure industry profitability in the face of declining or unfavorable markets for the finished lumber and pulp products.

While rate redeterminations for industry benefit are awarded during a falling market, there is no reciprocal arrangement for rising market conditions. If the selling price of finished lumber and pulp products rise during the period of a contract sale, no adjustment is made. Consequently, only industry benefits from rising market conditions, while the federal treasury loses revenue retroactive from past timber sales when markets decline.

Emergency rate redeterminations, by reducing stumpage fees, substantially reduce receipts by the government for timber sales in the Tongass. Recent redeterminations were granted to the two 50-year contract holders, ALP and LPK, due to depressed market conditions for pulp and timber products. As an example, retroactive to July 1, 1982, ALP had the 1981-86 appraisal rate per thousand board feet reduced for spruce sawlogs from $215.98 to $2.26, and for Alaska cedar sawlogs from $1,058.27 to $1.22. For LPK the 1979-84 appraisal rate for spruce sawlogs was reduced from $114.96 to $2.87 per thousand board feet, retroactive to December 1, 1981.

Economic Disadvantages Placed on Small Timber Operations.

Under existing regulations small, independent logging operators are put at a substantial disadvantage by the system of awarding rate redeterminations. Sales of less than 7 year's duration are not eligible for emergency rate redeterminations, and only the long-term contract holders, LPK and ALP, can receive the retroactive discounts.

Small logging operators are further disadvantaged because they must pay cash stumpage deposits much sooner than ALP. This is because the sale area boundary in the ALP contract encompasses inlets and bays where logs can be stored, and small sale contract areas are restricted to land. Small sale operators must pay cash stumpage deposits after logs have been in the water for 30 days, and ALP can leave logs in the water indefinitely without paying stumpage deposits.

Weaknesses of the Current Pricing System

A major weakness of the current pricing system for timber sales on public lands is that it invites timber companies to devise schemes to show minimal final product returns so that the stumpage fees they pay for cutting will be calculated at the lowest possible value. The system also invites companies to inflate logging and mill costs to force final stumpage prices even lower. Court records in which ALP and LPK were convicted of antitrust violations show that both 50-year contract holders have committed these practices in the Tongass (Reid Brothers Logging Co. vs. Ketchikan Pulp Co. and Alaska Lumber and Pulp Co., 1981).

Since roadbuilding is a leading deduction from the sale price of timber on public lands, it is desirable to minimize roadbuilding. One option available to reduce the number of miles of road being built in the Tongass is simply to better utilize existing roads. There are several important advantages of this approach to management. First, the high cost of roadbuilding would be reduced, an expense which is passed on to the taxpayer when the timber industry deducts it from stumpage fees paid to the Forest Service for trees

cut. The Forest Service estimates that in LUD III areas an additional 60 percent of roads is necessary on the first entry to harvest the same volume of timber as could be harvested in the first entry on an area managed more intensively for timber. Government pre-road funds pay directly for this additional 60 percent of road contruction (USFS, TLMP, p. H-2 1979).

Another advantage of using existing roads rather than constructing new ones is that additional impacts to habitat can be confined to drainages that have already been disturbed, and road construction and logging can be deferred in undisturbed drainages with high fish and wildlife values.

In addition to direct funding for roadbuilding in LUD III and marginal stands, credits are awarded to timber companies for additional roads which they build for cutting and transport. These credits are reductions made in the price paid to the Forest Service for timber. These roadbuilding credits are awarded in lieu of actual receipts to the National Forest and listed as part of a system of collector and arterial roads. Such credits deducted from the purchase price of timber can be quite substantial. In Fiscal Year 1982, for example, the Forest Service reported that roadbuilding credits accounted for 67 percent of Tongass Forest receipts.

Actual payments for the purchase of timber by corporations in the form of stumpage fees proved, by contrast, rather inconsequential. For Tongass Forest timber cut in 1982 and valued at $21.5 million, only $2.5 million or 11.5 percent of the appraised market value was actually paid to the National Forest fund after reductions including deductions for roadbuilding expenses. Roads built by timber companies for which they have received purchaser credits revert to the Forest Service after timber harvest is complete. The Forest Service either maintains them or "puts them to bed" so they cannot be used, but could be put back into use at a future date.

In summary, the current method of calculating stumpage rates by deduction of expenses, as well as the additional federal funds supporting pre-roading, result in high government expense and consistently below-cost timber sales in the Tongass.

Antitrust Violations

In 1981, ALP and KPC (Ketchikan Pulp Company, now LPK) were found guilty in United States District Court of conspiracy in restraint of trade and attempt to monopolize in violation of the Sherman Antitrust Law (Reid Brothers vs. Ketchikan Pulp Co. and Alaska Lumber and Pulp Co. 1981). The Ninth Circuit Court of Appeals upheld this ruling, and the Supreme Court let lower court decisions stand. Evidence presented during the Reid Brothers lawsuit showed

that the two large companies deliberately forced small, independent operators out of business and kept other large companies from competing.

These antitrust violations in the Tongass have been further scrutinized during recent congressional oversight hearings headed by Representative James Weaver examining Tongass Forest timber industry practices (U.S Congress 1983). The hearing record includes testimony by Forest Service, Justice Department, and industry representatives. In addition, documents were introduced which summarized illegal and potentially illegal activities in the Tongass. What follows is a summary of the most telling testimony.

First, the Weaver hearings cited a report by a three-man Forest Service team to the Alaska Regional Forester reviewing the evidence presented during the Reid Brothers lawsuit.

Collusive bidding practices by ALP and KPC in effect eliminated competition between these two major companies. These companies also bid preclusively against other, often smaller companies to prevent them from operating profitably in Southeast Alaska, and thereby retained control of Tongass timber themselves. The review team acknowledged that the Forest Service had been aware of the preclusive bidding practices occurring from 1966-1975, but apparently had done little to discourage this collusion.

Beginning in 1975-78 another form of collusion became apparent, according to the Forest Service review team: ALP and KPC allegedly boycotted Tongass timber sales. This boycotting of sales resulted in lower stumpage prices to be paid by the corporations. The practice stands as evidence that widespread collusion in bidding practices have continued beyond the original citations.

ALP and KPC sold pulp and lumber to parent companies at less than fair market value, while parent companies sold supplies to mills at inflated prices. These practices resulted in the deliberate reporting of false profit figures. By reporting falsely lowered profits, the two corporations were awarded reduced stumpage fees--in effect paying less for the timber they had cut. In this way the federal government lost revenues through the fraudulent accounting of the long-term contract holders. In turn, the State of Alaska lost its 25 percent share of these federal receipts from Tongass timber sales.

Additionally, KPC sold cedar logs to ALP and presented fraudulent invoices to the Forest Service to further depress the price to be paid to the government. The logs were then sold in Japan and the true profits divided between the two companies. The basic appraisal process for determining stumpage rates was also abused when KPC used subterfuge in making payments to loggers, thereby lowering the price to be paid the Forest Service.

Forest Service Review Team Recommendations

Overall, the Forest Service review team has recommended sweeping reforms of timber management practices in the Tongass National Forest.

To remedy the losses incurred by state and federal treasuries as a result of illegal activities by the long-term contract holders, the Forest Service report recommended that the State of Alaska and the Internal Revenue Service should be informed of revenues due to them which were fraudulently withheld by the long-term contract holders in the Tongass. The review team further recommended that the Justice Department of the United States be informed of the extent of revenues fraudulently withheld from the government so that appropriate actions can be taken against the corporations.

The Forest Service review team also recommended that 5-year rate redeterminations be frozen until end product values and charges from parent to subsidiary were verified as acceptable.

The review team further stated that LPK and KPC gained monopoly power and thereby destroyed competition, resulting in damages to the U.S. treasury in the millions of dollars.

Most significantly, the Forest Service team recommended that ALP and KPC and their affiliates and co-conspirators be debarred and suspended from future timber sales on the Tongass Forest to allow re-establishment of competition. Debarment should coincide with remaining contract time on long-term sales, with provision to reevaluate debarment after 3 years and periodically thereafter.

The report goes on to analyze a series of problems with current timber management practices which adversely affect the Tongass. First, cutting is concentrated in high-volume stands, and those most easily accessible. Prices paid by the corporations are not determined on the basis of what is actually cut, however, but instead rely on appraised values for timber based on average figures for vast acreages. These averages assume balanced cutting between low-volume and high-volume timber classes within the sales area.

The practice of cutting disproportionately large amounts of prime timber while passing over lower-volume stands has several adverse consequences for the Tongass National Forest. First, the stumpage fees are actually less than should be paid for the timber cut due to the averaging involved in appraising market value. More importantly, the practice of cutting the prime timber first has an unnecessarily intense impact on that part of the forest most valuable as habitat.

A second timber management practice addressed in the Forest Service review team report is the role the 50-year contract holders are given to "pick and choose" the timber stands to be appraised for harvest in each 5-year period. Apparent abuses of this system include the refusal of low-volume stands as well as valuable salvage timber which has been simply left to rot while logging continues in high-volume stands. The report concluded that the practice of industry selection of sites unduly restricts the Forest Service and hinders proper management of the Tongass.

Finally, practices concerning how environmental consequences of a given timber sale are reported was called into question by the Forest Service review team. Under current management practices, a single Environmental Impact Statement can be filed covering hundreds of thousands of acres to be cut during a 5-year period. The review team concluded that such blanket Environmental Impact Statements and Environmental Assessment Reports do not allow truly sensitive areas the appropriate level of intensive resource management expertise.

Another finding of the Forest Service review team was that the volume of utility logs cut during the 1960-75 period was never properly charged to the ALP contract. Contract provisions required the Forest Service to charge this volume against the guaranteed sale volume but it was never done.

Forest Service Chief R. Max Peterson submitted for the Weaver oversight hearing record a listing of actions the Forest Service had taken on the recommendations of the Reid Brothers lawsuit review team. Some of the more significant actions are summarized in the following paragraphs. Some recommendations, notably those on long-term contract modifications, were not addressed, and it is assumed they have not been acted on.

With regard to the recommendation by the Reid Brothers lawsuit review team to freeze unresolved 5-year stumpage rate redeterminations, the Forest Service eventually decided that ALP and KPC qualified for emergency rate redeterminations, and rates were reduced substantially, as has been discussed elsewhere.

The recommendation that damages due the government be determined resulted in a draft plan to recover damages that was submitted to the Justice Department in late 1982. Potential damages due the government were $33.3 million inflicted before 1975 and $43.2-$48.2 million after 1975, for a total ranging from $76.5 million to $81.5 million.

In response to other recommendations, the Forest Service has taken some actions to tighten timber sale bid procedures.

Debarment action has not been taken against KPC and APC as recommended. The Justice Department's continuing investigation was given as the reason.

Justice Department Actions

A Justice Department representative, H.F. Furth, also testified at the Weaver oversight hearing. The Justice Department, after reviewing the Reid Brothers case, decided not to try to obtain antitrust injunctive relief or recover damages on behalf of the United States. The Department concluded that the economic power of the two companies derives principally from their operation of the only two pulp mills in Southeast Alaska and from their 50-year contracts with the Forest Service. Any antitrust remedy involving cancellation of long-term contracts would require evidence of more substantial, and more recent antitrust violations than Justice Department investigation uncovered. The Department also considered that a court would be reluctant to order any relief that might result in suspending the operations of either company's pulp mill, because that would result in unemployment. The Department concluded that there was no basis for criminal proceedings because the 5-year statute of limitations period had passed. With regard to recovering damages under antitrust laws, the Department concluded there was no basis because the 4-year statute of limitations period had passed.

Mr. Furth noted that the Civil Division of the Justice Department is still reviewing claims of the Forest Service against the companies based on fraud and breach of contract. The time period for filing a fraud lawsuit is longer than for an antitrust suit. Since stating that it had concluded antitrust investigations, the Justice Department in June 1983 said it had reconsidered and was once again investigating the activities of the two major companies and their subsidiaries. In May 1984, the press reported that the Justice Department had decided against filing antitrust lawsuits against ALP and LPK, even though the Department found aspects of the companies' operations "troubling" and was concerned that ALP documents had been destroyed days before investigators sought to review them.

Timber Supply and Demand Report

Section 706(a) of ANILCA states that the Secretary of Agriculture will monitor timber supply and demand in Southeast Alaska and report annually on the ability of the Tongass National Forest to meet the mandate of 4.5 billion board feet per decade being made available to industry. The executive summary of the 1983 timber supply and demand report (Mehrkens 1984) is as follows.

"Based on the findings of this report, the Secretary of Agriculture concludes the available land base on the Tongass National Forest will be sufficient to maintain the 4.5 billion board-foot timber supply per decade specified in Section 705(a) of ANILCA. Market demand continues as the predominant factor governing the timber use levels on the Tongass NF. On the supply side, measures to reduce timber production costs are being implemented. A sufficient backlog of sold and unharvested timber exists to operate mills at capacity. Market conditions and labor strikes, however, have substantially lowered operating rates. The short-term economic wellbeing of the timber industry depends on improved markets in Japan, and markets now opened in South Korea and the Peoples Republic of China. Greater international competition and cost cutting strategies will continue to characterize the timber industry.

The industry structure, existing capacity, and operating rates are nearly the same as last year--well below capacity. The timber market structure in Southeast Alaska largely reflects the timber management policies of the USDA Forest Service and its objectives to maintain community economic stability. It is primarily governed, however, by export market conditions and the degree of competition from other suppliers. Forest Service management alone has virtually no effect on market demands but must be responsive to export market prices because the value of the timber is based on derived demand.

In comparison to the Pacific Northwest and British Columbia, Alaska generally serves as a residual or last-in, first-out, supplier to Japan's construction timber market. Large adjustments in the supply of hemlock cants occurs as international prices rise and fall. Moreover, the degree of this adjustment is affected by the level of log exports from the Pacific Northwest.

Unlike the hemlock trade in construction grade timber, Alaska is an important supplier of Sitka spruce to the Japanese market, accounting for up to 68 percent of the total spruce trade from North America. Alaska spruce logs and cants are of higher quality and command premium prices.

The demand for forest products remains low; Japan continues to be the principal market for all Alaska wood products. China is the other major market, representing 6 percent of Alaska's log exports and 9 percent of the lumber exports in 1983. In 1983, Alaska's wood products

export trade declined 12 percent in value from 1982. This trend is similiar to what occurred in 1982 when lumber exports fell in both volume and value, yet coincided with an increase in volume and total value for log exports.

National Forest timber harvests have declined consistently since 1981. In FY 1983, 250.5 MMBF was harvested (including utiltity volume) down 33 percent from 1982 when 370.7 MMBF of timber was harvested. In 1983, the amount of timber offered for sale fell slightly, 3 percent, to 453.6/MMBF of which 343.5 MMBF was sold or released for harvest. For FY 1984, an estimated 475 MMBF will be offered to industry. An analysis of timber accomplishments shows a slightly higher proportion of high quality, old-growth stands (30-50 MBF/AC.) has been offered and sold than what was scheduled in TLMP. This better timber helped offset lower end-product values caused by market conditions.

In contrast, Southeast Alaska Native corporations and the Bureau of Indian Affairs have steadily increased their harvests from 13 percent of the total Southeast timber harvest in 1980 to 41 percent in 1983. Over the past 3 years (CY 1980-82), the Native timber harvest in Southeast Alaska has risen from an estimated 70.3 MMBF to 216.5 MMBF.

Southeast Alaska has imported logs from British Columbia which were surplus to their domestic manufacturing needs. The future of this trade is uncertain, but imports in 1984 are expected to continue at about the same level as 1983. Because of reduced demand, log imports from British Columbia and National Forest timber supplies, Native corporations have a non-marketable supply of pulp-grade timber. Consequently, the corporations exported as many of their pulp grade logs as possible during 1981 to 1983 or left this lower grade timber in the woods.

In addition to the trade displacement from British Columbia and a severe drop in the market, timber purchasers have bid on National Forest timber sales during favorable markets at rates substantially above appraisal prices. These factors have forced some companies in Alaska to stop operating, triggering contract defaults and potential bankruptcies. The Forest Service has implemented policies to help alleviate this problem, but not all operators have been able to take advantage of contract extensions or stumpage rate redeterminations.

Logging and roading costs have increased steadily over the last decade. The causes have been inflation, stricter environmental controls, a greater proportion of permanant or specified roads (designed and constructed to engineering specifications), and a management objective of dispersed harvests. This rise in costs has led the Forest Service to analyze cost saving measures based on harvest unit size, utilization requirements and road standards. The development of transportation system and timber transfer sites are major costs associated with harvesting Alaska's old growth forests. However, greater average costs are associated with harvesting and yarding systems. The declining costs in 1982 and 1983 reflect the effort to lay out sales along established road systems and reduced road standards.

Nearly half the timber available for harvest from the Tongass National Forest has been used to produce dissolving pulp. If Alaska's traditional world market for dissolving pulp continues to shrink, while remaining uncompetitive in domestic paper pulp markets, there will be additional upward costs pressures on all Southeast Alaska timber based industries. Unless a major new market can be found for Southeast Alaska's pulp grade logs and, to a lesser extent, western hemlock sawtimber, growth prospects for all of Alaska's timber based industries are dampened."

CONCLUSION

Despite the large size of Southeast Alaska's Tongass National Forest (16.9 million acres), only a small portion (4 percent) is considered to have commercially important timber. These timber areas, often near tidewater at low elevations, or along valley bottoms of major river drainages, provide critical habitat for fish and wildlife. It is on this small, but important, component of the Tongass Forest that the wildlife and fisheries/logging debate centers. Clearcutting, the method of timber harvest in Southeast Alaska, is permanently converting high-volume, old-growth forest with high wildlife values to second-growth forest of much less value to wildlife species dependent on old growth. Of special concern are long-term effects of scheduled cutting on Sitka black-tailed deer; present knowledge suggests that deer numbers in many popular hunting areas will be reduced 60-80 percent during the first rotational cutting period of approximately 100 years. Additional research is necessary to determine long-term effects on fish.

A major question to be addressed is whether a highly subsidized timber industry should be maintained in its present form on public lands in Southeast Alaska to provide jobs and support an export trade, considering the adverse impacts to wildlife and other values. It seems especially important to address this now when timber prices are depressed, timber harvest is at a low level, and communities have adjusted to some degree to these conditions. Employment alternatives to consider include increased timber harvest on Native lands, increased timber harvest and processing for use in Alaska by small, independent operators (perhaps subsidized to some degree), increased tourism, increased mining, and maintenance and perhaps expansion of various types of guiding.

LITERATURE CITED

Alaback, P. B. 1982. Dynamics of understory biomass in Sitka spruce-western hemlock forest of Southeast Alaska. Ecology 63:1932-1948.

Alaback, P. B., and J. C. Tappeiner II. 1984. Response of understory vegetation to thinning in the Sitka spruce-western hemlock forests of southeastern Alaska. Cooperative Study, Forestry Sciences Laboratory, Juneau, Alaska and Oregon State University, Corvallis.

Archibald, W. R. 1981. Grizzly bears and coastal development, with particular reference to intensive forestry. Unpublished Problem Analysis. B.C. Fish and Wildlife Branch, Victoria, British Columbia.

Bachman, R. W. 1956. The ecology of four North Idaho trout streams with references to the influence of forest road construction. M.S. thesis, Univ. Idaho, Moscow, Idaho.

Bachman, R. A. 1984. Foraging behavior of free-ranging wild and hatchery brown trout in a stream. Transactions of the American Fisheries Society. 113:1-32.

Barlow, T. J. 1984. Mandate for oblivion. Wilderness. Spring 1984.

Barrett, R. H. 1979. Admiralty Island deer study and the Juneau unit timber sale. Pages 114-132 in O. C. Wallmo and J. W. Schoen, eds. Sitka Black-tailed Deer: Proceedings of a Conference in Juneau, Alaska. U.S.D.A. Forest Service, Alaska Region, Juneau.

Beier, L. 1984. A history of guiding and survey of guides in Southeast Alaska. Unpublished report. 24 pp.

Berndt, H. W., and G. W. Swank. 1970. Forest land use and streamflow in central Oregon. U.S.D.A. Forest Service, Pac. Northwest Forest and Range Exper. Sta. Res. Paper PNW-93. Portland, Oregon.

Bjornn, T. C., M. A. Brusven, M. P. Molnan, J. H. Milligan, R. A. Klamt, E. Chacho, and C. Schaye. 1977. Transport of granitic sediment in streams and its effects on insects and fish. Completion Report Project B-036-IDA, Bulletin 17, Idaho Cooperative Fishery Research Unit, University of Idaho, Moscow, Idaho.

Bloom, A. M. 1978. Sitka black-tailed deer winter range in the Kadashan Bay area, Southeast Alaska. J. Wildl. Manage. 42:108-112.

Bormann, F. H., and G. E. Likens. 1979. Pattern and process in a forested ecosystem. Springer-Verlag, New York. 253 pp.

Braun, C. E., F. Hamerstron, T. Ray, and C. M. White. 1975. Conservation committee report on status of eagles. Wilson Bull. 87: 140-143.

Brown, G. W. 1970. Predicting the effects of clearcutting on stream temperatures. J. Soil and Water Conserv. 25:11-13.

Brown, G. W. 1971. Water temperature in small streams as influenced by environmental factors and logging. Pages 175-181 in Proceedings of a symposium on forest land uses and stream environments. Oregon State University, Corvallis, Oregon.

Bunnell, F. L. 1979. Deer-forest relationships on northern Vancouver Island. Pages 86-101 in O. C. Wallmo and J. W. Schoen, eds. Sitka Black-tailed deer: Proceedings of a conference in Juneau, Alaska. U.S.D.A. Forest Service, Alaska Region, Juneau.

Burns, J. W. 1972. Some effects of logging-associated road construction on northern California streams. Trans. Am. Fish. Soc. 101:1-17.

Chamberlin, T. W. 1982. Influence of forest and rangeland management on anadromous fish habitat in western North America. U.S.D.A. Forest Service Gen. Tech. Rep., PNW-136, Pac. N.W. For. Ran. Exp. Stn., Portland, Oregon.

Christner, Jere. 1981. Changes in peak streamflows from managed areas of the Willamette National Forest. U.S.D.A. Forest Service, Willamette National Forest, Watershed Staff. January 1981. 28 pp.

Coggins, G. C., and M. E. Ward. 1981. The law of wildlife management on the federal public lands. Oregon Law Review

Cook, G. 1984. The legal framework of forest management in Southeast Alaska. Unpublished report. 47 pp.

Cooper, A. C. 1965. The effects of transported stream sediments on the survival of sockeye and pink salmon eggs and alevins. Int. Pac. Salmon Fish. Comm. Bull. 18.

Craighead, F. L., E. L. Young, and R. D. Boertje. 1984. Stikine River moose study, wildlife evaluation of Stikine Iskut Dams. Final Rep. Alaskan Dep. Fish and Game. Juneau. 72 pp.

Craighead, J. J. 1977. A proposed delineation of critical grizzly bear habitat in the Yellowstone region. Bear Biology Association Monograph Series No.1. 20 pp.

Craighead, J. J., J. S. Sumner and G. B. Scaggs. 1982. A definitive system for analysis of grizzly bear habitat and other wilderness resources. Wildlife - Wildlands Institute monograph No.1. University of Montana. 277 pp.

Crouse, M. R., C. A. Callahan, K. W. Malueg, S. E. Dominguez. 1981. Effects of fine sediments on growth of juvenile coho salmon in laboratory streams. Trans. Amer. Fish. Soc. 110: 281-286.

Culp, J. M., and R. W. Davies. 1983. An assessment of the effects of streambank clear-cutting on macroinvertebrate communities in a managed watershed. Can. Tech. Rep. Fish. Aquat. Sci. 1208:xv + 115 p.

DeVos, A. 1952. The ecology and management of fishes and marten in Ontario. Ontario Department Lands Forest Tech. Bull. 90 pp.

Doerr, J. G. 1983. Home range size, movements and habitat use in two moose, Alces alces, populations in Southeastern Alaska. Can. Field Nat. 97(1):79-88.

Elliott, Steven T. 1983. The summer standing crop of juvenile coho salmon in Southeastern Alaska streams logged during the 1960's. The Alaskan Working Group on Cooperative Forestry - Fisheries Research. Sportsfish Division, Alaska Department of Fish and Game, November 1983. 7 pp.

Elliott, S. T. Unpublished. Effects of clearcutting on juvenile coho salmon and Dolly Varden in coastal streams of Southeast Alaska. Alaska Department of Fish and Game, Juneau, Alaska.

Ellis, R. J. 1970. Report on a study of effects of log rafting and dumping on marine fauna in Southeast Alaska, June 6-9, 1970. National Marine Fishery Service Auke Bay Laboratory, Auke Bay, Alaska.

Emerson, P., A. T. Stout, and D. Kloepfer. 1984. The feds can't see their losses in the trees. The Wall Street Journal, Nov. 14, 1984.

Erickson, A. W., B. M. Hansen, and J. J. Brueggiman. 1982. Black bear denning study, Mitkof Island, Alaska. Unpublished final rept. School of Fisheries, University of Washington, Seattle. 86 pp.

Fight, R., P. I. McNamee, L. D. Garrett, and N. C. Sonntagg. SAMM: Southeast Alaska multi-resource model--a conceptional simulation model for estimating impacts of forest management action in Southeast Alaska. U.S.D.A. Forest Service General Technical Report. PNW--in prep. Portland, Oregon.

Fox, J. L. 1983. Constraints on winter habitat selection by the mountain goat (Oreamnos americanus) in Alaska. Ph.D. Dissertation, College of Forest Resources, University of Washington, Seattle. 147 pp.

Franklin, J. F., K. Cromack, Jr., W. Denison, A. McKee, C. Maser, J. Sedall, F. Swanson, and G. Juday. 1981. Ecological characteristics of old-growth Douglas-fir forests. U.S.D.A. Forest Service Gen. Tech. Rep. PNW-118, 48 p. Pac. Northwest Forest and Range Exp. Stn., Portland, Oregon.

Gates, B. 1968. Deer food production in certain seral stages of the coast forest. M. Sc. Thesis, University of British Columbia, Vancouver. 105 pp.

Gibbons, D. R., and E. O. Salo. 1973. An annotated bibliography of the effects of logging on fish of the western United States and Canada. U.S.D.A. Forest Service General Technical Report PNW-10, Portland, Oregon.

Hall, E. R., and K. R. Kelson. 1959. The mammals of North America. Vol. II. Ronald Press Co. New York. 1083 pp.

Hanley, T. A., O. C. Wallmo, J. W. Schoen and M. D. Kirchhoff. 1983. Habitat relationships of Sitka black-tailed deer. Submitted as a chapter for the Wildlife Habitat Relationships Program, Region 10. Forest Service, Juneau.

Hansen, H. A. 1962. Canada geese of coastal Alaska. North American Wildlife Natural Resources Conf. Trans. 27:301-320.

Harbo, S. J. 1958. An investigation of mink in interior and Southeastern Alaska. M.S. Thesis. University of Alaska. 93 pp.

Harestad, A. S. 1979. Influences of forestry practices on dispersal of black-tailed deer. Ph.D. Thesis, University British Columbia, Vancouver. 179 pp.

Harris, A. H., O. K. Hutchison, W. R. Meehan, D. N. Swanston, A. F. Helmers, J. C. Hendee, T. M. Collins. 1974. The forest ecosystem of Southeast Alaska, 1. The setting. U.S.D.A. Forest Service General Technical Report PNW-12. Portland, Oregon. 40 pp.

Hartman, G. F., L.B. Holtby, and J. C. Scrivner. 1984. Seaward movement of coho salmon (Oncorhynchus kisutch) in Carnation Creek, an unstable coastal stream in British Columbia. Can. J. Fish. and Aquat. Sci. 39:588-597.

Hau, R. D. 1980. Effects of timber harvest in streamflow in the rain-dominated portion of the Pacific Northwest. In: Proceedings, workshop on scheduling timber harvest for hydrologic concerns; 1979 November 27-29; Portland, OR. Portland, OR: U.S. Dept. of Agriculture, Forest Service, Pacific Northwest Region; 1980. 45 p.

Hebert, D. M. 1979. Wildlife-forestry planning in the coastal forests of Vancouver Island. Pages 133-158 in O. C. Wallmo and J. W. Schoen, eds. Sitka Black-tailed Deer: Proceedings of a Conference in Juneau, Alaska. U.S.D.A. Forest Service, Alaska Region, Juneau.

Heintzleman, B. F. 1923. The standby timber resources of Alaska. West Coast Lumberman 44 (518): 102-103, 108.

Hodges, J. E., J. G. King, and F. C. Robards. 1979. Resurvey of the Bald eagle breeding population in Southeast Alaska. J. Wildl. Manage. 43 (1): 219-221.

Hoopes, D. T. 1982. Old-growth timber and wildlife management in Southeast Alaska: a question of balance. Trans. North American Wildlife and Natural Resources Conference 47:588-604.

Hundertmark, K. J., W. L. Eberhardt, and R. E. Ball. 1983. Winter habitat utilization by moose and mountain goats in the Chilkat Valley. Final Rep. Alaska Department Fish and Game. Juneau. 44 pp.

Hutchison, O. K., and V. J. LaBau. 1975. The forest ecosystem of Southeast Alaska, 9. Timber inventory, harvesting, marketing, and trends. U.S.D.A. Forest Service General Technical Report PNW-34. Portland, Oregon. 57 pp.

Jones, G. 1975. Aspects of the winter ecology of black-tailed deer (Odocoileus hemionus columbianus Richardson) on northern Vancouver Island. M. Sc. Thesis, University of British Columbia, Vancouver. 79 pp.

Johnson, L. 1980. Brown bear management in Southeastern Alaska. Pages 263-270 in C. J. Martinka and K. L. McArthur, eds. Bears - Their Biology and Management. Bear Biology Association Conference Series No.3.

Jonkel, C. 1977. Clearcut logging, Cabin Creek and the grizzly bear in Southeastern British Columbia, University of Montana BCP Spec. Rep. No. 11. 11 pp.

Kessler, W. B. 1982. Wildlife and second-growth forests of Southeast Alaska: problems and potential for management. U. S. Forest Service, Alaska Region Admin. Doc. No. 110.

Kirchhoff, M. D., J. W. Schoen, and O. C. Wallmo. 1983. Deer use in relation to forest clear-cut edges in Southeastern Alaska. J. Wildl. Manage. 47:497-501.

Koehler, G. M., and M. G. Hornocker. 1977. Fire effects on marten habitat in the Selway-Bitteroot Wilderness. J. Wildl. Manage. 41:500-505.

Koski, K. V. 1966. The survival of coho salmon (Oncorhynchus kisutch) from egg deposition to emergence in three Oregon coastal streams. M.S. thesis, Oregon State Univ., Corvallis, Oregon.

Koski, K. V., T. R. Merrell, and G. R. Snyder. 1983. Effectiveness of buffer strips in protecting fish habitat in small streams during clearcut logging in Southeast Alaska. NOAA, NMFS, Executive Summary. 13 pp.

Lebeda, C. S., and J. T. Ratti. 1983. Reproductive biology of Vancouver Canada geese on Admiralty Island, Alaska. J. Wildl. Manage. 47(2):297-305 pp.

Lensink, C., R. Skoog, and J. Buckley. 1955. Food habits of marten in interior Alaska and their significance. J. Wildl. Manage. 19(3):364-368.

Leopold, A. S., and R. H. Barrett. 1972. Implications for wildlife of the 1968 Juneau unit timber sale. A report to U.S. Plywood-Champion Papers, Inc.

Lindzey, F. G., and E. C. Meslow. 1977a. Population characteristics of black bears on an island in Washington. J. Wildl. Manage. 41(3):404-412.

Lindzey, F. G., and E. C. Meslow. 1977b. Home range and habitat use by black bears in Southwestern Washington. J. Wildl. Manage. 41(3):413-425.

Mace, R. D. 1983. The effects of a logging activity on grizzly bear movements. In E. C. Meslow, ed. Proc. Fifth International Conference on Bear Research and Management.

Marshall, W. H. 1951. Pine marten as a forest product. J. For. 49.

Mason, J. C. 1976. Response of underyearling coho salmon to supplemental feeding in a natural stream. J. Wildlife Management 40:775-788.

Matthews, J. W., and D. E. McKnight. 1982. Renewable resource commitments and conflicts in Southeast Alaska. Trans North American Wildlife and Natural Resources Conference 47:573-582.

McNeil, W. J., and W. H. Ahnell. 1964. Success of pink salmon relative to size of spawning gravel bed materials. U.S. Fish and Wildlife Service Spec. Sci. Rep. No. 469.

Meehan, W. R. 1970. Some effects of shade cover on stream temperature in Southeast Alaska. U.S.D.A. Forest Service Res. Note PNW-113, 9 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oregon.

Meehan, W. R. 1974. The forest ecosystem of Southeast Alaska. Vol. 3. Fish habitats. U.S.D.A. Forest Service Gen. Tech. Rep. PNW-15, 41 p., illus.

Meehan, W. R. 1974. The forest ecosystem of Southeast Alaska. Vol. 4. Wildlife habitats. U.S.D.A. For. Serv. Gen. Tech. Rep. PNN-16. 32 pp.

Mehrkens, J. R. 1983. Timber supply and demand 1982, U.S.D.A. Forest Service report, Alaska Region.

Mehrkens, J. R. 1984. Timber supply and demand 1983, U.S.D.A. Forest Service report, Alaska Region.

Mickelson, P. G. 1980. Statement of reasons for appeal of 1981-1986 Alaska Lumber and Pulp Timber Sale Operating Plan. Alaska Chapter of the Wildlife Society. 13 pp.

Miller, S., and D. McAllister. 1982. Den site characteristics of Prince William Sound black bears. Alaska Dept. Fish and Game. Anchorage. 11 pp. (mimeo).

Moring, J. R. 1975. The Alsea watershed study: Effects of logging in the aquatic resources of three headwater streams of the Alsea River, Oregon. Part II - Changes in environmental conditions. Fishery Research Report No. 9, Oregon Dept. Fish and Wildlife, Corvallis, OR. Dec. 1975. 39 pp.

Mundinger, J. G. 1984. Biology of the white-tailed deer in the coniferous forests of northwestern Montana. In Proceedings of a Symposium on Fish and Wildlife Relationships in Old-growth Forests.

Murphy, M. L. 1983. Fish kills of adult pink salmon and chum salmon in Southeastern Alaska. Unpubl. manuscript, Northwest and Alaska Fisheries Center, Auke Bay Laboratory, National Marine Fisheries Service, NOAA, Auke Bay, Alaska.

Murphy, M. L., and K. V. Koski. 1984. (Submitted to Canadian Journal of Fisheries and Aquatic Sciences.) Links between habitat, juvenile salmonids and effects of logging in Southeast Alaska.

Myren, R. T., and R. J. Ellis. In press. Evapotranspiration in forest succession and long-term effects upon fishery resources: a consideration for management of our old-growth forests. In Proceedings of a symposium an old-growth forest relationships, Juneau, Alaska.

Olson, S. T. 1979. The life and times of the black-tailed deer in Southeast Alaska. Pages 160-168 in O. C. Wallmo and J. W. Schoen, eds. Sitka black-tailed deer: Proceedings of a conference in Juneau, Alaska. USDA Forest Service, Alaska Region, Juneau.

Peterson, R. M. 1980. Responsive statement to statements of reason in support of appeal from approval of Alaska Lumber and Pulp Companies 1981-86 Timber Sale Operating Plan. U.S. Forest Service. 12 pp.

Phillips, R. W. 1971. Effects of sediments on the gravel environment and fish production. Pages 64-74 in Krygier, J. T. and J. D. Hall, editors. Forest land uses and stream environments. Continuing Educ. Publ., Oregon State University, Corvallis, Oregon.

Poelker, R. J., and H. D. Hartwell. 1973. Black bears of Washington. Washington State Game Department Bull. 14. 180 pp.

Reiser, D. W., and T. C. Bjornn. 1979. Habitat requirements of anadromous salmonids. USDA Forest Service Pacific Northwest Forest and Range Exp. Sta. Gen. Tech. Rpt. PNW-96. Portland, Oregon.

Rideout, D., E. S. Miyata, and E. Olson. 1984. A statistical profile of the timber supply base of the Tongass area in Southeast Alaska. Colorado State University, Fort Colins. 131 pp.

Rose, C. L. 1982. Deer response to forest succession on Annette Island, Southeast Alaska. M.S. Thesis University of Alaska.

Rothacher, J. 1970. Increases in water yield following clear-cut logging in the Pacific Northwest. Water Resource Research 6:653-658.

Rothacher, J. 1971. Regimes of streamflow and their modification by logging. In Proc. Symp. Forest Land Uses and Stream Environment. pp. 40-54. Oregon State University, Corvallis.

Russell, D. 1974. Grizzly bear-mountain goat investigations in Knight Inlet, B.C. Project report B.C. Fish and Wildlife Branch, Victoria. 72 pp.

Schoen, J. W., and O. C. Wallmo. 1979. Timber management and deer in Southeast Alaska: current problems and research direction. Pages 69-85 in O. C. Wallmo and J. W. Schoen, eds. Sitka black-tailed deer: Proceedings of a conference in Juneau, Alaska. U.S.D.A. Forest Service, Alaska Region.

Schoen, J. W., and O. C. Wallmo and M. D. Kirchhoff. 1981. Wildlife-forest relationships: is a reevaluation of old-growth necessary? Trans. N. Amer. Wildl. and Nat. Resources Conf. 46:531-545.

Schoen, J. W. 1982. Brown bear habitat preference and brown bear logging and mining relationships in Southeast Alaska. Alaska Department Fish and Game, Federal Aid in Wildlife Rest. Vol. I. Prog. Rep. Proj. W-22-1 Juneau. 44 pp.

Schoen, J. W., and M. D. Kirchhoff. 1982. Habitat use by mountain goats in Southeast Alaska. Alaska Department Fish and Game, Federal Aid in Wildlife Rest. Final Rep. Proj. W-17-10, W-17-11, W-21-1 and W-21-2. Juneau. 67 pp.

Schoen, J. W., and L. R. Beier. 1983. Brown bear habitat preference and brown bear logging and mining relationships in Southeast Alaska. Alaska Department Fish and Game, Federal Aid in Wildlife Rest. Vol. II. Prog. Rep. Proj. W-22-2, Juneau. 37 pp.

Schoen, J. W., and M. D. Kirchhoff. 1983. Seasonal distribution and habitat use by Sitka black-tailed deer in southeastern Alaska. Alaska Department of Fish and Game, Federal Aid in Wildlife Rest. Vol. IV. Prog. Rep. Proj. W-211, Juneau. 50 pp.

Schoen, J. W., M. D. Kirchhoff, and O. C. Wallmo. 1984. Sitka black-tailed deer, old-growth forest relationships in Southeast Alaska: Implications for management. In Proceedings of a symposium on fish and wildlife relationships in old-growth forests.

Schoen, J. W., and M. D. Kirchhoff. 1984. Seasonal distributional habitat use by Sitka black-tailed deer in Southeast Alaska. Alaska Department of Fish and Game, Federal Aid in Wildlife Rest. Vol. V. Prog. Rep. Proj. W-22-2. Juneau. 25 pp.

Schoen, J. W., M. D. Kirchhoff, and M. H. Thomas. 1985. Seasonal distribution and habitat use by Sitka black-tailed deer in Southeastern Alaska. Alaska Federal Aid in Wildlife Restoration Final Report.

Scrivner, J. C., and B. C. Andersen. 1984. Logging impacts and some mechanisms that determine the size and summer population of coho salmon fry (Oncorhynchus kisutch) in Carnation Creek, British Columbia. Can. J. Fish. Aquat. Sci. 41:1097-1105.

Sealaska, 1982. Sealaska Corporation resource atlas, Vols. I and II. Sealaska Natural Resources Department, Juneau.

Sedell, J. R., and F. J. Triska. 1977. Biological consequences of large organic debris in northwest streams. In: Logging debris II, Applications of stream cleanup. Oregon State Univ., Corvallis, Oregon.

Seton, 1929. Lives of game animals. Vol. II, part I. New York: Doubleday Doran and Co. 367 pp.

Sheridan, W. L., and A. M. Bloom. 1975. Effects of canopy removal on temperatures of some small streams in Southeast Alaska. U.S.D.A. Forest Service Adm. Report. R-10.

Sigler, J. W., T. C. Bjornn, and F. H. Everest. 1984. Effects of chronic turbidity on density and growth of steelhead trout and coho salmon. Trans. Amer. Fish. Soc. 113:142-150.

Smith, B. 1978. Investigations into black and grizzly bear responses to coastal logging. Undergraduate thesis. Simon Fraser University. 85 pp.

Smith, C., K. Kohrt, B. Baker, J. Sturgeon, M. Barton, R. Harris. 1983. Deer and timber management in Southeast Alaska-issues and recommendations. Technical Committee Report. Wildlife Society, Society of American Foresters, State of Alaska, U.S.D.A. Forest Service, Sealaska Corporation. 44 pp.

Smith, C. A., and K. J. Raedeke. 1982. Group size and movements of a dispersed, low density goat population with comments on inbreeding and human impacts. Proc. North. Wild Sheep and Goat Counc., Ft. Collins, Colorado.

Smith, C. A. 1983. Habitat use by mountain goats in southeastern Alaska. Alaska Dep. Fish and Game, Fed. Aid in Wildlife Rest. Proj. W-22-1. Juneau. 88 pp.

Smith, O. R. 1940. Placer silt and its relation to salmon and trout on the Pacific coast. Trans. Amer. Fish. Soc. 69: 225-230.

Soutiere, E. C. 1979. Effects of timber harvesting on marten in Maine. J. Wildl. Manage. 43 (4):850-860.

Stalmaster, M. V., and J. R. Newman. 1979. Perch site preferences of wintering bald eagles in Northwest Washington. J. Wildl. Manage. 43(1):221-224.

Sullivan, E., and W. L. Sheridan. Undated. Sport fisheries of the Tongass and Chugach National Forests--An evaluation. U.S.D.A. Forest Service Alaska Region Report No. 128.

Swanson, F. J., G. W. Lienkaemper, and J. R. Sedell. 1976. History, physical effects, and management implications of large organic debris in western Oregon streams. U.S.D.A. for. Serv. Gen. Tech. Rep. PNW-56, Pac. NW. For. Ran. Exp. Stn., Portland, Oregon.

Tappel, P. D. and T. C. Bjornn. 1983. A new method of relating size of spawning gravel to salmonid embryo survival. North American Journal of Fisheries Management. 3:123-135.

Tschaplinski, P. J., and G. F. Hartman. 1983. Winter distribution of juvenile coho salmon (Oncorhynchus kisutch) before and after logging in Carnation Creek, British Columbia, and some implications for overwinter survival. Can. J. Fish. Aquat. Sci. 40:452-461.

Tuber, R., and K. Raedeke. 1980b. Black-tailed deer of the Olympic National Forest. Final Rept. to U.S.D.A. Forest Service, Olympic National Forest. Wildlife Science Group, college of Forest Resources, University Washington Seattle. 90 pp.

Tyler, R. W., and D. R. Gibbons. 1973. Observations of the effects of logging on salmon-producing tributaries of the Staney Creek watershed and the Thorne River watershed and of logging in the Sitka District. Final report, Part I, July 1, 1972-June 30, 1973. Alaska Loggers Association. 58 pp.

U.S. Congress. 1983. Timber industry practices in the Tongass National Forest, Alaska. Oversight Hearing before the Sub-committee on Mining, Forest Management, and Bonneville Power Administration of the Committee on Interior and Insular Affairs, House of Representatives, 98th Congress. Serial No. 98-19, U.S. Government Printing Office. 410 pp.

U.S. Forest Service. 1978. Tongass land management plan: wildlife task force working report. U.S.D.A. Forest Service Alaska Region.

U.S. Forest Service. 1979. Tongass land management plan. Final Environmental Impact Statement. U.S.D.A. Forest Service Alaska Region.

U.S. Forest Service. 1983. Alaska regional guide and final environmental impact statement. U.S.D.A. Forest Service Alaska Region Reports 126(a) and 126(b).

U.S. Forest Service. 1984. Tongass land management plan evaluation report. U.S.D.A. Forest Service Alaska Region Admin. Doc. 139.

Wallmo, O. C., and J. W. Schoen. 1980. Response of deer to secondary forest succession in Southeast Alaska. For. Sci. 26:448-462.

Weger, E. 1977. Evaluation of winter use of second-growth stands. B.S. Thesis, University British Columbia, Vancouver. 42 pp.