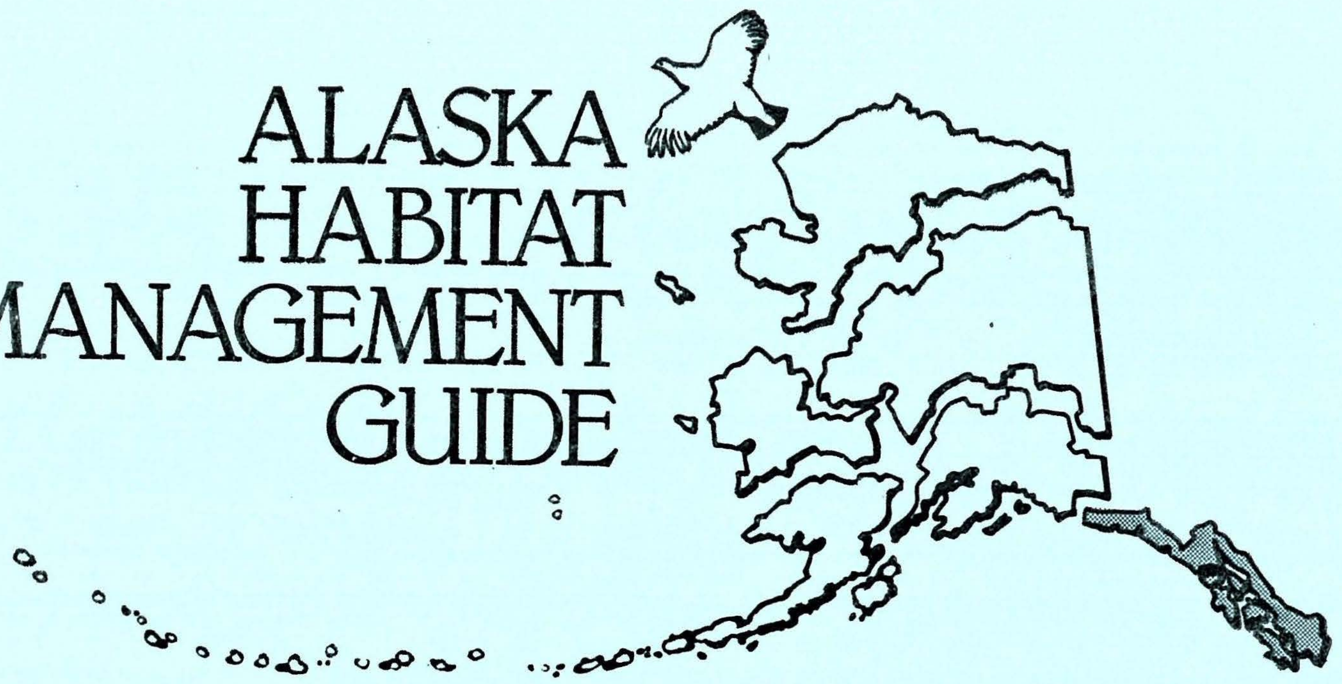
ALASKA HABITAT MANAGEMENT GUIDE



SOUTHEAST REGION: FISH AND WILDLIFE RESOURCES

Produced by
State of Alaska Department of Fish and Game
Division of Habitat

Juneau, Alaska

1986

A Compilation of Technical Reports Previously Published for the Southeast Region

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Contents

Overview of Habitat Management Guides Project

Background

Alaska is an immense and bountiful frontier, and until just recently it was all but inconceivable that we would ever need to worry about its capacity to sustain the wealth of fish and wildlife resources for which it is renowned. But the impetus of progress has not abated, and the pressure to develop our lands and waters intensifies daily. Every year more lands in Alaska are being proposed for uses other than as wildlife habitat, especially around cities, towns, and villages. These proposed uses include logging, mining, hydroelectric projects, agriculture, settlement, geothermal development, and oil and gas leases, among others. As the number of proposals and plans for development continues to increase, so does the need to carefully and efficiently evaluate their possible effects upon species and habitats and to recommend viable managerial options to guarantee that our valuable fish and wildlife resources and habitats are adequately protected and maintained. By using appropriate planning and managerial techniques most of the potential for damage and loss of access for human use can be avoided.

One of the responsibilities of the Alaska Department of Fish and Game (ADF&G) is to assist land managers by recommending to them the best ways and means, based upon the best available data, for protecting local fish, wildlife, and habitats against adverse effects and impacts. Because many proposals and plans for development and land uses require a rapid response from the department, there may not be enough time for staff to actually study the specific area in which the proposed development is to occur. However, the department still needs to accumulate and assess a wide variety of information in order to prepare recommendations for managing habitat. Therefore, the department initiated the Alaska Habitat Management Guides (AHMG) project to prepare reports of the kinds of information upon which its recommendations must be founded in order to responsibly and rapidly address land and water use proposals made by land managers. These guides are a major undertaking and will be of inestimable value to the state in its efforts to avoid or mitigate adverse impacts to Alaska's great wealth of fish and wildlife.

Purpose

This project presents the best available information on selected fish and wildlife species: mapping and discussing their geographical distribution; assessing their relative abundance; describing their life functions and habitat requirements; identifying the human uses made of them, including harvest patterns of rural communities; and describing their role in the state's economy. This last kind of information, because of the variety of values humans place upon fish and wildlife, is not easily derived. There are, however, several methods to estimate some of the economic values associated with these resources, and such estimates have become particularly important in land use planning because many potentially conflicting uses must be evaluated in economic terms.

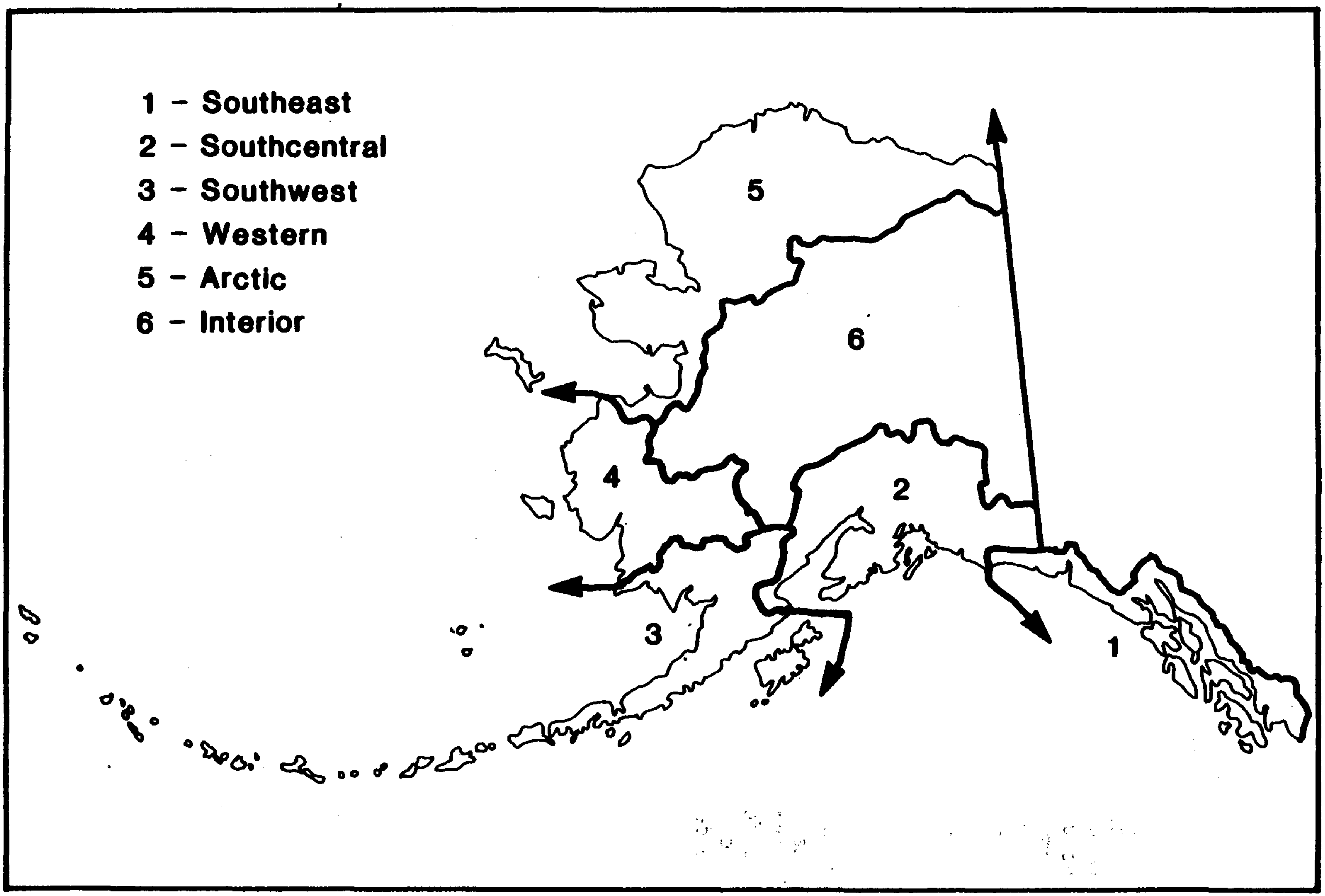
Essential to assessing what might happen to fish and wildlife if their habitats are altered is information about what effects or impacts are typically associated with particular kinds of developmental activities. The habitat management guides therefore also provide summaries of these known effects. This information, in conjunction with compiled life history information, will allow those concerned to estimate how sensitive a given species might be to a specific proposed activity - whether or not, and to what degree, the fish and wildlife are liable to be impacted. The guidance offered (a compilation of existing options for habitat management) is not site-specific. Rather, it is general information available to those who seek to avoid adverse impacts without placing undue restraints upon other land and water uses.

The completed guides coverage of fish and wildlife resources encompasses the Fish and Game Resource Management Regions established by the Joint Board of Fisheries and Game (map 1). These regions provide the most inclusive and consistent format for presenting information about fish and wildlife resources and relating it to management activities and data collection efforts within the department.

Applications

The choice of the term "guides" rather than "plans" for the reports is consistent with the largely advisory role of the department with respect to land management issues. The guides will provide the department as well as other state, federal, and private land managers with information necessary for the development of land and water use plans. Thus, the guides themselves are not land management plans and do not provide for the allocation or enhancement of fish and wildlife. Information included in a guide will be used by the department's staff in their involvement in the land use planning endeavors of various land managers. For specific land use planning efforts, the department joins with other agencies to recommend particular uses of Alaska's lands and waters, as for example in plans by the Department of Natural Resources (Susitna Area Plan, Tanana Basin Area Plan, Southeast Tidelands Area Plan). The public, by means of the public review that is an integral part of land management agencies' planning processes, then has an opportunity to evaluate any recommendations made by the ADF&G that are incorporated by the land-managing agency.

The guides have been designed to provide users with interrelated subject areas that can be applied to specific questions regarding habitat management. Each type of data will be presented in a separate volume, as indicated in figure 1. Material from the project's database can be used,



Map 1. The six regions of the Alaska Habitat Management Guides.

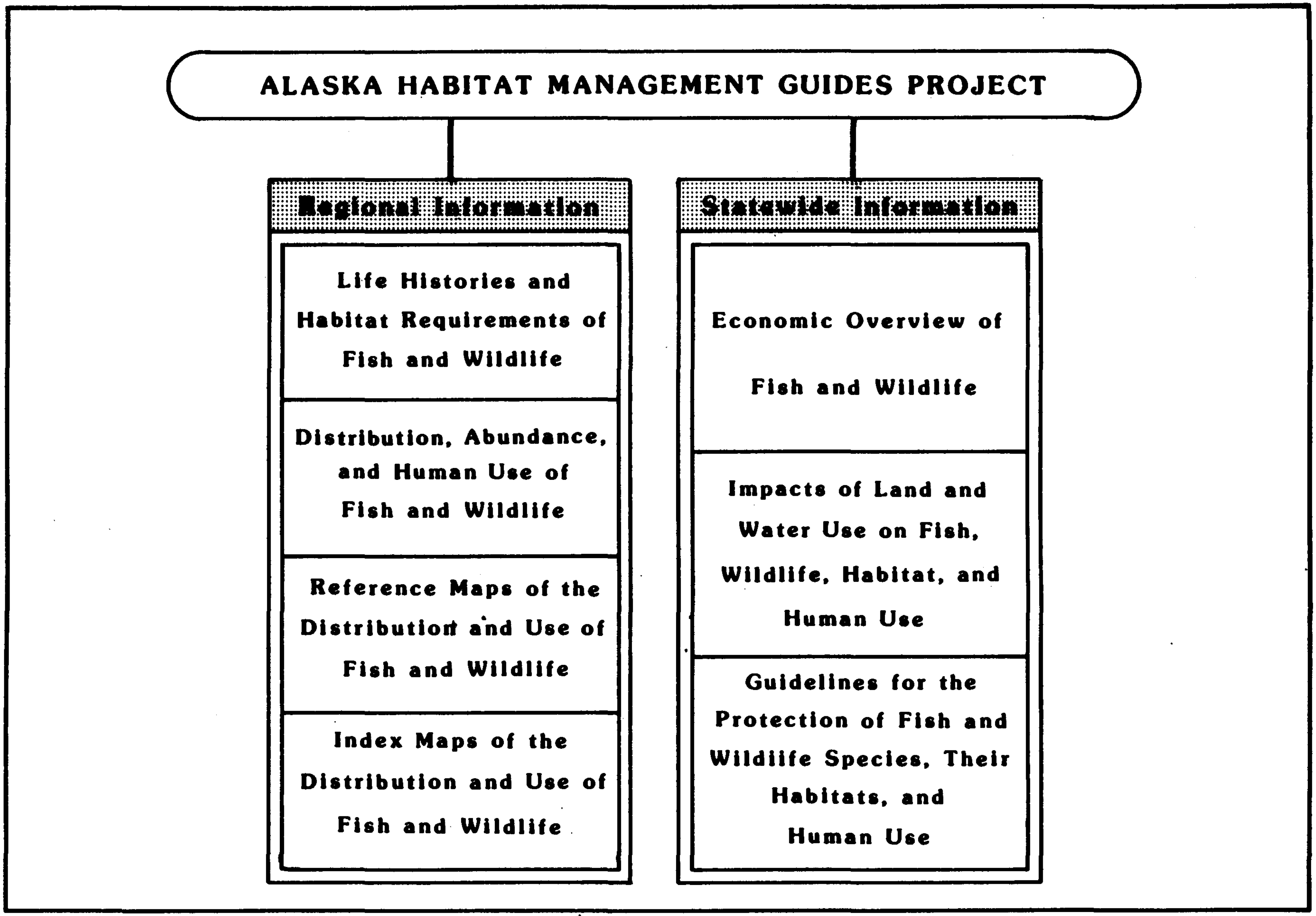


Figure 1. Types of narratives and maps produced by the Alaska Habitat Management Guides Project.

for example, to correlate information on species' seasonal and geographic habitat use with the written and mapped information on known distribution and abundance. The narratives and maps regarding human uses of fish and wildlife can be compared with abundance and distribution information to obtain an indication of the overall regional patterns of distribution, abundance, and human use for the species of interest. The specific information on habitat requirements also will relate directly to the information on impacts associated with land and water use. This in turn will form the basis for the development of habitat management guidance.

An additional purpose of this project is to identify gaps in the information available on species, human uses, and associated impacts. A particular species, for example, may be known to use certain habitats during certain seasons; yet information on the timing of these use patterns may be inadequate. In general, there is little documentation of impacts from land and water uses on species' habitats and on the human use of those species or on the economic values associated with the use of fish and wildlife resources.

To maintain their usefulness these habitat management guides are designed to be periodically updated as new research and habitat management options are reported to fill data gaps. Users of these guides are advised to consult with the appropriate species experts and area biologists, however, to check on the availability of more recent information.

Statewide Guides Volumes

The guides reports on impacts and guidance are being developed as statewide volumes, in which information is presented for statewide as well as for specific regional concerns. The statewide volume on impacts summarizes the effects of major types of development activities and land and water uses on fish and wildlife, their habitats, and their use by people. The activities discussed will be those actually occurring in the state or expected to occur in the future. This survey of impacts will be founded upon the most recent pertinent literature and upon the information presented in the species life histories and habitat requirements. The guidance volume will in turn be a synthesis of information based upon the impacts literature and the life history and habitat requirements information.

The following uses of land and water resources and types of development occur or are likely to occur in Alaska, and they will therefore be addressed in the statewide impacts and guidance volumes:

- Oil and gas development
- Harbors and shoreline structures
- Water development

- Placer mining
- Strip and open pit mining
- Underground mining
- Seafood processing
- Logging and timber processing
- Transportation - road, rail, air
- Transmission corridors
- Grain and hay farming
- Pipelines
- Geothermal energy development
- Settlement
- Fire management
- Offshore prospecting and mining
- Commercial fishing

A statewide volume is being developed to provide an overview of the regional economies, especially in regards to uses of fish and wildlife within each region. The necessary data on the fish and wildlife related sector will be by no means complete but will nevertheless afford a conservative estimate of such values within the regions. Economic data on commercial fisheries, for example, are relatively well documented. In those regions with significant commercial fishing activity, the relative value of fish and wildlife will be better represented. However, continuing effort is being made by the department and other agencies to improve the capability of accurately describing the socioeconomic importance of fish and wildlife to the people both within and outside the State of Alaska.

A separate statewide volume describing the life history and habitat requirements of selected fish and wildlife species is being prepared region by region; therefore the information in the Arctic guide addresses the species requirements in the Arctic, Southwest, and Southcentral regions, and also in the Western and Interior regions for belukha and bowhead whales, Pacific walrus, polar bear, and caribou. Other information will be added as reports are prepared for the remaining regions.

Impacts of Clearcut Logging on the Fish and Wildlife Resources of Southeast Alaska

Editor: Marilyn J. Sigman

Technical Report 85-3

Alaska Department of Fish and Game
Habitat Division
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PART I

The Impacts of Clearcut Logging on the Wildlife Resources of Southeast Alaska

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INTRODUCTION

Logging, as currently practiced and planned in southeast Alaska, has the potential to significantly and permanently alter large amounts of wildlife habitat. Wildlife species which are adapted to use existing habitat may decline and associated recreational and subsistence uses may be substantially reduced.

Clearcut logging, with no post-logging treatment, is generally the primary type of silvicultural system in southeast Alaska. The Forest Service is currently interpreting the Alaska National Interest Lands Conservation Act (ANILCA) as a mandate to offer for harvest 450 MMbf of timber yearly, which will result in the scheduling of an average of 158,000 acres of old growth for timber harvest during this decade alone. Once cut, stands will be managed on a multiple-entry rotation schedule of 80-125 years. Thus, old-growth stands on federal lands will be permanently converted to second-growth stands. While second-growth trees will reach maturity prior to subsequent harvest, many of the forest stand characteristics which develop in older stands will not recur. The major long-term impacts of this harvest schedule on wildlife species and numbers will depend on how the habitat characteristics will be altered through forest management relative to the species' habitat requirements. Significant timber harvests are also occurring on state and privately-owned lands.

Human activities associated with logging can also have both significant short-term and long-term effects on wildlife populations. Roads will be built in roadless areas, camps and facilities will be established, and accessibility to wildlife populations will increase dramatically. Harvest rates and human encounters with animals which are sensitive to human disturbance, such as mountain goat, brown bear and wolf, will increase.

The habitat requirements of many wildlife species in southeast Alaska are not well known. However, evidence is mounting that a number of species present in southeast Alaska are dependent on old-growth, spruce-hemlock forest for their survival. Extensive research has been conducted on the Sitka black-tailed deer (*Odocoileus hemionus sitkensis*) in southeast Alaska and other areas of its range. Certain types of old-growth stands provide critical winter habitat for the animals during severe winters and largely determine carrying capacity. Research in southeast Alaska has also documented the importance of old-growth forests to mountain goats (*Oreamnus americanus*), black and brown bears (*Ursus americanus* and *U. arctos*, respectively), moose (*Alces alces*), several furbearer species, cavity-nesting forest birds, bald eagles (*Haliaeetus leucocephalus*), Vancouver Canada geese (*Branta canadensis fulva*), and blue grouse (*Dendragapus obscurus*). Concern is growing over the rate at which old-growth forest is being converted into second growth and the likely impacts on wildlife populations.

GENERAL RELATIONSHIP OF WILDLIFE TO THEIR HABITAT

Wildlife habitat requirements can be generalized as food, water, cover, and special requirements such as those needed for breeding or denning areas, or migratory routes. Cover is essential for prey animals (e.g. deer), providing areas to hide from predators (e.g. wolves) or for a more sheltered environment from winds and deep snowfall. Food, breeding, and denning areas are extremely variable requirements, ranging from the needs of a tree cavity-nesting, insect-eating bird to that of a black bear that dens and gives birth in a hollow tree, then forages throughout the forest from spring through fall.

To determine how many animals a specific land area can support requires the determination of habitat requirements for each species and the interactions of the different species. The number of animals of a single species that can be supported is ultimately limited by whichever of its habitat requirements is in lowest supply, unless predation or disease has a severe impact on the population levels. This limiting factor will be different for different species. For example, deer numbers may be limited by the amount of nutritious, abundant food present while woodpecker numbers may be limited by the number of suitable nesting cavities present. Numbers of predators, such as wolves, may be indirectly limited by the same factors which limit the numbers of their prey species. The effects of a limiting factor can vary as well. Deer and wolves that cannot get enough food die of starvation and/or fail to reproduce; woodpeckers fail to nest and reproduce or move to another area where they search for unoccupied nesting holes. Over time, animal population numbers fluctuate as animals are born and die, but the amount and quality of habitat ultimately determines the upper limit of animals that can be supported by a given area. As habitat is altered, this upper limit, or carrying capacity, is also altered.

Although it is not always possible to determine the exact habitat requirements of all species, one general rule of ecology is that more species can be supported by a habitat with a diversity of conditions than one that is more homogeneous. Habitat diversity provides a variety of conditions which can meet the requirements of many wildlife species.

One primary type of diversity is structural diversity. Layers of vegetation contribute to structural diversity. In the forest, trees provide vertical structural diversity. A stand of trees can significantly modify the climate within the stand by intercepting snow and serving to break the force of winds. The trees provide a number of niches for animals that live or breed in tree cavities, feed on bark and leaves, den in dead, hollow logs, or use the tree foliage as cover for hiding from danger. Plants growing on the ground and litter fall from the trees add to diversity, providing more abundant and varied winter foods for browsing and grazing animals than may be available in open areas that have deep snow accumulations. Shrubs add another layer of structural diversity, providing different food sources, nesting habitat, and better cover. The structural complexity of an area may satisfy a diversity of habitat requirements. A second important type of diversity is provided by the spatial distribution of different habitat types referred to as "patch diversity." Areas with different plants or structural diversity in close proximity can support animals that require more than one habitat type to meet all its survival needs. The pattern of habitat interspersion is a key consideration of habitat diversity, however the productivity of each habitat type must also be considered.

DESCRIPTION OF OLD-GROWTH FORESTS AND SERAL STAGES FOLLOWING CLEARCUTTING

OLD-GROWTH FORESTS

The term "old growth" refers to uneven-aged forests that have developed without major disturbance over a period of centuries. Old growth is an ecological concept related to composition, structure, and function of a forest stand that has reached its climax stage (Franklin et al. 1981).

Sitka spruce (Picea sitchensis) and western hemlock (Tsuga heterophylla) dominate the old-growth forest overstory in southeast Alaska. On some less productive sites, mountain hemlock (Tsuga mertensiana), western red cedar (Thuja plicata), and/or Alaska cedar (Chamaecyparis nootkatensis) may also exist as associate species. The understory of old growth is composed of shade tolerant conifer seedlings, saplings, and small trees in a wide range of size classes, plus diverse shrub, fern, herb, bryophyte, and lichen species (Alaback 1982). Many wildlife species find their optimum habitat either year-round or seasonally in old-growth forest.

An evaluation of the structural components of old-growth provides considerable insight into why it is preferred habitat of many species. Structurally, old-growth forests are characterized by the presence of large (greater than 3 foot diameter) trees, snags, and fallen logs on land and in streams; an uneven-size and aged forest stand composition; well-developed, multi-storied canopies with large diameter limbs and large overstory crown radii; diverse, and often patchy, shrub and herb understory; and snags, fallen logs, and dying standing trees in a variety of stages of decomposition (Franklin et al. 1981, Schoen et al. 1981, Alaback 1982). No other stage of forest succession provides these characteristics.

The functional qualities of old-growth forests have been summarized by the Society of American Foresters Task Force on Scheduling the Harvest of Old-Growth Timber (SAF 1984). The standing crop of wood fiber in climax forests remains stable or increases slowly over centuries with net primary production offsetting mortalities. The proportion of shade tolerant species may increase with time, and in southeast Alaska, spruce may comprise less than one tree/acre in some old-growth stands (Alaback 1982). Erosion and nutrient losses are lower in old-growth forests than other successional stages; water quality in streams associated with old growth is typically high. Old-growth forests are generally prolific conifer seed producers. Old growth, with its multi-layered canopy, allows enough light to reach the forest floor so that understory production is high, while intercepting sufficient snow to make that forage available to herbivores (e.g. deer) in winter (Wallmo and Schoen 1980). In addition, forage quality of blueberry (Vaccinnium spp.) and bunchberry (Cornus canadensis (important foods for herbivores) is higher in old growth than in clearcut stands (Billings and Wheeler 1979, Rose 1982, Schoen and Kirchhoff 1983).

The final element of old-growth forests relates to time. It takes 150 to 250 years before even-age stands begin to develop more diverse canopy structure and heterogenous understory (Alaback 1982). Considerably more time is required to develop an uneven-aged forest composition, diverse snag production, and large accumulations of large diameter woody debris in various stages of decomposition. Three hundred or more years may be required to create old growth on productive sites and slower growing sites will take even longer. Old growth, for practical purposes, is a nonrenewable resource under rotations of up to 150 to 250 years in length.

Once the climax successional stage of the spruce-hemlock stands is reached, the forest remains in an old-growth condition until a major disturbance such as windthrow, fire, landslide, or cutting destroys the standing forest. The frequency of such natural occurrences is relatively low in southeast Alaska, as the high ratio of old growth to young forest indicates. Old growth is a stable, albeit dynamic habitat that can persist for centuries. Mortality occurs among individual trees or small clumps within the stand, thus perpetuating patches of "young growth." This renewal process is an inherent feature of old growth and allows early successional species, such as Sitka spruce, Pacific elderberry (Sambucus racemosa), and trailing black currant (Ribes laxiflorum) to persist in varied abundance in old-growth stands and perpetuates uneven-aged forests with high vertical and horizontal structural diversity.

Commercial old-growth forests in southeast Alaska differ widely in appearance and in structural and functional qualities. The net inventory volume (merchantable wood biomass) of commercial old growth, for example, ranges from 8,000 to over 100,000 board feet per acre depending on site productivity and stand history. In general, however, stands having in excess of 30,000 board feet per acre are considered high volume and commercially important, and make up a relatively small percentage (13%) of the commercial forest-land base in the Tongass National Forest (Smith et al. 1983). High-volume stands typically occur at lower elevations in well-drained, U-shaped valley bottoms or near tidewater. They are characterized by larger trees, a higher proportion of spruce, and a more open understroy than low-volume stands. Different types of old growth, by virtue of their unique structural and functional characteristics, can be viewed as ecologically distinct habitats.

EARLY SUCCESSIONAL CLEARCUTS

The pattern of forest succession on the Tongass National Forest has been documented by Harris and Farr (1979) and Alaback (1982). The removal of old-growth forests by clearcutting generally retains the understory vegetation, except where severe soil disturbance and landslides occur. In situations where timber utilization is relatively high, vascular plant production recovers within 3 years following logging, and shrub and herb production increases linearly until the stand reaches about 20 years of age. Reduced utilization standards which result in leaving large amounts of uneconomic timber and slash in clearcuts is likely to retard this recovery or result in different patterns of colonization. In situations where rapid recovery occurs, understory biomass peaks at about 5,000 lbs/acre 15 to 25 years after clearcutting and is generally at the highest level for any age of forest. Woody shrubs comprise the bulk of the understory production, but fern and forb growth may also be relatively high in some early successional clearcuts.

Tree regeneration following clearcutting is generally excellent (Ruth and Harris 1979), with canopy cover approaching 100% on productive forest soils 15 to 25 years after logging. On soils with lower conifer site indices, canopy closure may be delayed.

Within 10 years of canopy closure, understory biomass becomes essentially absent (Alaback 1982). Forb and fern losses are most rapid, with woody shrub biomass (e.g. blueberry species, Vaccinium spp.) persisting somewhat longer. Snags, unless specifically retained, are absent, as are any large diameter trees for future snags and tree cavities. Logging residue, including limb debris and large downed logs, is substantially higher than in undisturbed old growth.

Much of the understory in early clearcuts results from the substantial understory that existed in the old-growth forest before clearcutting. In contrast, understory succession following logging of second-growth forests lacking forbs, ferns, and deciduous shrubs will undoubtedly be significantly different. This aspect of forest succession has not been studied in southeast Alaska.

Clearcuts can also directly affect the stability of the adjoining forests. The loss of the forest trees over a large area results in a simultaneous decay of all the large root structures that aid in soil stabilization. On steep slopes (generally those over 75%), the breakdown of the roots triggers landslides (Burke 1983, Doug Swanston, per. comm.) which may destroy forests downslope and deposit large amounts of silt in streams. For example, 116 landslides occurred in the Maybeso Valley within 9 years of clearcutting compared to only 13 landslides in the 100 years prior to logging (Bishop and Stevens 1964).

Clearcutting exposes the surrounding forest to greater risks of blowdown (Ruth and Harris 1979). This increased risk has not been well quantified, but it is evident that hundreds or thousands of acres of old growth along the edges of clearcuts are damaged or lost each year to windstorms. The frequency and degree of windthrow is many times higher in old growth adjoining clearcuts than in forests removed from cutting areas. "Salvage sales," on public lands designed to utilize windthrown timber, often incorporate additional old growth to enhance the economics of the sale. The net result is an "unravelling" of the surrounding forest and clearcut sizes significantly larger than originally planned.

It should be noted that this early seral stage occurring immediately after clearcutting is temporary and of rather short duration relative to the harvest rotation commonly planned for areas of southeast Alaska.

POLE STANDS

By 25 to 35 years of age, the forest stand that has received no post-logging treatment has generally developed into a pole-sized stand. Trees are small, densely stocked, and of uniform size compared to old growth. Canopies lack depth and well developed, large-limbed crowns. However, canopy cover may exceed 90 percent due to the high stem density. Large diameter snags and snag replacement trees are absent, although large-diameter logs may persist for more than 70 years. The forest floor of pole stands is dominated by mosses with less than 100 lbs/acre standing biomass of shrubs and herbs (Alaback 1982). Mosses increase significantly in biomass for the next 110 to 130 years if the site is not disturbed (Alaback 1982). In some cases, ferns become the dominant vascular plant in the understory about 50 to 60 years after logging (Alaback 1982).

Conifers produce seeds in the pole stand, but the timing of seed re-establishment and abundance of seed production relative to old growth are poorly understood. Decaying wood is less abundant on the forest floor of older pole stands compared to old-growth (Alaback 1982).

One hundred and forty to 160 years after the clearcutting, an understory of deciduous shrubs, herbs, and conifer seedlings begin to re-establish (Alaback 1982). Uneven-aged forest composition, old-growth overstory structural features, and large diameter snags with denning cavities develop during the next century or two. The transition stage between a pole stand and old-growth occurs well beyond the typical timber harvest rotation of 100 years, currently planned for areas of southeast Alaska.

The poorly-developed understory and even-aged overstory in pole stands results in relatively low habitat diversity (Schoen et al. 1981). These stands may persist for 75% of the harvest rotation and are the least valuable of all seral stages to wildlife populations.

EFFECTS OF PRECOMMERCIAL THINNING ON FOREST SUCCESSION

Over the past 10 years, the Forest Service (FS) has developed an active precommercial thinning program to increase the rate of timber production following clearcutting. Thinning usually consists of sawing off conifers and deciduous trees, such as alder, below the lowest live limb, while leaving a dominant conifer standing at spacings ranging from 8' X 8' to 16' X 16'. Stands are treated at 8-to-30-years of age, although most thinning occurs between ages 10 and 20. It has been speculated that thinning may benefit wildlife use of early successional stands by prolonging the deciduous shrub, fern, and forb understory (Ruth and Harris 1979, Kessler 1982).

Alaback (1984) and Alaback and Tappeiner (1984) found that while understory production may be prolonged or promoted by thinning, the species benefiting most are often conifers or deciduous shrubs with little forage value to the desired wildlife species. Doerr (in press) presented understory measurements from a 26-year-old clearcut experimentally thinned at 20 years of age that indicated prolonged understory forage production.

Doerr and Sandburg (in prep.) examined a 34-year-old clearcut on Big Level Island that had been thinned at 16 years of age. This is believed to be the earliest thinned stand in the Tongass National Forest. Forage was abundant in the understory compared to unthinned stands which had little forage and deer use.

The most significant understory response to thinning is dense conifer regeneration, coupled with increased vertical limb growth of leave trees (Alaback and Tappeiner 1984, Doerr and Sandburg in prep.). Thus any increased deciduous browse or forb production would likely be short-lived, and both studies concluded that repeated thinnings would be necessary to maintain the understory -- an option which, at this time, has not been shown to be economically feasible. Furthermore, a two-layered conifer stand is considered undesirable for timber production (Ruth and Harris, 1979). In British Columbia, thinning regimes developed to enhance deer habitat conflict with thinning regimes to maximize timber production and economic returns (McDaniels Research Limited 1980).

Kessler (1982) and other biologists have observed high slash accumulations (often exceeding heights greater than 4 feet above the ground) which they felt restricted deer movements and use in clearcuts. Thinning slash had largely decomposed 18 years after treatment on Big Level Island, but may have affected deer use of the treated stands immediately after thinning (Doerr and Sandburg in prep.). Morrison and Gibbs (1984) documented increased summer use of areas following a controlled burn of slash in the Pavlof drainage. However, conditions suitable for controlled burns are relatively rare in southeast Alaska.

Alaback and Tappeiner (1984) have presented measurements that show that thinned clearcuts cannot mimic old-growth forests. Understory diversity, composition, production, and quality, as well as overstory canopy cover, height of dominant and subdominant trees, crown radius, and limb size and structure, differ markedly between thinned stands and old growth. Ability to intercept snow will usually decrease in thinned stands (Kessler 1982, Doerr and Sandburg in prep.) compared to unthinned stands.

In summary, the data suggest that thinned stands may temporarily prolong shrub forage, while decreasing snow interception capabilities, and will result in the development of a two-layered (two-age class) pole stand with low understory biomass.

TLMP scheduled precommercial thinning on the most productive forest sites and assumed that at least some thinned stands would be managed on a shortened rotation of about 80 years. This shortened rotation, together with potential for prolonged understory production, could increase the capability of the thinned stands to provide forage over a longer portion of the harvest rotation, but this forage would be available only in periods of no or little snow accumulation. Neither state nor private land managers have scheduled or employed precommercial thinning as a silvicultural technique in the southeast Alaska region.

EFFECTS OF COMMERCIAL THINNING ON FOREST SUCCESSION

Commercial thinning (CT) is not an established silvicultural practice in southeast Alaska. The FS recognized this fact during TLMP preparation and did not assume that it would occur in determining the allowable sale quantity because its widespread use had not been demonstrated (FS 1983). Any discussion of the potential for commercial thinning is speculative.

OTHER NATURAL FOREST TYPES

Although old growth is the predominant forest "type" in southeast Alaska, other forest types exist which are valuable for fish and wildlife habitat and timber production. Among these forests are spruce river terrace stands, some of which exist as a subclimax community subject to periodic natural disturbance from flooding. River terrace forests and braided floodplain forests may play significant roles in the ecology of the freshwater streams they border and stabilize and protect some of the most important spawning and rearing habitat of salmon, trout, and char. Eagle nests are common in river terrace forests along the larger mainland rivers. River terrace forests provide key moose winter range and routes for migration to calving areas and are important habitat for a wide variety of furbearers and nongame bird species.

Logging changes the character of these forest habitats, and can result in both short and long term effects to species that utilize or depend on them. Subclimax river terrace forest habitat probably cannot be regenerated by a clearcutting system and subsequent shortened rotation.

OTHER POTENTIAL HABITAT MANAGEMENT TECHNIQUES

The FS has experimented with other techniques to mitigate alteration of natural wildlife habitats, but, to date, none has been successful that would be feasible for application on a broad scale. The Society of American Foresters recently completed a review of the state-of-the-art with regard to creating stands with old-growth characteristics and managing second-growth stands to maintain or enhance desirable stand characteristics. The report (SAF 1984) concluded:

Old growth is a complex ecosystem, and lack of information makes the risk of failure high. In view of the time required, errors could be very costly. At least until substantial research can be completed, the best way to manage for old growth is to conserve an adequate supply of present stands and leave them alone.

For the same reasons, it is not clear that second-growth stands can be managed to enhance their old-growth characteristics. Thus, if old-growth stands are to be part of a managed forest, the management must begin with existing stands. Then the quantity to be retained must be considered in planning timber harvests.

IMPACTS OF TIMBER HARVESTING ON SPECIFIC WILDLIFE SPECIES

DEER

The Sitka black-tailed deer reaches the northern limits of its natural range in southeast Alaska. The species is indigenous to the mainland and most islands, however they are absent or in low numbers on some of the smaller islands of the Alexander Archipelago. They are the most frequently sought after game animal in the region, and provide an important dependable food supply for recreational and subsistence hunters. Due to the importance of deer to residents of the region, considerable research on the impacts of logging on deer has been conducted since 1979 when ANILCA passed.

Deer populations have historically fluctuated in response to winter weather conditions, quality of range, and predation rates. In addition, large-scale logging results in a major alteration of habitat. Concern is growing that logging will significantly and permanently reduce deer numbers throughout the region as old-growth forests are converted to second-growth forests (Wallmo and Schoen 1980, Rose 1982, Schoen et al. 1984, 1985; Hanley et al. 1985, Territorial Sportsmen 1985). Under certain combinations of natural conditions, local deer populations may be reduced to levels so low that they will not be able to recover.

A major symposium on Sitka black-tailed deer was held in Juneau in 1978. Existing knowledge on the impacts of logging on deer was presented which documented the basis for concern for the future of southeast Alaska deer populations. At that time, the following facts were known:

1. Intensive timber harvest of the coastal forests of Vancouver Island, the area most similar to southeast Alaska in terms of forest community and climate, had resulted in deer population declines of 50-75% (Hebert 1979).

2. Winter conditions, specifically the depth and persistence of snow cover in combination with the pattern of cold temperatures, were the major factor affecting deer populations (Olson 1979).

3. Snow depths during winter were much higher in clearcuts than in adjacent uncut areas due to the interception of snow by trees (Merriam 1971, Jones 1975, Weger 1977, Schoen and Wallmo 1979).

4. Preliminary results of a deer forage study indicated that green forage was important nutritionally to overwintering deer (Schoen and Wallmo 1979). The most nutritious forage was most abundant and available under old-growth stands with mature canopies (Billings and Wheeler 1979).

5. In a study on Admiralty Island, deer winter distribution was correlated with the availability of one preferred plant species, Vaccinium, which was in turn influenced strongly by snow depth. Preferred range areas were at elevations of 200-700 feet in stands of moderately high timber volume (Barrett 1979).

6. A large percentage of commercial forest lands (CFL) with valuable and accessible timber was also valued as deer winter habitat (Harris and Farr 1979).

7. The successional pattern following clearcut logging in southeast Alaska had been described as 20 years of understory production followed by 180 years with little herbaceous or shrub understory under a closed canopy followed by an opening of the canopy and understory development (Robuck 1975 in Schoen and Wallmo 1979).

8. Preliminary results of a deer habitat use study indicated that deer used regrowth stands during summer only 1/5 as much as they used old growth stands. Regrowth stands less than 15-40 years old had dense shrub growth and logging slash accumulations that precluded deer movement and use. Deer use of clearcuts decreased in stands 4-147 years old (Schoen and Wallmo 1979).

9. Wolf predation appeared to be having a significant impact on deer populations, whereas hunting mortality appeared to be having little overall effect (Olson 1979).

In summary, by 1979, a conflict between deer winter range requirements and clearcutting was well-documented. An additional future potential conflict based on the inability of regrowth stands to sustain summer food production for deer had already been identified. Finally, a complicating natural factor, wolf predation, was recognized as an important component of the management situation.

The results of subsequent research by the Alaska Department of Fish adn Game (ADFG) and FS have caused what was of concern in 1979 to become a significant wildlife habitat management issue in coastal forests in Alaska in 1985.

In 1979, the Alaska Chapter of the Wildlife Society (TWS) adopted a position statement concerning forest practices in Alaska (TWS 1979). It recommended 1) that research be conducted to provide information on the ecological relationships of wildlife to old-growth forests and of the effects of clearcutting on wildlife, and 2) that to provide for maintenance of optimal deer winter habitat, and to ensure survival of deer during severe winters, substantial portions of high-volume commercial forest land should never be clearcut. In 1980, the Alaska Joint Boards of Fisheries and Game passed a resolution (#80-8-JB) that recommended revision of TLMP to provide more protection for fish and wildlife habitat and to reflect then-recent research findings, additional research and incorporation of results into planning, cessation of harvest of timber stands of more than 50,000 board feet per acre, and harvest of other timber volume classes in proportion to their occurrence. In 1982, the Northwest Section of the TWS passed a resolution recommending funding of research on old-growth forests while research was being conducted to provide management guidelines (TWS 1982). In the same year, the Alaska Chapter of the Society of American Foresters passed a resolution recommending that a technical committee be established to review the timber harvest-deer habitat issue with existing commitments for timber in land management plans to be maintained in the interim (SAF 1982).

The outgrowth of this last resolution was the appointment by the Governor and the Regional Forester, of a Technical Committee to look into the timber-wildlife habitat situation in southeast Alaska. Members included the State Forester, the Forest Service's Deputy Regional Forester, the Deputy Director of the Alaska Department of Fish and Game's Habitat Division, and representatives of Sealaska Corporation, SAF, and TWS.

The Technical Committee focused its attention on the deer-logging issue and offered its findings and recommendations in its 1983 report (Smith et al. 1983) entitled, "Deer and Timber Management in Southeast Alaska - Issues and Recommendations." The Technical Committee made twenty-one recommendations dealing with deer and forest ecology, economic considerations, and professionalism.

A second symposium on wildlife relationships in old-growth forests was held in Juneau in April, 1982. Further research findings were presented and the implications for forest management of deer habitat summarized by several wildlife biologists. The published symposium papers were not available for review during preparation of this report, but have recently been published (Meehan et al. 1984).

In 1984, a task force appointed by the Governor of Alaska to determine how to improve the economic outlook for the timber industry endorsed the recommendations of the Technical Committee appointed by the Governor and Regional Forester(ATTF 1984).

In 1985, the Alaska Chapter of the Wildlife Society (1985) adopted a position statement concerning old-growth forest management in Alaska. Noting the strong evidence that cutting old growth adversely affects black-tailed deer populations, the Alaska Chapter of TWS recommendations included: (1) management of the Tongass National Forest should comply with the National Forest Management Act, (2) the FS and the Alaska Department of Fish and Game should develop an educational program to inform the public about the long-term consequences for wildlife and fish resulting from harvesting old-growth forest, (3) the disproportionate harvest of high-volume, old-growth timber classes should cease, and (4) specific old-growth stands with exceptional fish and wildlife values should be identified and managed to protect those values, including the management option of no harvest.

Research conducted by the Alaska Department of Fish and Game after 1979 has fulfilled many of the recommendations of the Technical Committee. That Sitka black-tailed deer make highest use of forest stands in areas that have not been cutover has been confirmed. Use of pellet-group transect counts and radio-tracking of collared deer have documented that old-growth stands with well developed canopies are preferred winter habitat (Schoen et al. 1985). Optimum deer winter range under moderate to severe conditions have been described through discriminant factor analysis as high-volume, old-growth stands on productive, well-drained sites with irregularly spaced trees and a well-developed understory consisting of preferred deer winter foods, i.e. bunchberry (Cornus canadensis), blueberry (Vaccinium spp.), and five-leaved bramble (Rubus pedatus), or fern-leaved goldthread (Coptis aspleniifolia)(Schoen et al. 1982, Rose 1982). Greater dispersal of deer was observed in a milder winter when deer made more use of low-volume timber stands (Schoen and Kirchhoff 1983). In all winters, however, and in areas of both northern and southern southeast Alaska, deer preferred old-growth habitats and avoided clearcuts and regrowth stands (0-147 years) and upper forest areas where deep snow accumulations occurred (Wallmo and Schoen 1980, Schoen et al. 1982, Rose 1982). These findings concerning the relationship of forest stand types in terms of timber volume class and logging history to deer winter range have significant implications for appropriate management of timber harvest that protects this critical component of deer habitat.

Research on food habits and quantity and quality of available winter forage has also confirmed the importance of old-growth stands with large irregularly spaced trees, well developed canopies, and well developed understories with abundant deer forage (Schoen et al. 1985, Kirchhoff and Schoen 1985, Hanley and McKendrick 1985). Schoen and Kirchhoff (1984) documented that the nutritional value of bunchberry was highest in high-volume, old-growth forest stands, intermediate in low volume old-growth stands, and lowest in clearcuts. Other researchers (Billings and Wheeler 1979, Van Horne 1982, Rose 1982) documented the high nutritional value of a variety of plants in old-growth understory. Lichen litterfall emerged as an important food source for deer in old-growth stands in areas similar to southeast Alaska (Rochelle 1980).

More information has been gained on home range patterns and seasonal distribution, as well. A radio-tracking study (Schoen and Kirchhoff 1985) documented that a portion of a deer population in a watershed reside at higher elevations during all seasons. Resident deer have overlapping summer and winter ranges while those of migratory deer are distinct and average up to 8 km apart. Home ranges are relatively small in size (averaging 79 ha) and individual deer display strong fidelity to seasonal home ranges, rarely dispersing from one watershed to another watershed. Deer move downward from higher elevations as snow accumulates, and may eventually be driven into the coastal forest fringe under severe conditions. Winter use can also range inward from the coast up to 9 km (Schoen and Kirchhoff 1985). Thus, the concept of critical deer winter range has been expanded to include inland forest stands, as well as beach fringe stands. When deer habitat is restricted to coastal beach fringe areas, heavy losses during severe winter conditions are more likely than if inland winter habitat also exists. These findings are also significant ones to consider in long-term management of critical deer winter range.

Kirchhoff et al. (1983) investigated whether deer made preferential use of the "edge" areas of clear-cuts adjacent to mature stand and found that they did not. Clear-cuts emerged as areas which received extremely low winter deer use and could serve as a barrier to deer movements from beach fringe to inland habitats at higher elevations during winter (Schoen and Kirchhoff 1985).

Research results on the successional pattern following clear-cut logging, including the response to thinning, were reviewed in the previous section. The results indicate that understory vegetation is essentially eliminated during forest succession for approximately 75% of a 100-year rotation. These cut-over stands are characterized by extremely low deer use (Wallmo and Schoen 1980, Rose 1982). Alaback (1984), Alaback and Tappenier (1984), and Doerr and Sandburg (in prep) concluded that precommercial thinning may temporarily prolong understory productivity in young (pre-canopy closure) stands, but that any prolonging of deciduous browse or forb production will be short-lived. Thinning also promotes a two-layered conifer stand.

Logging slash has been shown to be an effective barrier to deer movement in areas other than southeast Alaska (Lyon and Jensen 1980). Parker et al. (1984) calculated the high energetic costs of movement through logging slash and deep snow. Kessler (1982) and Morrison and Gibbs (1983) have observed high slash accumulations (often exceeding heights greater than 4 feet above the ground) which they felt obviously restricted deer movements and use in clearcuts. Gibbs and Morrison (1984) studied the effects of prescribed burning to reduce slash. They concluded that deer use was higher in burned areas because large accumulations of small slash had been removed. More recently, FS biologists have experimented with clearing trails through slash accumulations. Thinning slash had largely decomposed 18 years after treatment of a clearcut on Big Level I, but may have affected deer use of the treated stands immediately after thinning (Doerr and Sandburg in prep.). Gibbs and Morrison (1984) cautioned, however, that an increase in carrying capacity of summer range could not alter carrying capacity of winter habitat, often the limiting factor for deer populations.

A study of wolf predation on deer in southeast Alaska was initiated by ADFG with some FS funding in 1984. In 1982, Van Ballenberghe and Hanley (1985) reviewed deer-wolf studies in other areas and modeled deer-wolf relationships in southeast Alaska. They concluded that logging of old-growth forests could initiate deer population declines by lowering the carrying capacity of the environment for deer, and that wolves could accelerate the rate of decline and keep deer numbers at extremely low densities. They summarized the implications of both the successional pattern of the forest and of deer predation as follows:

> The closed-canopy, second-growth stage (age 25 or 30 years to rotation) is a virtual desert in terms of forage for deer. Deep accumulation of snow in the young (25-30 yrs) clearcuts buries forage and makes it unavailable to deer. . . Thus, in regions of southeast Alaska where snow accumulates to an important degree in winter, the conversion of old-growth forest to managed, even-aged forest is expected to result in substantial declines in deer population levels.
>
> We visualize the long-term effects of removing old-growth timber on deer in Alaska as ultimately acting to reduce the rate of increase of deer. In the absence of wolf predation and hunting, deer populations subject to extensive logging would be expected to decline; the rate of decline would be greatly accelerated if predation and hunting were intensive. Deer would then remain at low densities unless wolf numbers were reduced.

Schoen et al. (1985) modeled existing knowledge about the impacts of the scheduled harvest in the Tongass National Forest throughout the first 100-year rotation on the deer populations of southeast Alaska. Of 461 VCUs analyzed, 340 VCUs will have less than 50% of current deer populations and 100 VCUs will have less than 25% of current deer populations at the end of the rotation.

MOUNTAIN GOAT

Mountain goat populations in southeast Alaska occur on most major ridge complexes of the mainland and have been introduced successfully to Baranof Island. They were also recently transplanted to Revillagigedo Island near the city of Ketchikan. Population and habitat use studies have been conducted near Juneau (Schoen 1978, Fox 1979 a, b, c; 1982, Schoen et al. 1980, Schoen and Kirchhoff 1982), Haines (Hundertmark et al. 1983), and Ketchikan (Smith 1982, 1983a, 1983b, 1985), and in areas outside of southeast Alaska with similar habitat conditions.

Mountain goats are considered specialists, with a very narrow range of habitat characteristics that meet their life history requirements. Seasonal ranges are distinctive, but steep, broken terrain is a predominant feature of all goat habitat with the possible exception of some travel corridors (Smith 1985, Fox et al. in prep.). Although mountain goats are generally thought of as living in areas well above treeline, use of forested habitat has been found to occur throughout the year (Schoen 1978; Fox 1978, 1979a,b,c, 1980; Schoen et al. 1980; Fox et al. 1982; Schoen and Kirchhoff 1982; Smith 1982, 1983a, 1985; Hundertmark et al. 1983; Fox et al. in prep.). Summer use of forests is limited and considered a response to wet, windy weather when lower elevation, sheltered areas are used (Fox 1978) or for heat and/or insect relief habitat during hot weather (Smith pers. comm.). Use of forested habitat during winter may be extensive and appears to be most influenced by the availability of food resources (Fox 1983).

In the southern portion of the region where wet, heavy snow covers all alpine terrain for 5 to 6 months each year, goats were found to winter almost exclusively on forested slopes and commercial size timber was found to be a significant factor in predicting the location of goats during winter (Smith 1985). Near Juneau, where colder temperatures and high winds combined to clear ridgetops of snow and expose forage, some goats used areas above treeline for much of the winter while others wintered as low as a few hundred feet above sea level (Schoen and Kirchhoff 1982). Hundertmark et al. (1983) did not find any use of forested habitat by goats near Haines, possibly because of mild winter conditions or a lack of steep forested terrain within the study area, but others (Schnabel pers. comm. and Smith unpub. data) have observed goats wintering below treeline in this vicinity. Thus in areas with significant snowfall, timbered habitat may be critical winter range for goats as it is for deer.

The steep, broken habitats used by goats are often not suitable areas for logging given present technology. However, clearcutting has already removed timber from known wintering sites in Alaska near Icy Bay (Smith and Reynolds 1977), Haines (Hundertmark et al. 1983), and Baranof Island (L. Johnson, pers. comm.) and in areas of Washington (Reed 1983). The proximity of cutting units to goat range must be carefully evaluated. Schoen and Kirchhoff (1982) and Smith (1983b) have developed techniques to accurately identify areas of goat habitat. Wintering areas at low elevations or on southerly exposures are particularly critical wintering sites.

Hundertmark et al. (1983) recommended deferring timber harvest adjacent to a goat range in the Haines area to avoid long-term impacts. Schoen and Kirchhoff (1982) and Hundertmark et al. (1983) recommended leaving a windfirm buffer strip of timber not less than 800 m. wide around goat concentration areas. More specifically, Fox et al. (in prep.) recommend a 400 m. wide buffer strip to escape terrain, but also recommended that these postulated areas of habitat use be verified with more detailed information particularly in forested wintering areas. As harvest methods change (e.g. helicopter logging and multi-span high-lead systems), more significant conflicts could develop.

Large clearcuts in areas outside of goat wintering areas could create barriers to movement between patches of escape terrain within the winter ranges of individual goats during periods of deep snow or pose barriers to dispersal to "islands" of preferred goat habitat (Schoen and Kirchhoff 1982). Fox et al. (in prep.) recommend that travel corridors be identified and maintained between important wintering sites and summer range. They also recommend that forested travel corridors between wintering sites be kept intact.

Human activity involving noise and vehicle traffic has been documented as disturbing goat behavior and potentially interfering with reproductive behavior through separation of nannies and kids. Such disturbance can increase susceptibility of kids to predation (Foster and Rahs 1983). Abandonment of summer range and increased mortality, associated with disturbance stress, has occurred in response to camps and other activity within 2 km of goat habitat. (Foster and Rahs 1983). In Montana, goats left an area during timber harvest operations that occurred near, but not, within goat habitat, then returned some time after the disturbance ceased (Chadwick 1973).

Road access is a major long-term impact that can cause disturbance, displacement, and overharvest of goat populations. Female goats displayed high fidelity to home range, and roading has resulted in elimination of use of high-quality, preferred range by nannies for many years (Chadwick 1983). Roads can bisect goat movement corridors between seasonal habitat use areas, effectively eliminating traditional habitat use. These impacts have been documented in areas other than Alaska (Brandborg 1955, Chadwick 1973, Rideout 1974, Herbert and Turnbull 1977, Kuck 1977). Phelps et al. (1983) described the history of mountain goat management in the Kootenay Region of British Columbia. They concluded that goat populations declined as a result of progressive exploitation and decimation of previously unhunted herds as new industrial roads expanded. Foster (1977) also attributed a large decline in goat populations in British Columbia to increased hunter access that followed the creation of new road systems in formerly undeveloped areas.

BROWN/GRIZZLY BEAR

Historically the brown/grizzly bear (*Ursus arctos*) was widely distributed in North America from central Mexico to northern Canada and Alaska and from the Mississippi to the Pacific Coast (Hall and Kelson 1959). The distribution of this species, today, is greatly reduced from its former range with brown/grizzly 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. Human-induced mortality, disturbance, and habitat alteration have been identified as prime factors in the decline of grizzly bear populations.

Brown/grizzly bears, commonly referred to as brown bears within the region, are indigenous to southeast Alaska where they occur on the mainland and islands north of Frederick Sound. Studies of habitat use and the impacts of timber harvest are in progress in southeast Alaska, but impacts have been documented in other areas of the bears' range.

In the northern Rockies, timber management has affected wildlife habitat more than any other activity (Zager and Jonkel 1983). 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) suggested that development in coastal mainland forests in British Columbia appears to result in declining brown bear populations.

Brown bears, in general, are opportunistic omnivores and able to utilize a variety of food sources. Food does not appear to be a limiting factor for brown bear populations in southeast Alaska. Work done on feeding habits has identified seasonally important food sources that include sedge/carex meadows, berry-producing areas, and anadromous fish streams (Russell 1974, Smith 1978, Lloyd 1979, and Johnson 1980). Berry-producing areas are important and seasonally vital to brown bears. The consumption of berries is critical during the late-summer, fall weight gain period. Salmon runs constitute a critical seasonal component of most brown bears' annual food intake (Johnson 1980).

Recent studies of brown bears radio-collared on Admiralty and Chichagof Islands have documented high use of old-growth forest habitats during all seasons (Schoen and Beier 1983, 1985; Schoen et al. in press) and consumption of salmonberries, devils club berries, and currants as major foods during summer (T. McCarthy unpub. data). Riparian old-growth stands receive high use during the salmon runs. Many den sites have been located in old-growth stands, with several excavated under the base of large-diameter, old-growth trees (J. Schoen and V. Beier unpub. data). Clearcuts are used, but use is relatively low compared with old growth; bears do not appear to prefer these areas during any season (Schoen and Beier 1985). Research is continuing to assess the effects of forestry practices on brown bears in southeast Alaska.

Potential impacts to southeast brown bear populations include both alteration of habitat or habitat use and human-induced mortality. Studies in Montana documented that the initial removal of the forest canopy removes hiding cover for bears which is an important habitat component even in the absence of predators or man (Black et al. 1976). Understory food plants, e.g. berry-producing shrubs are damaged or destroyed (Mealey et al. 1977). Opening the forest canopy can result in high berry production during early regrowth stages which were potentially beneficial to bear populations. Extensive clearcuts result in an initial flush of berries, with an eventual decline as the forest canopy closes (Mealey et al. 1977). This decline in berry crops could be detrimental to brown bear populations, as it is with black bears. Because of the importance of salmon as a seasonal food source, protecting the integrity of salmon streams and their productivity is also important for maintaining bear populations.

Research in other areas indicates that bear use of clearcuts is not based on food availability alone. Russell (1979) documented avoidance of clearcuts and other open areas by hunted bear populations in British Columbia. Logging slash in clearcuts can impede bear movements (Smith 1978) and clearcuts and roads can serve as barriers to movement (Elgmork 1976, Zager et al. 1983). Where slash is not treated in Montana, food production for bears is lower than that in mature forests (Zager et al. 1983). Timber leave strips can play an important role in meeting short-term cover requirements by bears feeding on salmon. Lloyd (1979) described mechanisms that have developed so that bears do not meet and fight, which results in injuries and deaths. Leave strips may thus serve as critical visual screens for bears aggregating on rivers to feed on salmon runs (Archibald 1983). Zager and Jonkel (1983) recommended that timbered strips be left around feeding sites such as wet meadows and as stringers for travel routes along riparian zones and snow chutes, and between cutting units.

Roads and camps can reduce habitat carrying capacity through disturbance to bears and a resultant loss of portions of their former range. In southeast Alaska, some former logging camps on federal land have become permanent communities through state land selections and subsequent transfer into private ownership. An interconnected road and ferry system will greatly increase recreational and administrative use of currently remote areas. In British Columbia, hunted bear populations avoid clear-cuts and other open areas and require forest cover for movement (Russell 1974). In Montana, bears used only the portions of logged units furthest from primary roads and only within 50-75 m. of cover (Zager 1980). In Norway, the density of forest roads has been found to be negatively correlated with bear densities over a 25-year period (Elgmork 1976, 1978). Bears often avoid roadside habitat along the Denali National Park road as well (Tracy 1977). Zager et al. (1983) concluded that cutting unit location in relation to open roads and the availability and proximity of escape cover were important factors in determining bear use. Thus, size and shape of cutting units can have an indirect effect on bear use because they determine the proximity of cover.

Human-induced bear mortality tends to increase when an area is developed for timber harvest. Accessibility to the area is increased through the construction of docking facilities and roads into a formerly unroaded area. Human use of the area inevitably increases unless access is restricted. Current Forest Service policy in southeast Alaska encourages public and administrative use of primary road systems, and silvicultural management and multiple entry logging requires that roads be maintained and re-used. Human-induced mortality results from legal and illegal hunter kills and killing of "problem" or nuisance bears. Such "bear problems" are often due to accumulations of human garbage, which, when improperly disposed, becomes an attractant to the opportunistically-feeding bears. Road access is a quantum change that generally leads to a much higher human-caused bear mortality rate.

Road access may initially increase hunter success and hunting mortality because it provides hunters access to previously unexploited populations. Archibald (1983) described the resultant management problem well in reference to British Columbia coastal bear populations:

> Forestry access roads provide legal hunters with the capability to hunt unexploited populations. Man-bear conflicts associated with logging or recreational activities in these watersheds often

develop. Poaching is a problem: illegal hunters have access to seasonal concentrations of coastal grizzlies in areas where enforcement staff is minimal due to high costs of patrolling and insufficient enforcement staff.

Additional mortality results when bear-human conflicts increase. Grizzly bears avoid traditional use areas where active logging is occurring (Mace and Jonkel 1980). However, they are attracted to camps or other human facilities by food or garbage. Artificial food sources result in changes to natural movement patterns (Mundy and Flook 1973) and the resulting conflicts are well documented from situations in national parks (Cole 1972, Herrerro 1976), pipeline construction camps (Douglass et al. 1980), outfitter guide camps (Hoak et al. 1983), and logging camps (Archibald 1983). Conflicts are generally resolved through destruction of the bear because of the difficulty of discouraging bear visits and the costs and ineffectiveness of relocating bears which either return or cause problems in new areas. Johnson (1980) estimated that bears killed in defense of life and property around logging camps in southeast Alaska could make up as much as 10% of the reported kill.

Jonkel (1977) concluded that extensive, uncontrolled road construction and access invariably leads to increased human activity and eventually increased human/grizzly conflicts. Human/grizzly impacts nearly always result in adverse actions to grizzlies and in many situations have led directly to extirpation of the grizzly from the ecosystem. Craighead (1977) also suggested that human-induced mortality associated with logging was one of the major contributions to grizzly declines.

Ruediger and Mealey (1978) summarized potential adverse impacts on grizzly bears from human development : 1) easy access for humans into grizzly habitat, 2) conversion of travel corridors for grizzlies into developments and areas where grizzlies are not tolerated, and 3) increased human use of adjacent backcountry which can lead to competition for space, legal and illegal hunting, settlement, increased camping and picnicking, and potential increases in the amount of garbage and other unnatural foods. They also developed guidelines for coordinating timber harvesting in grizzly bear habitat in Montana. They recommended road management as the most effective management tool to reduce the long-term negative impacts of roading on grizzlies during presale activities. Road management would include: restricting road and management activities during periods of high bear use, closing roads after work is completed, planning sales to avoid repeated entries over short periods, maintaining large areas of good quality "security" bear habitat as roadless areas, closing roads adjacent to active sale areas, and maintaining one-mile buffer zones between areas where road access is permitted and grizzly habitat. Zager and Jonkel (1983) also recommended minimizing new roads in occupied bear habitat to provide isolation and route roads only in sites with little bear food away from feeding and travel sites. These practices likely conflict with objectives for laying out economical timber sales in drainages in southeast Alaska with high brown bear populations.

In summary, road construction and increased human access are likely to increase human disturbance and human-induced mortality on brown bears. The old-growth habitat which receives the bulk of observed bear use will be significantly reduced. Protection of salmon stream productivity and sedge/grass meadows can maintain two seasonally-important food sources, and berry crop productivity may initially increase following opening of the canopy. However, research to date indicates that brown bears do not appear to be attracted to clearcuts and in fact, prefer old-growth forest habitats. Following canopy closure, berry and herbaceous forage production will be eliminated, removing this important food source. Thus, it is likely that conversion of old growth to clearcuts and second-growth succession will result in a decrease in carrying capacity for brown bears. Quantification of this relationship, however, remains unknown at this time.

Based on the above evidence, brown bear population declines will likely result from the altered pattern of hunter access, increased bear-human conflicts, and alteration of preferred habitat. If land use impacts in the region are similar in severity as they have been on other portions of the bear's range, the species may be vulnerable to local or regional reductions to the level of threatened or endangered status.

BLACK BEAR

As with brown bear, little work has been done regarding black bears and their habitat in southeast Alaska. The large-scale removal of cover and increased access by roads can render bears more visible and vulnerable to hunting. Increased harvest of black bears has resulted from improved access brought about by logging roads in southern southeast Alaska (ADFG 1981).

Erickson et al. (1982) observed a preference by black bears for young clearcuts (to 25 years) on Mitkof Island. Bears fed on the first green plants in south facing clearcuts during spring and on berries in late summer and early fall. However, the proximity of cover is also an important factor in determining bear use of available food supplies (Lindzey and Meslow 1977).

Canopy closure after 15-25 years and the resultant long-term poorly-developed ground cover will significantly reduce food supplies for bears in regrowth areas (Erickson et al. 1982). Food shortages can, in fact, limit black bear populations (Jonkel and Cowan 1971). The availability of den sites may be reduced in second-growth forests. Black bears studied on Mitkof Island denned in hollow logs left in clearcuts, the bases of diseased boles of hollow living hemlock trees, or in rotten stumps of hemlock trees. All den sites were the product of large-diameter, old-growth trees. Above-ground denning in trees appears to be an adaptation to the conditions of shallow, wet soils which were not suitable for excavating dens (Erickson et al. 1982, Hanson 1982, Hanson and Doerr 1982). These researchers noted that although hollow logs may be left in clearcuts, these will eventually decay and provide only temporary denning habitat. Second-growth stands, managed on a 100-year rotation will likely not provide a source of den trees of sufficient size to provide large cavities. The researchers also noted that a long time period is necessary for the development of heart-rot, other diseases or weather damage that result in hollow cavities accessible to bears. Silvicultural practices aimed at timber production will result in removal of diseased trees that would eventually develop into suitable denning sites.

Researchers have reported the importance of suitable denning habitat for pregnant female black bears in Washington (Polker and Hartwell 1973, Lindzey and Meslow 1976) and in Alaska (Miller and McAllister 1982). Erickson et al. (1982) noted indications of an apparent low rate of reproduction in the bears of Mitkof Island after 20 years of intensive logging and urged that an in-depth study of the population characteristics of these bears be undertaken.

Emigration may also result from habitat changes following logging. Lindzey et al. (in press) documented emigration of black bears as a result of aggression and poor reproductive success as the quality of habitat and food abundance deteriorated following logging on an island off the Washington coast.

MOOSE

In southeast Alaska, moose populations are generally associated with large, mainland river systems that provide suitable forage. Because this type of habitat is generally limited in distribution in Southeast, moose populations are relatively small and typically isolated. Work by Doerr (1983, 1985), Hundertmark et al. (1983) and Craighead et al. (1984) characterized moose populations in Thomas Bay, the Chilkat River, and the Stikine River drainage, respectively.

These studies have all indicated that certain coniferous forest stands are an essential component of moose winter range. The type and structure of these forests vary between the areas studied and include old-growth hemlock-spruce forests, spruce river terrace forests with riparian or blueberry browse, spruce-cottonwood forests, and upland lodgepole pine forests with mixed hardwoods. In addition, moose use old-growth, river terrace, and other unlogged forests to a considerable degree throughout the year. These forests may be important for calving areas (K. Hundertmark, pers. comm.) and as thermal cover from the summer sun (Hundertmark et al. 1983). In the Yakutat area, "stringers" of riparian spruce are used in early spring as migratory corridors when deep snow persists on the ground (B. Dinneford, pers. comm.).

In areas where riparian or other high-quality browse is limited, young clearcuts with high understory production may provide important foraging areas for moose during spring, fall, and winter periods with low snowfall (Doerr 1983, 1985). If adequate winter range is retained, the presence of high-forage regrowth areas may promote a temporary increase in moose numbers.

At Thomas Bay, clearcuts up to 30 years of age were selected over old-growth forests during spring, fall, and mild winters (Doerr 1983). During deep snow conditions, browse in clearcuts was unavailable and moose selected spruce river-terrace forests, riparian shrub stands with preferred browse, and old-growth forests. In late winter with deep snow accumulations, tracks in the Yakutat area documented high use of old-growth stands for browsing and/or resting and avoidance of open areas (B. Dinneford, pers. comm.)

As with deer, forest succession will limit the period of time moose will utilize clearcuts. As clearcuts mature, young conifers begin to dominate and forage is lost. The reduced quantity of browse will undoubtedly result in a lower carrying capacity and perhaps severe declines in moose populations (Doerr 1985). In situations where riparian habitat is limited initially (e.g. Thomas Bay), moose populations may be reduced below "huntable" levels as clearcuts become dominated by conifer regrowth.

Habitat management concerns for moose are specific to each area of southeast Alaska. However, studies to date strongly indicate that forested winter range is necessary for severe winter conditions and suggest that clearcutting certain forest habitats is detrimental to moose. Hundertmark et al. (1983) recommended that existing forests within and surrounding high density feeding, breeding, and movement areas be retained from timber harvest in the Chilkat Valley. Doerr (1985) recommended that all the limited river terrace forests and some of the high-volume (30+ MBF/acre) old-growth forest at Thomas Bay be permanently excluded from harvest to provide for the winter needs of moose.

Doerr (in press) addressed the need to maintain a mixture of forested winter range and clearcuts with high forage production in order to sustain moose populations at Thomas Bay. He recommended sustaining equal acres of forested winter range and regrowth with high forage production. Suitable moose habitat could be maintained by a combination of reducing the rotation length; retaining high-volume, old-growth and river-terrace forest winter range by avoiding timber harvest in these areas; clearcutting low volume (non-winter range) coniferous forests; and precommercial thinning. He developed a model to address long-term habitat needs of moose at Thomas Bay.Assuming that high forage production could be maintained for 30 years with precommercial thinning and assuming a 100-year harvest rotation, 46% of the CFL in moose range could be maintained over the rotation as moose habitat with acreage split equally between retained winter range and high-forage regrowth. Under a 60-year harvest rotation, 67% of the CFL could be maintained as moose habitat under the above conditions.

For clearcut rotations of 60 and 100 years, the model required that 33 and 23%, respectively, of the CFL, would be permanently retained as moose range and predicted that 33 and 54 percent, respectively, of the CFL would always be in second growth pole stands with little forage production or value as moose habitat. The amount of retention to be allocated for moose winter range in the model is considerably greater than that provided under TLMP. The results of the model are specific to Thomas Bay, an area with very limited riparian shrub habitat, and indicate that the key factors in maintaining moose habitat are 1) the amount of winter range retained for the entire rotation, 2) the degree to which the FS schedules the harvest equally over the rotation, and 3) the degree of implemention of shortened rotations and thinning to increase the percentage of time a clearcut provides forage.

In the more typical moose habitat of southeast Alaska where riparian forage is naturally abundant, the preservation of the existing natural habitat may likely be the optimal habitat management strategy for these moose populations (Hundertmark et al. 1983, Craighead et al. 1984).

Roading, whether prior to logging or concurrent, also affects moose populations indirectly. Where access for hunting is already adequate due to the presence of landing strips, existing roads, rivers or other water access, increased road access may result in crowded hunting conditions and overhunting. Hundertmark et al. (1983) recommended that roading and logging developments around Haines avoid restricted migration corridors between high density concentration areas and that restrictions be placed on use of roads in moose concentration areas to reduce potential harassment and poaching losses.

Where river or other inland access is largely limited, the construction of logging roads may promote increased moose hunting opportunities, such as at Thomas Bay. The increased intensity of hunting at Thomas Bay, however, has required ADF&G to closely monitor the harvest. Restrictions on motorized access, season closures, harvest quotas, emergency closures restricting the harvest, and registration permit hunts have all been implemented to prevent overharvesting of moose. Recent research in Yakutat indicates that while hunter use may shift to a road system, hunter success declines rapidly (D. Mills unpub. data).

WOLF

Wolves are found along the mainland coast of southeast Alaska and on the islands south of Frederick Sound. They are not presently found on Admiralty, Baranof or Chichagof Islands. Little work has been done to document habitat or predator-prey relationships of wolves in southeast Alaska.

Wolf population dynamics depend on the population dynamics of prey species. Black-tailed deer are a primary food source for wolves in southeast Alaska; moose, goats, salmon, and beaver are also important food sources (Merriam 1964, Smith unpub. data). The effects of logging on the carrying capacity of habitat of prey species thus directly affects the carrying capacity of an area for wolves.

Some research has been conducted within the region to determine predator-prey relationships of wolves. Wolves were introduced to Coronation Island as part of an "experiment" to evaluate wolf-deer relationships (Merriam 1964). Within a few years following introduction of wolves to the island, deer were virtually eliminated. Subsequently, the wolves fed on marine carrion, then on each other, and finally disappeared from the island. Recently the deer population has re-established and increased on the island. Although this study lacked a "control" and the small size of the island (approximately 70 km^2) prevented eventual stability of a predator-prey system, the rapid decline of deer following wolf introductions indicates the potential effects of wolves on an insular deer herd.

VanBallenberghe and Hanley (1985) synthesized the limited existing knowledge of wolf predation into a conceptual model applicable to the old-growth forest ecosystem of southeast Alaska. Their model inter-relates various deer productivity and mortality rates, kill rate for wolves, and influence of hunter harvest on deer recruitment. It then calculated wolf:deer ratios required to maintain equilibrium of both populations. Using this approach, these authors concluded that wolves are capable of limiting deer populations. They suggested that in view of the detrimental effects of logging and hunter harvest on deer productivity, wolves would be an additive factor in depressing deer populations. Biologists studying deer-wolf relationships on Vancouver Island (Hebert 1981, Hebert et al. 1982, Scott and Shackelton 1980 and Jones and Mason 1983) have clearly documented the role of wolves in reducing and limiting deer in ecosystems similar to these in southern southeast Alaska where timber harvest has reduced deer winter ranges.

Retention of "islands" of high-quality winter habitat can be expected to concentrate deer during severe winters and increase the efficiency of wolf predation (Harestad 1979, Hebert et al. 1982). The implications of reduction of deer habitat carrying capacity through logging coupled with the demonstrated capability of wolves to reduce deer populations below the capacity determined by habitat and winter conditions may severely limit management options. Jones and Mason (1983) concluded that meeting population objectives for deer would require maintaining winter ranges, regulating hunting, and managing predators if habitat capabilities were to be realized. Van Ballenberghe and Hanley (in press) also concluded that wolf control would be necessary to maintain deer populations at the carrying capacity of the habitat. To reduce the necessity for wolf control, which is strongly objectionable to a large segment of the Alaskan and national public, critical winter habitat will have to be retained in sufficient quantity to maintain deer populations at levels that can sustain both a desired human harvest and an unmanaged wolf population.

Management of the wolf is of special concern due to the unique status of Alaska as one of two states where the species is not endangered and one of the few areas of the wolf's former broad range where it is still abundant.

FURBEARERS

Marten, beaver, mink, and land otter are four furbearer species commonly trapped in the region. Wolves are also trapped where they occur in the region, but are discussed in the preceding section.

Muskrats, wolverines, and lynx are also available in some areas. Logging may affect furbearers through habitat alteration, reduction of prey species following reduced understory food production and habitat diversity in second-growth stands, impeded travel through slash, and increased mortality through increased trapper access.

Marten

Marten are present on the mainland and were introduced to Prince of Wales, Baranof, and Chichagof Islands and are abundant on Admiralty Island. They are present on most of the other islands in southeast Alaska, but absent from some.

Specific habitat requirements of marten in southeast Alaska are not known. Johnson (1981) has reviewed the literature on habitat use and the effects of logging on marten in other areas. The following is excerpted from his review. Elsewhere, within their range it has been reported that marten are creatures of mature forests (Seton 1929, Marshall 1951, deVos 1952, Lensink 1953, Hawley 1955, Francis and Stephenson 1972, Koehler et al. 1975, Clark and Campbell 1977, Koehler and Hornocker 1977, Mech and Rogers 1977, and Soutiere 1978). The marten is considered to find optimum habitat in old-growth Douglas fir forests in western Oregon and Washington (Meslow et al. 1981).

Researchers in other areas have found that alteration of the pristine forest can have significant impact on marten populations. Marshall (1951) in Idaho, deVos (1952) in eastern Canada, and Mech and Rogers (1977) in Minnesota reconstructed the decline of marten populations following settlement with its attendent forms of land alteration, especially clearing, logging, and fire. Marshall (1946) reported little marten sign in winter in areas devoid of tree cover. In Canada deVos (1952) noted that marten were less abundant in second growth stands than in mature forests. Lockie (1964) traced a similar decline in the related pine marten (M. martes) in Scotland. In response to a 1976 survey, nine states and one Canadian province reported marten as extirpated from their jurisdictions. The reason for extirpation was given as habitat destruction (Deems and Pursley 1978). Soutiere (1978) also documented marten numbers in clearcut areas to be one-third those in undisturbed forests in Maine. Major (1979) also described lower population levels following clearcutting.

Several workers have documented changes in small mammal populations which provide the main food source for marten (Martell and Radvanyi 1977), particularly reductions in red-backed vole populations (Tevis 1956, Gashwiler 1970, Hoovan 1973, Sims and Buckner 1973, Clark and Campbell 1977).

The habitat requirements that are likely to be adversely affected by clearcut logging include canopy cover, high prey populations, and tree cavities for denning. Koehler et al. (1975) in Idaho showed that marten prefer stands older than 100 years and that such a stand must have a canopy cover greater than 30 percent. Those authors also reported that marten will cross but not hunt in openings less than 300 feet in width during winter. They noted that marten were not observed to have crossed openings greater than 300 feet and that marten do not use "dog hair thickets" because of minimal small rodent populations. Soutiere (1978) observed marten tracks in openings as wide as 200 m. Habitat requirements in summer seem to be less rigid than in winter (Grinnell et al. 1937, Marshall 1946). Clark and Campbell (1977) in Wyoming reported that marten do not utilize harvested areas at least within one year following harvest. These authors further noted that in winter, marten foraging was confined to dense, mature stands of coniferous forests. Koehler et al. (1975) and Steventon (1979) observed that in winter females are more reluctant to enter clearcut areas than are males.

No study of the food habits of marten in southeast Alaska has been conducted, however in other areas, microtine rodents, especially red-backed voles, are the primary prey of marten (Cowan and Mackay 1950, Remington 1950, Newby 1951, Lensink 1953, Hawley 1955, Lensink et al. 1955, Quick 1956, Lockie 1961, Murie 1961, Weckwerth and Hawley 1962, Clark and Campbell 1977, Koehler and Hornocker 1977). Red squirrels and deer mice do not appear to be preferred food items for marten, according to these and other studies, but tree squirrels, berries, and arthropods may be seasonally important. The winter use of witches broom (mistletoe infection) areas has also been reported, possible to provide feeding opportunities on flying squirrels which nest in the witches broom (R. Mowry, pers. comm.).

Marten rest, give birth, and rear their young in dens. The few natal dens that have been found have been in rocky banks, hollow trees, woodpecker or squirrel holes, boulders, or hollow logs. As noted under the discussion of cavity-nesting bird habitat, second-growth forests managed on a 80-100 year rotation would have few excavated holes or hollow trees and logs for den sites. Reduction in denning sites would also contribute to reduced carrying capacity for marten.

Road access is likely to increase trapping pressure on marten. In areas where road systems are available to the trapper, marten may be reduced below levels which make it profitable for trappers to trap. Traditionally, marten trapping has been accomplished by boat, working the beach fringe. As trapping removed animals from the beach fringe, other animals moved in from the "reservoir" of animals in upland areas. As "reserve" areas are roaded and trapped, marten populations and trapping success will decline over a relatively large area.

Beaver

Beaver are abundant in major mainland river drainages or other areas with extensive freshwater marsh areas and deciduous woodlands. They are also present on islands of the Alexander Archipelago with suitable habitat.

The only study of beaver in southeast Alaska has been conducted in the Petersburg area. Beaver dens, lodges, and food caches were observed along deep, slow-moving streams and sloughs bordered by Sphagnum moss mats surrounded by sedge-alder or hemlock communities, along deep slow-moving streams with clay banks, and in lakes with Sphagnum moss mats with steep banks for denning. Swift, shallow streams with sandy or rocky bottoms, areas of tidal influence with fluctuating water levels, and salt marsh meadows did not appear to provide suitable habitat. Beaver food caches contained stems from a variety of shrubs and hemlock (Curatolo et al. 1981). Beavers use conifers extensively for food and for lodge and dam construction in portions of their range in southeast Alaska (J. Doerr pers. obs.).

Beaver ponds and streams deepened by beaver activity serve as important habitat for furbearers such as muskrat (Boyce et al. 1981), mink, otter, and wolves. They also provide rearing habitat for certain fish species, including coho salmon (Bryant 1984), cutthroat trout, Dolly Varden char, and steelhead; and waterfowl habitat for nesting, rearing, molting, and migrational habitat (J. Doerr pers. obs.). Emergent aquatic plant in beaver ponds provide foraging areas for moose (B. Dinneford, pers. obs.). Snags bordering wetlands and often resulting from flooding by beaver dams are valuable habitat for snag-dependent wildlife (J. Doerr pers. obs.).

Roads, facilities, and cutting units which include beaver ponds may encroach and alter this habitat through fill, equipment movement through the pond, sedimentation, or slash deposition. The maintenance of a riparian buffer zone around beaver ponds and stream habitats can benefit beaver as food sources, and serve as a filter for sediment from erosion following logging and soil disturbance and thus provides a natural mitigation measure for other fish and wildlife species.

Mink

Mink populations are distributed primarily along the coastal fringe of the region, but are also abundant in riparian habitat along streams. Harbo (1958) documented high use of intertidal invertebrates as a food source, and mink movements along beaches and in wooded cover parallel to the beach. He described den sites in rock crevices, rock piles, and in cavities under tree roots. Natal dens were located within spruce cover in close proximity to intertidal feeding areas.

Johnson (1985) recently completed a study on the use of coastal habitat by mink on Prince of Wales Island in southeast Alaska. He found that mink use was concentrated within 10 m of the shrub-tree border of the shoreline and only occurred inland for crossing of points or peninsulas. His data indicated that mink use was highest in residual beach fringe and old-growth low-volume timber; higher in old-growth (high-volume, low-volume, and residual stands) than in second growth; and lowest in clearcuts and virtually nonexistent in muskegs and along streams. He concluded that beach-fringe timber was used for travel, denning, feeding on captured prey, and escape cover. He recommended that buffer strips of timber which would withstand windthrow (at least 60 m inland from the shoreline) be maintained. If beach-fringe timber was to be clearcut, he recommended that 1) the shoreline length of the clearcut be as short as possible, preferably less than the smallest average range of mink (.8 km), and 2) clearcutting beach-fringe timber should be avoided on islet points, on convex, and reef shorelines; along short intertidal zones (less than

40 m from 0- m to +6 m lines), and along intertidal areas with high amounts of bedrock and boulder cover.

Land otter

Land otters occur throughout the region. Recent studies in southeast Alaska (Larson 1983, Woolington 1984) documented an avoidance of clearcuts for travel routes, burrows, and natal dens. Woolington (1984) suggested that logging would result in temporary removal of shrub cover needed by otters, slash deposition that would impede their travel, mechanical destruction of den sites and burrows under stump mounds and rotting stumps, road encroachment through their habitat, disturbance during the breeding period, and loss of natal den sites in riparian forest stands along stream courses. He recommended that logging be avoided adjacent to watercourses during the breeding season from early May to late summer.

Based on these recent studies (Larson 1983, Woolington 1984), clearcut logging along beaches and stream courses will alter preferred otter habitat for travel, forage, cover, burrows, and natal dens. Conversion of old-growth forests to second-growth forests could remove important breeding and burrowing habitat. Loss of suitable habitat for reproduction can have a significant adverse impact on otter populations.

Both Larson (1983) and Woolington (1984) recommended retaining a fringe of timber along the beach to meet otter habitat requirements. Larson (1983) recommended a minimum width of 60 m, while Woolington (1984) recommended a minimum of 50-75 m, with larger leave strips where windthrow was likely. The latter author also recommended that no roads be located adjacent to steep, rocky shorelines and along watercourses to protect natal den sites.

SMALL MAMMALS

Studies on small mammals are very limited in southeast Alaska, but information on general habitat requirements of the species present strongly indicate that clearcutting can have long-term impacts on populations of certain species.

Forb and shrub understory production in the forest is necessary for abundant populations of certain rodent species. Van Horne (1981, 1982) demonstrated that both longtail voles (*Microtus longicaudus*) and deer mice (*Peromyscus maniculatus*) prefer sites with high understory production.

Small mammals which depend on forbs and shrubs during summer may benefit from the initial high shrub production in clearcuts. However, the results of field studies have been contradictory for the deer mice. Harris (1968) reported consistently lower population levels of deer mice in clearcuts on Prince of Wales Island compared to nearby forested areas during the first 10 years following cutting; whereas Van Horne (1981) documented a slight increase in deer mice populations in clearcuts continuing until the stage of maximum shrub production prior to canopy closure. Deer mouse populations appeared to decrease with canopy closure and understory loss in pole stands and likely remain low until an understory is reestablished as the stands develop into old growth (Van Horne 1981).

Van Horne (1982) also conducted population studies on longtail voles, a species that primarily occupies forest edges or shrubby areas. She concluded that the species appeared to find optimum habitat in young, 7-to-10-year-old clearcuts, and attributed this preference to the availability of low cover in the form of shrubs and logs and open areas with high production of preferred herbs and berries. She found that forb production declined 10 to 25 years after logging, resulting in declines in vole carrying capacity and abundance. She predicted that 30-to-150-year-old pole stands would be entirely devoid of long-tailed voles and that such stands would act as barriers to dispersal of voles between suitable habitat patches.

Other herbivorous small mammals, i.e. other mouse species and voles, also require understory forest production to maintain their populations. Because clearcutting on a 100-year rotation results in a pole stand with a low-diversity understory for approximately 70% of the harvest rotation, overall small mammal diversity and production will likely decline significantly in areas where extensive clearcutting occurs.

In addition to the reduction of understory food supplies, some small mammal species depend on cone seeds for food and/or require tree cavities. Removal of the tree canopy will eliminate denning and feeding areas for red squirrels (Tamiasciurus hudsonicus) and flying squirrels (Glaucomys sabrinus). Red squirrels, a common small mammal throughout much of southeast Alaska, depends on seed production from conifers to survive (Wolff and Zasada 1975). Field observations indicate that clearcutting essentially eliminates red squirrel habitat in southeast Alaska, as has been documented in other coniferous biomes (J. Doerr, pers. obs.). This impact persists until cone production is reestablished in second-growth stands which should occur within 20-30 years for western hemlock trees and within 20-40 years for Sitka spruce (FS 1965).

The northern flying squirrel is a species that merits habitat management concern. Meslow et al. (1981) described the species as one that finds optimum habitat for breeding or foraging in old-growth Douglas fir forests. Harris (1984) described a particular ecological role in energy transfer that flying squirrels fill in these forest ecosystems through their consumption of arboreal lichens during winter. The squirrels also feed on ectomycorryhisal fungi, e.g. truffles, and dig up and spread the below-ground spores of the fungi to other areas where they perform an essential role of fixing nitrogen for the roots of many conifers. Thus, truffle-feeding small mammals play a positive role in forest regrowth following logging or disturbance (Maser et al. 1978).

Although no work has been done on the habitat requirements of the flying squirrel in southeast Alaska, research has been conducted in interior Alaska. Mowrey and Zasada (1984) found that flying squirrels fed on truffles, mushrooms, and other fungi, berries, insects, and carrion when available, but depended primarily on cached fungi and arboreal lichens during winter. They preferred spruce trees over hardwood trees because of the rough bark that permitted clinging both after gliding to the tree and by young squirrels during rearing in den trees. Large diameter, tall trees also afforded a better landing surface; spruce trees provided year-round cover. Trees were used for denning, both to rear young and for thermal cover and protection from wind and rain. During the coldest weather, all squirrels denned in white spruce trees infected by mistletoe that produced clumps of abnormal growth of branches or "witches broom." In warm or wet weather, they use tree cavities excavated by woodpeckers, thus utilizing the same old-growth stands preferred by woodpeckers for nesting. Mowrey and Zasada (1984) observed a maximum home range size of 31 ha, a maximum distance between den trees equal to 470 m., and as many as 13 different den trees used over the year within the home range.

Mowrey (1982) concluded that old coniferous forest stands with den trees containing "witches broom," woodpecker cavities, and natural cavities for nesting were essential habitat. Mowrey and Zasada (1984) recommended timber leave strips between clearcuts in excess of 30 m. in width for use as travel corridors from tree to tree. They also noted that the size and number of forest openings a squirrel had to cross were an important consideration and recommended that openings generally not be more than 20 m. across and that openings wider than 30 m. should contain scattered trees, especially tall spruce.

These data suggest that in the southeast region, early regrowth clearcuts would lack trees for denning and landing sites and that second-growth forests with poor arboreal lichen development could reduce winter carrying capacity for flying squirrels when conditions are most severe through reduced food supplies, feeding areas, and den trees. Second-growth management for timber production will eliminate diseased trees that provide cold weather nests. Stands managed on a 100-year rotation will be harvested before they develop sufficient heart-rot to permit cavity excavation by woodpeckers.

Decreases in small mammal populations as a result of clearcutting will affect those mammal and bird species that depend upon these species as a prey base, including owls, hawks, marten and weasels.

A final concern for small mammals is the potential for the elimination on a localized or regional basis of old-growth dependent species. Basic biology questions such as habitat needs, species distribution, and even proper taxonomic classification surround many of the small mammal species that inhabit the Tongass. This unique archipelago limits interisland dispersal by small mammals, thus increasing the chances for local extinction.

A number of small mammal species have extremely limited known distributions in southeast Alaska. These include the meadow jumping mouse, Zapus hudsonius, water shrews, Sorex palustris and S. arcticus, and the endemic species Coronation Island vole Microtus coronarius, and Sitka deer mouse, Peromyscus sitkensis, (MacDonald and Pengilly 1979). A unique subspecies, the Prince of Wales flying squirrel (Glaucomys sabrinus grisifrons) may be old-growth dependent and has recently been proposed to "Category 2" of the federal Candidate Species List for endangered and threatened vertebrates.

BIRDS

The Tongass National Forest provides migratory and breeding habitat for numerous bird species as well as important winter habitat for resident birds. Of approximately 100 species observed on the mainland during a species and habitat inventory (Gibson and MacDonald 1975), and some 80 species observed in the Alexander Archipelago (Gibson 1976), 18 and 14, respectively, were resident species. The surveys reported that the mainland area had 170 known breeders and 19 other possible breeders, while the Archipelago had 43 breeders and 19 probable breeders. Survey work and research on the effects of timber harvest on birds have focussed on breeding birds during the spring and summer season. More recently, Hughes (in prep.) conducted winter surveys and enumerated 20 species within old-growth forest plots on Admiralty Island. Research has also recently been concluded on winter habitat requirements of bald eagles (Hansen et al. 1984).

Breeding Habitat Studies

Several studies in the southeast Alaska region have been conducted on the effects of logging on breeding bird populations (Noble 1978, Kessler 1979, Reid et al. 1980). Studies have also been conducted on breeding requirements of bald eagles (Hodges and Robards 1981), marbled murrelets (Quinlan and Hughes in prep.), and two resident birds, the blue grouse (Doerr et al. in press), and the Vancouver Canada goose (Lebeda and Ratti 1983).

Table 1 summarizes the results of studies conducted in the region and in the Pacific Northwest on the effects of clearcutting on some bird species which breed in the region. Noble (1978) conducted preliminary surveys of breeding birds in logged and unlogged Sitka spruce, western hemlock forests on Prince of Wales Island, Alaska during June and July of 1977. He reported that golden-crowned kinglets (Regulus satrapa), ruby-crowned kinglets (Regulus calendula), and red-breasted sapsuckers (Sphyrapicus ruber) are drastically reduced or eliminated when old growth is removed whereas other species reached higher densities in small clearcuts and regrowth areas than in old growth because of their preference for early successional stages or nesting in shrubs. Noble further speculated that other species known to require old growth, but not occurring in his limited old-growth study plots (i.e., three-toed woodpecker (Picoides tridactylus), hairy woodpecker (Picoides villosus), downy woodpecker (Picoides pubescens), sharp-shinned hawk (Accipiter striatus), red-tailed hawk (Buteo jamaicensis), blue grouse (Dendragapus obscurus), pine grosbeak (Pinicola enucleator), pine siskin (Carduelis pinus), red crossbill (Loxia curvirostra), yellow-rumped warbler (Dendroica coronata), chestnut-backed chickadee (Parus rufescens), and brown creeper (Certhia americana) would also be

Table 1. Reported response of bird species breeding in southeast Alaska to clearcutting.

I.	Species that will increase following clearcutting of oldgrowth:	
	Orange-crowned warbler	(Noble 1978, Kessler 1979)
	Wilson's warbler	(Noble 1978)
	Dark-eyed junco	(Noble 1978, Kessler 1979, Mannan and Meslow 1980)
	Fox sparrow	(Noble 1978, Kessler 1979, Reid et al. 1980)
	Hermit thrush	(Noble 1978, Kessler 1979)
	Winter wren	(Kessler 1979)
	Steller's jay	(Kessler 1979)
	Swainson's thrush	(Kessler 1979)
	Ruby-crowned kinglet	(Kessler 1979, Mannan and Meslow 1980)
	American robin	(Kessler 1979)
	Song sparrow	(Kessler 1979)
II.	Species that will decrease following clearcutting of old growth:	
	Ruby-crowned kinglet	(Noble 1978)
	Chestnut-backed chickadee	(Noble 1978, Kessler 1979)
	Golden-crowned kinglet	(Noble 1978, Kessler 1979)
	Townsend's warbler	(Kessler 1979)
	Varied thrush	(Kessler 1979)
	Western flycatcher	(Kessler 1979)
	Yellow-bellied sapsucker	(Kessler 1979)
	Red-breasted sapsucker*	(Noble 1978)
	Hairy woodpecker	(Kessler 1979)

*This species was listed by the author in the publication as the yellow-bellied sapsucker, however the common name was subsequently changed by the American Ornithologists Union (1982).

substantially reduced or eliminated as old-growth habitat is eliminated.

Kessler (1979) working on Kosciusko Island, (near Ketchikan, Alaska) added Townsend's warbler (Dendroica townsendi), chestnut-backed chickadee, varied thrush (Ixoreus naevius), western flycatcher (Empidonax difficilis), and hairy woodpecker, to Noble's list of known bird species whose populations would be decreased by clearcutting. Kessler (1979) also reiterated a concern for other old-growth dependent species which might be present on her study plots but which remained unrecorded due to low densities or nocturnal habits. Her partial listing of these species includes northern goshawk (Accipiter gentillis), western screech-owl (Otus kennicottii), great horned owl (Bubo virginianus), great gray owl (Strix nebulosa), northern hawk-owl (Surnia ulula), boreal owl (Aegolius funereus), northern saw-whet owl (Aegolius acadicus), boreal chickadee (Parus hudsonicus), red-breasted nuthatch (Sitta canadensis), and brown creeper.

Reid et al. (1980) censussed breeding bird populations in clearcuts, old growth, and scrub forest in the Pavlof drainage. Lowest total bird densities were found in recent (two-year-old) clear-cuts and highest densities in scrub (non-commercial stands) forest. The study provided additional habitat use information for the eight bird species that bred in successional stands but not in old-growth commercial stands in the studies by Noble (1978) and Kessler (1979). Four species (Steller's jay, tree swallow, American robin, and rufous hummingbird) utilized scrub forests for breeding and two species (Swainson's thrush, song sparrow) nested in old-growth forests but at densities low enough to be missed by earlier census plots. They concluded that clearcutting might benefit fox sparrow populations.

In summary, all breeding bird studies have concluded that fox sparrows will likely benefit from clearcutting. Noble (1978) and Kessler (1979) both concluded the orange-crowned warbler, dark-eyed junco, and hermit thrush would also benefit, while Reid et al. (1980) observed that these species also bred abundantly in non-commercial scrub forests. The breeding bird surveys and consideration of requirements for characteristics of old-growth forests concluded that a number of bird species would likely be adversely affected by clearcutting. The species most commonly described as requiring old-growth forests included hawks (sharp-shinned and red-tailed hawks, northern goshawk, and American kestrel), owls (boreal owl, western screech-owl, northern hawk-owl, northern saw-whet owl), woodpeckers (downy and three-toed woodpeckers), blue grouse, boreal chickadee, brown creeper, and red-breasted nuthatch. A number of other species have been described as potentially benefitting from or being adversely affected by clearcutting.

Noble (1978) recommended retention of old-growth tracts within areas to be logged with a minimum site of 400 acres. He also recommended that such tracts be no more than one mile from any similar tract and that old-growth corridors be left to connect the tracts.

Winter Habitat Studies

Hughes (in prep.) censussed bird species resident in old-growth forest stands on Admiralty Island during winter (Table 2). He further described old-growth habitat use during winter by five species of cavity and snag-nesting birds (hairy woodpecker, three-toed woodpecker, red-breasted sapsucker, chestnut-backed chickadee, and brown creeper) by timber volume classes (Table 2). Winter food can be the limiting factor for resident bird populations (Haapanen 1965, Fretwell 1972), and for resident, hole-nesting birds in particular (McClelland 1977).

Hughes (in prep.) found that brown creepers and hairy woodpeckers were most numerous in high-volume stands (greater than 40,000 MMbf/acre) while three-toed woodpeckers were most numerous in high and medium-volume stands (25,000-40,000 MMbf/acre) and red-breasted sapsuckers and chestnut-backed chickadees were most numerous in low-volume stands (less than 25,000 MMbf/acre) during winter. He concluded that harvesting high-volume, old-growth stands would impact hairy woodpecker populations more severely than harvesting low or medium-volume stands. He also concluded that timber harvesting in old-growth stands would probably have the greatest impact on snags with cavities used as winter roosts by chestnut-backed chickadees. He noted that the high densities of chickadees might reflect a seasonal habitat shift with birds moving into southeast Alaska from areas with more continental, colder climates.

He recommended that winter habitat be maintained as well as breeding habitat through retention of undisturbed old-growth tracts.

Bird Use of Snags and Tree Cavities

Recent research in southeast Alaska (Hughes in prep.) has focussed on the impacts of timber harvesting on bird species that utilize snags, particularly those that depend upon the presence of standing dead trees or older, decaying trees with heartrot or other diseases that make them suitable for excavation of cavities for nest sites or winter roosts. Noble and Harrington (1978) described 25 bird species in southeastern Alaska that are cavity-dependent or cavity-users. Birds such as the hairy woodpecker, three-toed woodpecker, and red-breasted sapsucker, are primary hole nesters, i.e. they excavate their own nest. They depend upon tree characteristics that permit excavation. Other bird species, including the chestnut-backed chickadee and brown creeper, are secondary hole nesters, and usually do not excavate their own nests. Instead, they depend upon the presence of natural cavities or cavities excavated by primary hole nesters. Four of the five hole-nesters mentioned above are winter residents of southeast Alaska, while the red-breasted sapsucker is an early migrant.

Birds in southeast Alaska have also been observed using snags for song perches, by territorial males during breeding season, for perches and courtship display areas for band-tailed pigeons, and as foraging perches for sharp-shinned hawks and goshawks (Gibson and MacDonald 1975, Gibson 1976). Snags may also be used as drumming sites by

Table 2. Winter use of old-growth forest habitat (Hughes in prep.)

I.	<u>Bird species resident in old-growth forest in southeast Alaska</u>
	Bald eagle
	Northern pygmy-owl
	Blue grouse
	Common raven
	Steller's jay
	Black-billed magpie
	*Hairy woodpecker
	*Red-breasted sapsucker
	*Three-toed woodpecker
	*Brown creeper
	*Chestnut-backed chickadee
	American robin
	Varied thrush
	American dipper
	Winter wren
	Pine siskin
	Dark-eyed junco
	Golden-crowned kinglet
	Red crossbill
	White-winged crossbill

*Species requiring tree cavities or snags for nesting or roosting.

woodpeckers or for insect "hawking" or hunting (Hughes, pers. comm.). Cavities are used as roosts by birds that overwinter in the forests (Hughes in prep.).

In areas other than southeast Alaska, the importance of snags and trees that provide for cavity excavation and re-use is well-documented. Raphael and White (1984) recently cited 20 studies that document the regular use of snags by wildlife for nesting, feeding, shelter, communication, and resting. Studies have also focussed on adverse impacts of timber harvests that resulted in snag removal. The findings of Raphael and White (1984) in the Sierra Nevada complemented findings from other studies in Finland (Haapanen 1965), Sweden (Nilsson 1979), and Arizona (Balda 1975, Scott 1979) that removal of snags resulted in 32% to 52% fewer cavity-nesting birds than in adjacent areas with snags. Raphael and White (1984) determined that populations of cavity-nesting birds were proportional to snag density and that larger trees were preferred. Cavity nesting birds exhibited a strong preference for large snags for cavity excavation on Admiralty Island (Hughes in prep.). Snags were also preferred as foraging areas by several species. Mannan and Meslow (1984) compared populations of breeding birds and the structure and composition of managed and old-growth forests in northeastern Oregon and concluded that the abundance of snags in old growth was responsible for the relatively high numbers of hole-nesting birds. Large trees were indirectly important to hole-nesting birds as a source of large snags.

Timber harvest can result in loss of snags suitable for use by cavity-nesters in two ways: (1) through removal of snags during logging or associated human activities and (2) through shortened rotations which result in no recruitment of "new" old, large snags in areas managed intensively for timber production (Conner 1978). The first type of loss could be minimized by retaining snags during timber harvest. In Alaska, however, the majority of snags are removed to meet human safety requirements.

Improved public access by logging roads results in additional utilization of snags for firewood. Silvicultural practices, including thinning and improvement cuttings, often selectively remove diseased trees that would develop into snags suitable for cavity-excavation (Evans and Conner 1979).

The problem of snag recruitment is a more long-term impact. Hughes (in prep.) census of snags in old-growth forest stands resulted in the identification of key characteristics of snags of commercial tree species which had bird cavities. Bird cavities were most often located in large-diameter, broken-top western hemlock snags with heartrot and with more than 80% of the bark remaining. Intensive forest management practices necessary to achieve rotations of 80-125 years will result in removal of defective trees before these characteristics can develop.

Hughes (in prep.) made the following management recommendations concerning snag management:

(1) Specific guidelines should be adopted for each cutting unit to maintain a diversity of habitats for hole-nesting birds.

(2) The forest planning process specified in the National Forest Management Act of 1976 should be completed for the Tongass National Forest to select representative management indicator species for cavity-nesting wildlife and determine desired population levels.

(3) Until the planning process is completed, managers should attempt to retain all snags within cutting units, in patches, where possible, to survive intensive timber management practices and potential windthrow. Snag patches should be left connected to cutting unit borders rather than isolated within cutting units.

(4) A program to provide a sustained supply of snags is essential. Second-growth management techniques, such as girdling live residual trees, leaving snags, and identifying defective trees with heartrot or fungi to be left throughout the rotation should be implemented.

(5) Firewood cutting areas should be designated by the Forest Service to insure that snags left standing for wildlife are not removed by the public.

(6) Patches of undisturbed old-growth forests should be retained to meet all habitat needs of cavity-nesters, including winter habitat for resident species. Retention areas of at least 160 ha have been recommended by Noble (1978) for breeding birds.

Bald Eagle

Southeast Alaska supports the highest density of breeding bald eagles, estimated at more than 7,000 breeding birds (King et al. 1972, Hodges et al. 1979), and the largest breeding population in North America (Conant et al. 1979). This important resource has been the subject of nest surveys since 1969. Productivity surveys of a core area of 90 nests along 52 miles of coastline have been conducted since 1972. However, some areas of the coastline remain unsurveyed. By 1981, 3850 nests had been located.

Based on the survey of these approximately 4,000 nests, Hodges and Robards (1982) concluded that eagles utilize large, primarily live old-growth trees near the waterfront to support their nests. Exposed coasts, prominent points, and islets are preferred foraging areas. Few nests are located beyond 200 m (220 yd) inland of the saltwater coastline. Eagles also nest in large cottonwood trees along river bottomlands of large mainland river systems and occasionally along the major freshwater streams and lakes of the largest islands. Ground nests are rare. Nests are usually located in trees with bushy, live, broken, and deformed tops. Over the ten-year period 1969-79, the highest nesting activity occurred in nests in heavy old-growth stands and on islets with limited or sparse amounts of timber. Based on average nest tree characteristics, typical nest trees are approximately 400 years old.

Bald eagle nest trees are an important component of eagle habitat. The Bald Eagle Act of 1940 prohibits disturbance or harassment of bald eagles. Known bald eagle nests are protected from timber harvest by state and federal regulations. A Memorandum of Understanding (MOU) between the U.S. Forest Service (USFS) and U.S. Fish and Wildlife Service (USFWS) requires that areas be surveyed for nests and that an undisturbed wildlife habitat zone 330 feet or more in radius be established around each eagle nest tree. Encroachments within the buffer zone are permitted by the USFWS on a case-by-case basis. During the period 1969-1983, 126 variance requests were received by the USFWS for activities in the Tongass National Forest. Fifty-two variances were issued before the impact to the buffer had occurred; 3 were issued following the impacts; 42 requests were denied; 14 nests were found after construction; and 15 variances had insufficient records to determine the circumstances. Forty-one percent of the variance requests occurred during the 1979-1982 period (M. Jacobsen, unpub. data).

Hodges (1982) evaluated the 100-meter protective zone for bald eagle nests in southeast Alaska and concluded that the zone was inadequate for providing nesting and perching habitat indefinitely in the face of adjacent sustained yield clearcut logging practices. He surveyed 89 nests where logging activity had occurred within 1.6 km of the nests, 77 nests 1.6 km or more away from the same logging activities, and 60 additional nests at least 10 km away from any logging activity. Sample sizes were too small to detect a significant difference in nest activity rate as a function of distance from logging development, however he concluded that logging development did not result in a substantial decline of nesting activity. During the five-year period of study, nest destruction rates from natural causes was highest when development activity was within 45 m of the nest trees; and blowdown of nest trees was 20 times more common than when logging activity was further than that distance from the edge of clearcuts. Many protective buffer zones were lost either as a result of human development or as a result of blowdown. He concluded that clearcuts adjacent to protective buffer zones would result in substantial loss of the forested zone within five years and a higher potential for loss of nest trees through blowdown. He recommended that only carefully planned access corridors and selective logging be practiced in shoreline fringe forests and that blowdown be anticipated and cautiously removed along pre-planned routes to minimize disruption of beachfront habitats.

During winter, bald eagles are distributed fairly evenly where food is available along the unfrozen coastline, however large concentrations occur on the Chilkat River near Haines and in response to large eulachon runs during late winter and early spring on specific river systems within the region. Conifers are used extensively for communal roosting during mid- to late fall and winter (Hansen et al. 1984). Wintering populations are significant, with up to 3000-3600 eagles in the Haines area (Hansen et al. 1984) and an estimated 5000-7000 birds in northern southeast Alaska in March - 3000 more than in March during the breeding season (Hodges and Conant 1980). Concentrations of eagles on the Stikine River during eulachon runs reached a peak of 1500 in 1979 (Hughes 1980a).

Perch and roost trees are also an important habitat requirement for bald eagles. Perching and roosting are strategies that help conserve energy output during periods of food shortage and energy stress through reduction of stressful weather conditions and minimizing activity (Hansen et al. 1984).

The USFS-USFWS MOU also requires that a tree, or cluster of trees, if necessary to improve wind-firmness, be preserved in forested areas as feeding and perch trees in each hundred yards of beachfront. No similar provision currently exists for state, municipal, or private lands. Removal of existing or potential perch and feeding trees will remove habitat that provides thermal cover (Stalmaster 1981) and lowered risks of predation and injury (Hansen et al. 1984). Hodges et al. (1982) found that areas without old-growth trees were used less than their proportion of availability for perching.

Timber harvest within winter concentration areas could remove roosting trees which serve the same purposes as perching trees, but are more critical to overwinter survival during periods of severe winter weather. The important Chilkat River Valley winter concentration area and feeding grounds was placed in a protective State Bald Eagle Preserve status in 1982. Other wintering concentration areas and concentrations to exploit seasonally abundant food sources like eulachon are poorly documented so no protective measures have been developed.

Timber harvest could impact bald eagle populations indirectly if adverse impacts occurred to their food sources, especially specific salmon and eulachon runs (Hansen et al. 1984). Food is described by Hansen et al. (1984) as controlling both survival and reproduction. Breeding birds require food in close proximity to their nests during the six-month breeding period and it is likely that only a portion of the breeding habitat offers a stable food supply throughout the period in any given year. Measures which maintain the productivity of salmon and eulachon runs also benefit the eagle population.

A similar problem exists for eagle nest, perch, and roost trees as that for snags; conversion of the large acreages of the forest to second-growth forests on 100-year rotations is likely to significantly reduce the recruitment of trees with the characteristics associated with eagle use as existing nest and roost trees eventually die. The result would be a long-term loss of carrying capacity.

Hansen and Hodges (1985) have recently reported that a large portion of the Southeast eagle population are non-breeding birds, with sub-adults, and unsuccessful breeders comprising 30-89% of the population surveyed in May and June during four different years. Use of available nests ranged from 25 to 49%. The trend in these two population parameters has been toward an increase in the proportion of non-breeders and a decrease in use of available nests. They advanced two hypotheses for the trends: (1) that low breeding rates are normal where food resources are ephemeral so that more individuals survive than can reproduce and (2) that recent environmental disturbance has seriously reduced the breeding rate. They urged that efforts be made to determine the cause of this low breeding rate and also urged that measurement of reproductive success be expanded to include monitoring the status of other population segments to determine long-term population trends. They recommended that managers would be prudent to consider the requirements of sub-adults and non-breeding adults in an eagle population with an excess of non-breeders.

Osprey

Ospreys are one of the few raptors for which habitat information is available in Southeast. Hughes (1980b) identified four active nesting territories including 8 nest sites in the Stikine Area of the Tongass National Forest. All nest trees were located in the spruce-hemlock forests and all nests were at the top of large-diameter trees or snags. Other areas have apparently not been surveyed for osprey nests.

Hughes (1980b) observed mortality of two nestlings one year as a result of behavioral responses by the breeding pair to disturbance created by equipment noise associated with timber cutting and road construction. He concluded the adults were preoccupied with nest defense and were unable to provide adequate food and brooding. Working in northern California, Levenson and Koplin (1984) observed a decline in the average percent of occupied nests producing fledglings and the average number of young fledged per occupied nest with increasing logging activity that commenced after ospreys began nesting. They concluded that logging initiated after nesting commenced had a significant negative impact on productivity of osprey populations. Hughes (1980b) recommended additional surveys for osprey nests, horizontal and vertical buffers around nest sites, monitoring of impacts, and a possible need for restrictions on potential disturbances during the breeding period. Levenson and Koplin (1984) recommended minimizing human activity near nesting ospreys, no initiation of activity after nesting had commenced, and designing logging operations to minimize disruption by delaying operations until the young have fledged.

Marbled Murrelet

Marbled murrelets are seabirds which breed throughout the region and are known to utilize forested habitat for nesting (Quinlan and Hughes in prep.). The department initiated a research project in 1983 to characterize their breeding habitat requirements. Only one nest has been located to date, due to the difficulty of installing radio transmitters on the small birds and tracking them. The nest was located in an area similar to that described as typical for murrelet tree nests by Binford et al. (1975); a large decadent tree, with an open crown structure to allow easy access to feeding areas, and moss-covered limbs large enough to support and camoflauge a nest. The forest stand containing the nest tree was inaccessible for logging, however. Quinlan and Hughes (in prep.) speculate that use of moss-covered limbs for nests may restrict murrelet tree nesting to old-growth forest habitats.

Blue Grouse

Doerr et al. (in press) surveyed breeding male blue grouse on Kuiu Island, Mitkof Island and at Thomas Bay in southeast Alaska. Densities of territorial males averaged 7.2 birds/100 ha in old-growth forests vs. .16/100 ha in clearcuts. Singing males were found in large, live trees and more than 15 m above the ground. Birds located in clearcuts were in live, residual trees, either in individual trees or in clumps of residuals. Their observations suggest that old-growth forests are heavily used and clearcuts largely avoided for breeding habitat. In contrast to studies in areas other than southeast Alaska that have emphasized the importance of open habitats as preferred breeding areas, they found no evidence that territory selection was a function of distance to openings. They recommended that leaving trees greater than 15 cm diameter at breast height (dbh) and more than 80 m from the forest edge might increase breeding use of clearcuts, but emphasized the lack of information concerning habitat needs of blue grouse and relationships between forest succession and seasonal habitat use.

Vancouver Canada Goose

Over 90% of the estimated world population of Vancouver Canada geese (a largely nonmigratory subspecies) occurs in southeast Alaska (Bellrose 1976). This goose nests and rears its broods in forested habitats, a unique phenomenon among waterfowl. Nests have been observed on tree snags and tree-nesting is likely. Trees are used for perching, as well. Forest habitats are used as escape cover by breeding adults and broods and may function as the equivalent of large bodies of water used by other waterfowl to escape from terrestrial predators. Brood-rearing areas and nesting sites are typified by heavy understory vegetation, abundant food sources, and surface water sources. Heavy use is made of one timber stand type with commercial volumes of timber (Lebeda and Ratti 1984). Conversion of these stands to managed second-growth will likely lower the carrying capacity of this habitat for goose production.

Birds - Final Considerations

Research completed to date indicates that several bird species are likely to be adversely impacted by logging, secondary succession, and intensive management of second-growth stands. Timber management will eventually reduce the supply of large, old live trees and large snags. A few species may benefit from early successional stages. While snags can be selectively retained to prolong their useful life in second growth, researchers in the Pacific Northwest have recommended old-growth stand retention as the best overall management strategy (Bull 1978, Raphael and White 1984, Mannan and Meslow 1984). Old-growth stand retention will also maintain habitat for species requiring the characteristics of large, old trees as well as those requiring large snags for breeding, feeding, and winter habitat. Table 3 summarizes the other reported bird species which may fit this category for which research is lacking.

Devising a habitat management strategy for birds is a complex undertaking due to the diversity of species currently present and their corresponding diversity of habitat requirements. Habitat management is of lowest priority for those species that are abundant throughout a variety of habitats and on those habitats that are not commercial forest lands. The selection of Forest Service Management Indicator Species, as required by the National Forest Management Act, and development of monitoring strategies should seek to ensure that the full complement of bird species is maintained. To do so, the process should focus on species most vulnerable to logging impacts, despite the difficulties of monitoring species present in low numbers or difficult to detect.

Table 3. Bird species identified as requiring characteristics of old growth for which research in southeast Alaska is lacking

Downy woodpecker	(Noble 1978, Hughes in prep.)
Sharp-shinned hawk	(Noble 1978)
Red-tailed hawk	(Noble 1978)
Northern goshawk	(Kessler 1979, Meslow et al. 1981)
American kestrel	(Noble and Harrington 1978)
Western screech-owl	(Noble and Harrington 1978, Hughes in prep.)
Northern hawk-owl	(Noble and Harrington 1978, Kessler 1979, Hughes in prep.)
Boreal owl	(Kessler 1979, Hughes in prep.)
Northern saw-whet owl	(Noble and Harrington 1978, Kessler 1979, Hughes in prep.)
Great horned owl	(Kessler 1979)
Great gray owl	(Kessler 1979)
Northern pygmy-owl	(Noble and Harrington 1978)
Blue grouse	(Noble 1978, Doerr et al. in press)
Pine grosbeak	(Noble 1978, Meslow et al. 1981)
Pine siskin	(Noble 1978)
Red crossbill	(Noble 1978)
Boreal chickadee	(Kessler 1979, Hughes in prep.)
Yellow-rumped warbler	(Noble 1978)
Red-breasted nuthatch	(Noble and Harrington 1978, Kessler 1979, Hughes in prep.)
Vaux's swift	(Noble and Harrington 1978, Meslow et al. 1981, Mannan and Meslow 1984)
Northern flicker	(Noble and Harrington 1978)
Common goldeneye	(Noble and Harrington 1978)

CONCLUSIONS AND MANAGEMENT IMPLICATIONS

1) The review of documented impacts from clearcut logging and of research conducted to date in southeast Alaska have documented two likely general patterns of response to clearcutting and post-logging succession in the region:

   a) a loss of habitat carrying capacity in second-growth timber stands for Sitka black-tailed deer, land otter, brown bear, mountain goat, and several bird species, and possibly for marten. Breeding bird studies indicate the following species of birds will be adversely impacted by clearcut logging and resultant succession: yellow-bellied sapsucker, red-breasted sapsucker, golden-crowned kinglet, hairy woodpecker, western flycatcher, varied thrush, Townsend's warbler, chestnut-backed chickadee, blue grouse, osprey, and the Vancouver Canada goose. Concern also exists for removal of old-growth winter habitat for cavity-nesting resident bird species, the brown creeper, hairy woodpecker, three-toed woodpecker, and chestnut-backed chickadee; and of breeding bird habitat for an early migrant cavity-nester, the red-breasted sapsucker.

      For wildlife species which are adversely affected throughout post-logging succession or by the long-term loss of old-growth forest characteristics, avoiding timber harvest in optimum habitat is the appropriate management strategy. The management goal should be to identify and maximize the amount of optimum habitat to be retained, for example, retention of low elevation (1000 feet and below), high-volume old-growth timber stands which are relatively rare in occurrence in southeast Alaska and which comprise critical deer winter range; and

   b) a short-term benefit during the early clearcut stage of succession (3 to 15-25 years) due to increased abundant forb and shrub production in combination with a loss of winter habitat carrying capacity during periods of deep snow accumulation. The wildlife species that appear to exhibit this response pattern include black bear, moose, long-tailed vole, wolf (indirectly from deer population responses), and a number of migratory breeding bird species that nest and/or feed in understory vegetation. Due to loss of the understory, the benefits of this stage are absent in the pole stand stage of succession which occurs for approximately 75% of the rotation. The carrying capacity of the pole stand is low to non-existent for these species.

      For wildlife species that are beneficially affected during early clearcut stages of succession but which require winter habitat with relatively shallow snow depths, long-term scheduling of timber harvest to maximize the availability of both types of habitat through time is the appropriate habitat management strategy. The goal of habitat management should be to ensure an optimum mix of old-growth and early-clearcut-stage forest stands that will be distributed in time and space in a manner that is appropriate to the species' typical movement patterns.

2) Other patterns of response include a loss of carrying capacity until well into the pole stand stage (when spruce cone production resumes for red squirrels), avoidable losses through maintenance of riparian buffer strips (beaver), short-term responses dependent on suitable snag retention in clearcuts followed by a long-term loss of carrying capacity, through lack of suitable snag recruitment (flying squirrels, cavity-nesting birds), and a long-term loss of carrying capacity through lack of old-growth nest tree recruitment (bald eagle).

   Land managers should develop and implement policies to retain riparian habitat and to manage stands for retention and recruitment of large-diameter snags.

3) Adverse impacts of increased human access have also been documented, and have been particularly severe for mountain goats and the brown/grizzly bear leading to severe population declines in other portions of their range. Black bears, deer, moose, and furbearers will also be subject to the potential for local over-harvests, displacement, and harassment from increased human activity.

   One objective of timber sale planning should be to minimize the effects of roading and increased human activity on vulnerable wildlife species. Guidelines and mitigative measures, including no roading in wildlife concentration areas as identified by the Alaska Department of Fish and Game, should be developed and implemented. Roading of areas in advance of timber sales, and particularly when no timber harvest activity is scheduled within five or ten-year planning horizons, should not occur.

4) Timber harvest activity can affect wildlife habitat through disturbance of habitats adjacent to forest stands. Most notably, adverse impacts to beaver pond habitat through roading or hydrological changes will also adversely affect several fish species, muskrats, and waterfowl, and should be avoided during timber sale planning.

5) Research should be conducted to further delineate wildlife habitat requirements and responses to second-growth timber management. Research from other geographic areas should be relied upon for habitat management direction only when its applicability and relevancy to habitat conditions in southeast Alaska can be clearly demonstrated.

6) Adverse impacts on habitats adjacent to cutting units and other indirect adverse impacts to wildlife should be minimized through long-range planning and on-the-ground monitoring.

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PART II

The Impacts of Clearcut Logging on the Fisheries Resources of Southeast Alaska

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INTRODUCTION

Land and water system processes that shape the character of the aquatic environment are complex and dynamic. The activities of man can affect these processes in ways that result in environmental changes that go beyond natural effects or result in impacts that otherwise would not have taken place.

Salmonid fishes have definite freshwater habitat requirements. Considerable data have been collected that indicate timber harvesting and associated road construction activities alter many habitat variables critical to salmonid fishes. Certain of these impacts singularly or collectively produce short and long term effects on salmonid populations and their users. However, in Alaska, long-term effects of logging on fish populations are still not completely understood because logging and related research are relatively new to the region.

Research on the habitat requirements of juvenile salmonids and the effects of logging on rearing ecology is on-going in the region. A more detailed literature review on this aspect of logging effects will be contained in a 1985 Alaska Department of Fish and Game Federal Aid in Fish Restoration and Anadromous Fish Studies Annual Report (Elliott, in press).

IMPORTANT AQUATIC HABITAT VARIABLES FOR FISH PRODUCTION

STREAMFLOW AND HYDROLOGICAL DYNAMICS

Streamflow is defined as "the amount of water flowing in a channel per unit time," and is only meaningful in regards to fish habitat when it is correlated with water velocity, depth, the amount of channel covered, and how the flow, at a particular time, compares to what is considered normal for the channel (Chamberlain, 1982).

Streamflow can be a barrier to fish movement when the depth is too shallow or velocity is too high (Thompson, 1972). Obviously, when there is no escape from depths too shallow to maintain adequate oxygen and moisture for a fish, death results. Drought conditions can strand adult pink and chum salmon in pools in southeast Alaska as the water level drops, where they often die from anoxic conditions (Murphy in press).

Streamflow requirements by fish vary by life history stage. Optimum streamflows for spawning in given channels are those that will maximize the availability of suitable areas during the spawning season. If flows are so low that suitable spawning gravel is dewatered, eggs will not be deposited in these areas and potential productivity will not be realized from these areas. However, Reiser and White (1983) have documented high survival of king salmon eggs which were deposited but dewatered during the winter. As flow increases, there is a level past which velocity may be so high that eggs deposited in the gravel are washed away, also resulting in lost potential production (Reiser and Bjornn, 1979).

The streamflow requirements for salmonid egg incubations have not been determined because it is difficult to measure flows through the intragravel environment. However, it is generally assumed that to assure successful incubation of salmonid embryos, enough surface flow should be present to permit emergence of fry out of the gravel and velocities no greater than that which would scour gravel from redds ("nests" where eggs have been deposited). Rapid water fluctuations and increased peak flows can result in direct mortality of salmon eggs (Gangmark and Broad 1956) and trout eggs (Seegrist and Gard 1972).

Recommendations concerning the required streamflows for salmonid rearing have usually been based indirectly on the relationships of habitat components such as food or cover as they are affected by streamflows rather than directly to productivity in terms of numbers or biomass of fish (Reiser and Bjornn, 1979). The density of juvenile anadromous salmonids may be regulated by the abundance of food in some streams (Chapman, 1966). Streamflow is related to the amount of cover available, which is related to the standing crop of juvenile salmon (Murphy et al. 1985; Heifetz, in press).

The most significant effects of streamflow are the effects of freshets on juvenile abundance. Hartman et al. (1982) and Scrivener and Anderson (1984) showed that if coho fry emerge earlier than normal, their numbers are rapidly reduced by spring floods.

Some researchers believe that water velocity is the most important parameter in determining the distribution of aquatic invertebrates, one of the primary food sources for fish, in streams (Scott, 1958; Allen, 1959). The relationship between water depth and aquatic invertebrate production is not well understood. In one study, mayflies, stoneflies, and caddisflies were found in depths less than 0.3 meters (Kimble and Wesche, 1975). Hooper (1973) reported that areas of highest invertebrate production most often occur in streams at depths between 0.15 and 0.9 meters if substrates and velocities are suitable.

Water depths are important because juvenile salmonids have requirements for space in streams which vary with species, age, and time of year and are likely related to the abundance of food (Chapman, 1966). The standing crop of coho salmon has been shown to be directly related to pool volume (Nickelson and Hafele, 1978) and a similar relationship has been shown for chinook salmon in small streams (Bjornn et al., 1977).

Streamflow is an important site-specific variable, but it is only one aspect of the hydrologic cycle of a watershed that is affected by timber harvesting. Streamflow can be considered an output in an overall watershed balance equation:

$$\text{Inputs} - \text{Losses} \pm \text{Storage} = \text{Output},$$

where inputs include amounts of rain, snow, and fog drip; losses include amounts of evaporation from water, ground, and foliage, transpiration from plants, and deep seepage to ground water tables; storage may be in amounts of water in surface depressions, the soil, in channels, or as snowpacks; and, as mentioned above, the amount of stream runoff is the output. The equation expresses the relationship between the amounts of water in each component at any given time, but not with the rates of movement of water over time, which can also be affected by land use practices.

WATER QUALITY

The principal water quality parameters important for the quality of salmonid fish habitat that may be affected by land use activities are temperature, dissolved oxygen content, sediment levels, and organic matter content (Chamberlain, 1982).

Temperature: Salmonid fishes are cold water organisms, and have definite thermal requirements for physiological functioning. Water temperature affects growth rate, swimming ability, functional behaviors like catching and using food, and resistance to disease. Water temperature also affects the availability of dissolved oxygen in water, because more oxygen stays in solution at lower temperatures. Table 1 lists preferred, optimum, and upper lethal temperatures (degrees Celsius) of selected salmonid fishes and illustrates that salmonids generally prefer rather narrow ranges of temperature.

Researchers have found that sub-lethal high temperatures result in cessation of growth and feeding and lower fry densities. Salmonids cease growth at 20.3 C because metabolic activity increases instead at the expense of growth. Growth rates of chinook parr increase as temperature increases from 10.0 C to 15.7 C; growth rates then decrease with increasing temperature (Burrows in Reiser and Bjornn 1979). A similar relation for brook trout has been shown. Growth rate increases as temperature increases from 9.1 to 13.1 C and there is a decrease in growth rate after temperature exceeds 17.1 C. At 17.1 C, brook trout cease feeding and at 21.2 C eat only 0.85% of their body weight per day (Baldwin 1956).

Successful incubation of salmonid eggs occurs within a range of upper and lower lethal temperatures as well. Combs and Burrows (1957) and Combs (1965) showed that pink and chinook salmon eggs can tolerate long periods of low temperature and remain viable as long as the temperature during initial deposition and early embryogenesis is above 6.0 C. Extremely cold air and water can cause mortality on incubating eggs and alevins (yolk sac fry) by the formation of frazil ice or anchor ice that reduces water exchange in the gravel (Neave, 1953; McNeil, 1966; Reiser and Bjornn, 1979).

Water temperatures also affect adult and juvenile fish. Water temperature affects upstream migration of adult anadromous salmonids (Reiser and Bjornn, 1979). Sheridan (1962) showed that the timing of pink salmon runs was associated with temperature and Hartmen and Holtby (1982) found that warmer waters may inhibit coho adults from le 1. Preferred, optimum and lethal temperature ranges of selected fish species in degrees Celsius (from Reiser and Bjornn 1978)

SPECIES	PREFERRED TEMP. RANGE	OPTIMUM TEMP.	UPPER LETHAL TEMP.
Chinook	7.3 - 14.6	12.2	25.2
Coho	11.8 - 14.6	---	25.8
Chum	11.2 - 14.6	13.5	25.8
Pink	5.6 - 14.6	10.1	25.8
Sockeye	11.2 - 14.6	---	24.6
Steelhead	7.3 - 14.6	10.1	24.1
Cutthroat	9.5 - 12.9	---	23.0

entering streams. Abnormal stream temperatures can facilitate disease outbreaks and accelerate or retard ripening for spawning.

Water temperature also appears to regulate the density of salmonids. Hahn (1977) found twice as many steelhead fry in stream channels at 13.5 C than in a channel at 18.5 C and that fry density at 8.5 C was double that at 13.5 C. Stream temperatures in Southeast Alaska frequently exceed these levels during the months of July and August.

Dissolved Oxygen Concentration: Survival and development of salmonid eggs and embryos occurs within a critical range of dissolved oxygen concentrations (Lindroth, 1942; Hayes et al., 1951; Wickett, 1954; Alderdice et al., 1958). Laboratory tests with coho, chum, and chinook salmon, and steelhead trout eggs indicate the following relationships: sac fry from embryos incubated in low and intermediate oxygen concentrations are smaller and weaker than sac fry reared at higher concentrations (Silver et al., 1963); reduced oxygen concentrations lead to smaller newly hatched fry and a lengthened incubation period (Shumway et al., 1964); and low oxygen concentrations in the earliest stages of development can delay hatching or increase the incidence of abnormal embryos (Alderdice et al., 1958).

Dissolved oxygen concentrations in streams are important to rearing salmonids. Generally, stream water is at or near saturation levels for oxygen, however, the warmer the water, the less dissolved oxygen the water can contain at saturation. Herrmann et al. (1962) showed that growth rate, food consumption rate, and the efficiency of food utilization of juvenile coho salmon all decline when oxygen is less than 6 mg/L. Also, juvenile chinook salmon avoid water with oxygen concentrations near 1.5 to 4.5 mg/L in the summer, but show weaker avoidance reactions to low levels in the fall when temperatures are lower (Whitmore et al., 1960).

The swimming speed of rainbow trout is impaired by reduced oxygen levels in the water (Jones, 1971). Low dissolved oxygen concentrations can adversely affect the swimming performance of migrating salmonids (Reiser and Bjornn, 1979). Low dissolved oxygen can also cause avoidance reactions or cause migration to stop (Whitmore et al., 1960). Oxygen levels recommended for spawning fish include levels at the 80% saturation level and temporary absolute levels no lower than 5.0 mg/L.

Sediment Load: Suspended and deposited fine sediment can adversely affect salmonid habitat if present in excessive amounts. Streams with silt loads averaging less than 25 mg/L of suspended sediment can be expected to support good freshwater fisheries (Reiser and Bjornn, 1979), assuming that other environmental elements to be suitable. On the other hand, high levels of suspended solids may abrade and clog fish gills, reduce rates of feeding, and cause fish to avoid some areas (Trautman, 1933; Pautzke, 1938; Smith, 1939; Kemp, 1949; Wallen, 1951; Cooper, 1956; Bachman, 1958; Cordone and Kelley, 1961).

Suspended sediment directly affects rearing salmonids. Long term exposure of coho salmon and steelhead to suspended sediment (11-14 days at 23-84 NTU's) results in lower growth rates and greater emigration from test channels (Sigler et al. 1984). Observations of trout in the wild indicate that fish cease feeding at 35 mg/L suspended sediment (Bachman 1958) or reduce their feeding rate (Bachman 1984). Decrease in feeding rates may be responsible for low growth rates of salmonids, as observed by Sigler et al. (1984). Suspended sediment can fill in the interstices of, or completely cover, stream gravels, and where gravels are used as cover by juveniles, suitable foraging sites and refuge sites may be lost. The rate of production in coho can be reduced (Crouse et al. 1981) or emigration of steelhead and chinook can result (Bjornn et al. 1977).

Deposited sediment can change the composition of spawning substrates and reduce permeability to oxygen. McNeil and Ahnell (1964) determined that highly productive spawning streams have gravels with high permeability. Permeability is high when bottom materials have less than 5% sands and silts and is low when fine sediments make up more than 15% of the bottom material. Successful fry emergence is impaired as well by excessive amounts of sand and silt in the gravel. Koski (1966) examined redds where eggs had developed normally but the hatched fry were unable to emerge because of sediment. Phillips et al. (1975) found an inverse relation between quantity of fine sediments and fry emergence.

<u>NUTRIENT CYCLING</u>: Information regarding nutrient cycling in aquatic habitats is limited and even more limited concerning the relationships of nutrient cycling to fish production.

<u>PHYSICAL HABITAT FEATURES</u>

<u>Stream banks</u>: Stream bank areas provide lower water velocities compared to main stream currents. Undercut banks, overhanging root complexes, vegetation, and stable debris provide shade and protection from predators. Root networks contribute to stream bank stability and minimize bank erosion during high water flows (Chamberlain, 1982).

<u>Riparian Vegetation</u>: Plants living adjacent to streams, as mentioned above, help maintain stream bank integrity, which in turn provides continued shelter for rearing and spawning anadromous salmonids. Riparian vegetation also directly provides overhead cover and protection for fish. Certain anadromous salmonids, like chinook salmon and steelhead trout enter freshwater months before they spawn, and cover is essential for fish waiting to spawn (Reiser and Bjornn, 1979). Nearness of cover to spawning areas may be a factor in the selection of spawning sites by some species (Johnson et al., 1966; Reiser and Wesche, 1977).

Cover is extremely important to rearing salmonids, the life stage most vulnerable to predation by other fish, birds and mammals. Riparian vegetation is used by most salmonids as overhead cover (Newman, 1956; Wickham, 1967; Butler and Hawthorne, 1968; Baldes and Vincent, 1969;

Bjornn, 1969; Chapman and Bjornn, 1969; Lewis, 1969). Streamside vegetation also provides shade which is important in maintaining cool water, as discussed earlier. This factor appears to be important not just in temperate zones but in southeast Alaska as well (Meehan, 1970).

The presence of streamside vegetation enhances food supplies in the stream. Plant detritus (dead matter) that falls into streams from streamside vegetation may be an important source of food to aquatic invertebrates, which in turn are sources of food for fish. Terrestrial insects and other invertebrates that fall into streams from nearby plants also are eaten by fish. In southeast Alaska, rearing anadromous salmonids feed heavily on invertebrates that either fall from riparian vegetation, or else live in the streams but obtain energy from riparian plant detritus (Schmidt and Robards, 1974; Schmidt, 1975; Schmidt, 1976).

Finally, large plants like spruce, hemlock, and cottonwood provide sources of large organic debris (LOD) when they fall into streams, after death, when currents cut banks and undermine these large trees, or when they are blowndown during storms. These downed trees, which have a stream life yet to be accurately determined, create water velocity barriers, plunge pools, and provide cover for rearing and spawning anadromous salmonids. LOD appears to have a significant role in the evolution and maintenance of stream habitat diversity.

Barriers: Permanent blocks to fish movements, like large waterfalls, have always been a significant factor in shaping the distribution of anadromous salmonids in a stream system. Man has often attempted to open up new habitat for anadromous fish by devising ways to get fish above previously insurmountable barriers. Other natural barriers to upstream migrants may include excessive water velocities, debris jams, low water flows, excessive water temperatures, and pollution. All of these are of a more temporary nature, with the possible exception of large debris jams, and all can be the result of the activities of man.

SHORT-TERM EFFECTS ON FISH HABITAT

The activities of road construction, movement of logging equipment, felling and yarding of trees, and transportation of logs result in direct impacts to fish habitat which cease when the activities cease or which are relatively short-term. The major categories of impacts are changes in water quality parameters and changes in the physical structure of the habitat. By their nature, streams possess a natural capacity to restore disturbed portions to natural functioning, for example, flood flows will re-distribute sediment that has settled. The forest industry and forest managers have also developed logging practices, termed "best management practices" which help to minimize the extent or duration of short-term impacts during periods of human activity.

The extent and duration of impacts are directly related, in particular, to management of the riparian area adjacent to the stream.

This riparian area, or streamside zone, is comprised of vegetation in the extended floodplain of the stream which is influenced by its proximity to the stream and the stream's flooding characteristics. The natural streamside zone contributes to maintenance of fish habitat in several ways, thus activities related to timber harvesting which occur in this zone can affect these natural functions.

CHANGES IN WATER QUALITY

Temperature

The removal of streamside vegetation during timber harvest activities increases solar radiation to the stream and results in warmer water during the summer, especially in small streams (Greene, 1950; Chapman, 1962; Reinhart et al., 1963; Brown and Krygier, 1967, 1970; Levno and Rothacher, 1967; Gray and Edington, 1969; Meehan et al., 1969; Meehan, 1970; Brown et al., 1971; Narver, 1972; Tyler and Gibbons, 1973; Moring and Lantz, 1974). As water warms, its capacity for containing dissolved oxygen is diminished, which in turn can lead to salmon mortality from hypoxia. The magnitude of temperature change depends on the amount of timber harvested adjacent to a stream (Meehan et al., 1969; Brown and Krygier, 1970) and is a temporary effect until streamside vegetation regrows.

One of the most detailed studies on the effects of logging on a watershed has been the 15-year Alsea Watershed Study in coastal Oregon (Moring, 1975). Three small headwater tributaries were studied. One stream served as a control and remained unlogged, another watershed was completely clearcut, and a third was partially clearcut with buffer strips left along the stream. Water temperature ranges and maximums increased in the completely cut watershed and monthly average temperatures increased over pre-logging averages by 12.7 C in June, 11.8 C in July, and 9.3 C in August. Water temperatures in the completely cut watershed exceeded the pre-logging maximum fluctuation (4.4 C) 28% of the days in 1966 and 82% of the days in 1967. At no time during or after logging were these maximum fluctuations exceeded in the buffered or control creeks.

In southeast Alaska, Meehan et al. (1969) found that maximum temperature in logged streams exceeded those of unlogged control streams by about 5 C, but that temperatures did not reach levels lethal to juvenile salmonids. The increased water temperatures frequently exceeded the optimum for pink and chum salmon documented by Reiser and Bjornn (1979).

High summer air temperature has, however, been associated with adult salmon mortality. The Alaska Department of Fish and Game compiled a list of 43 streams that had mortality of pink and chum salmon in 1977 associated with high water temperature and low flow. The largest clearcut in Alaska is located within the watershed of Staney Creek. In 1979 15,000 pink salmon died there before spawning, a result of warm water and low oxygen. In an effort to help cool Staney Creek, the FS planted cottonwood trees along the stream to provide shade.

Murphy (1985) concluded that mortality of adult salmon in another instance, was primarily due to low water and suffocation, rather than warm water and thermal shock. Fish were stranded in pools when the water level became low during lowtide and that they then depleted the oxygen in the water. High temperatures could also have been an exacerbating factor, however, because warmer water contains less oxygen at saturation than cooler water.

Removal of riparian vegetation in northern areas may result in lower stream temperatures during winter, increasing the chances for frazil and anchor ice formation (Chamberlain, 1982).

Research at Carnation Creek, British Columbia showed that logging of coastal watersheds can cause a shift in temperature regimes that results in a complex chain of physical and biological effects. Winter water temperatures were warmer after logging, resulting in accelerated development rates of incubating salmonid eggs and alevins. This caused emergent coho fry to leave the gravel earlier than normal, and at a time when spring freshets are common. Consequently, many fry were swept to sea causing some sections of the stream to be underpopulated. The resulting low density population grew faster and fish were larger by fall. Larger fish tended to have better winter survival and greater potential to smolt at an earlier age. This resulted in a positive effect by increasing the number of smolt leaving the stream and by presumably increasing the adult return (Hartman et al. 1982).

The implications of these processes are unclear for southeast Alaska. As described in a following section, other research shows that regardless of increased summer growth, the number of potential smolt is regulated by the amount of winter habitat (Mason 1976) and by the severity of the winter climate (Murphy and Elliott, unpub. data) thus causing a neutral effect after logging. Other research suggests that rapid growth would stimulate some fish to leave the stream in the fall rather than during the spring, or chum fry to enter estuaries prior to the spring phytoplankton blooms that are their major food (Hartman and Holtby 1982). Fall and early smolt have poor marine survival and thus do not contribute to the fishery and can result in a negative effect by decreasing the number of returning adults.

Thus, in streams that have been logged, extended periods of high temperature will occur which may affect feeding, growth rates, and the density of juvenile salmonids. Additional research is needed concerning the effects of increased winter temperatures. Lower winter temperatures could result in winter mortality in the gravel, while higher winter temberatures could result in early emergence and vulnerability to flooding. It is presumed that temperature regimes return to normal levels after regrowth of vegetation occurs in the watershed. Some streams however, are considered particularly "temperature-sensitive" and prone to temperature extremes. The USFS has developed criteria to define this stream type. Special measures are needed to maintain their normal temperature regime.

Dissolved Oxygen Concentration

Logging can affect dissolved oxygen concentrations when organic debris, logging slash, or fine sediments enter streams and accumulate on and in streambeds. This accumulation reduces concentrations of dissolved oxygen in intergravel spaces and places a higher biological oxygen demand on available supplies. Research indicates that excessive logging debris in streams can reduce stream velocity and exchange of intergravel water. Fine sediments can also clog surface gravels and restrict intergravel flow enough to lower dissolved oxygen concentrations. This latter type of flow restriction is more often associated with road construction and land slides (Chamberlain, 1982).

Increases in stream temperatures can exacerbate adult mortality during drought conditions. Additionally, rapidly growing, second-growth forests with higher water demands may reduce streamflows relative to pre-logging levels. Combinations of high temperatures and decreased stream flows may occur more frequently until vegetation regrows to shade the stream, which can be 50 years.

The Alsea Watershed Study investigated the effects of logging on dissolved oxygen concentrations in streams. Clearcutting a tributary stream leaving no buffer strips resulted in sharp declines in surface dissolved oxygen levels during the summer of logging when debris was in the stream bed. After debris was removed and winter rains came, surface levels of dissolved oxygen returned to pre-logging levels (Moring, 1975). The study also showed a dramatic decrease in intragravel dissolved oxygen during the winter after logging, which could lower successful incubation rates for salmonid eggs.

Sediment Load

There are four main ways in which sediment is introduced into streams as a result of timber harvest: (1) harvesting techniques which cause mass slope failure, and landslides; (2) landslides caused by road building, erosion of roadbeds and gravel pits; (3) streambank and stream channel disturbance, and (4) construction of bridge and culvert crossings.

Clearcutting practices, construction of logging roads, and resultant landslides have caused sediment to wash into salmon streams in this region and elsewhere (Sheridan and McNeil, 1968; Novak, 1975; Cordone and Kelly, 1961). Studies conducted in southeast Alaska on the effects of sedimentation on salmon, have focused on sediment particles with diameters of 0.833 mm or smaller as those most likely reducing gravel permeability. A significant percentage increase in this size range of sediment was noted in the Harris River by Sheridan and McNeil (1968) and in 108 Creek by Novak (1975) following logging. However, results from these early studies were inconclusive regarding effects on salmon numbers because of the variation in escapement management (Pella and Myren 1974; Sheridan 1982).

Suspended sediment in streams is increased from accelerated surface erosion or slope mass movements, both of which may result from timber harvest and road construction activities. The Alsea Study showed significant increases in suspended sediments from 293.8 to 451.0 metric tons per year in Deer Creek (the watershed with patch clearcuts and buffer strips) following road construction and from 39.5 to 120.6 metric tons per year (205.0% increase) in Needle Branch (the watershed completely clearcut). Sediment discharge increased by only 0.1% in Flynn Creek (control creek) during the same time period.

Sediment deposition can alter or destroy stream benthic communities which comprise fish food sources (Newbold et al., 1980; Culp and Davies, 1983). Sedimentation can also cause mortality of incubating salmon eggs and alevins. Cederholm et al. (1981) showed that cumulative sedimentation from logging roads significantly reduces the survival of coho salmon eggs and alevins (sac fry in the gravel) (Clearwater, Washington). Where egg survival is being impaired both Cederholm (1981) and McNeil (1980) recommend increased escapement to offset the effect of lowered production. The Carnation Creek study on Vancouver Island, B.C. concluded that a significant reduction in the survival of chum and coho from egg to emergent fry occurred due to fines settling in the top strata of gravel spawning beds after logging commenced (Scrivener and Brownlee, 1981, Holtby and Hartman, 1982). Results of the Carnation Creek study also indicated that large freshet flows flushed fines out of the gravels when the source of sediment had been arrested. However, fines less than 0.297 mm persisted in the gravel for more than a year.

Sedimentation as a result of road construction or development of rock and gravel sources have been documented in southeast Alaska, and landslides have been triggered by these activities. Benda (1983) showed that during road construction there was an 11.5% increase in sediment particles less than 4.0 mm diameter and a significantly lowered mean survival of pink salmon alevin resulting from a 2,300 m rock and overburden slide into a tributary of the Blossom River in southeast Alaska. Often, the rock source for a road is located above a stream on an adjacent mountain slope. In many cases fine powdered rock from the pit enters the stream via overland washing and becomes a chronic point-source of sedimentation (Edgington 1976). Debris avalanches are natural events in the relative young soils of southeast Alaska and the conditions that trigger such mass wasting are fairly well understood (Swanston 1970). However, road building under mountain slopes and rainfall conditions conducive to avalanching caused two major land slides on Bear Creek (Mitkof Island) in 1976. These slides covered a total of 7 and 13 acres, dammed the stream and cost in excess of $29,000 to rehabilitate (Edgington and Larson, 1977).

Mass wasting of slopes is a common natural event in southeast Alaska. Logging can trigger landslides by destabilizing soils. Neither the frequency of occurrence nor the extent of damage resulting from landslides or road building is reported or monitored in a standardized fashion by the USFS. Several slides that were a result of logging activities have, however, been observed by Alaska Department of Fish and Game staff. Bishop and Stevens (1984) noted a four-fold increase in the rate of landslides in Maybeso Creek valley following logging. A reporting mechanism should be activated to track the sources and extent of land disturbances that may affect salmon streams.

Logging in and through a stream can also result in massive siltation. The USFS documented a logging contract violation that almost completely eliminated the odd year pink salmon cycle into Bayhead Creek, Freshwater Bay, in 1964. The Alaska Department of Fish and Game noted virtually no return of adults in 1965 and 1967 to Bayhead Creek, whereas, in 1966 and 1968 (the even year cycle) several thousand spawners returned to the creek. A similar contract violation occurred in Saginaw Creek, Saginaw Bay, in 1965.

Most short-term severe sedimentation events such as landslides or road failure are caused by human error, poor layout design, or from activities in violation of standard practices. Evidence from Carnation Creek studies in British Columbia suggests that sedimentation from bank destruction and destabilization of debris may be a greater and more long-term source of mortality of salmonid embryos. Though most sediment is flushed from the stream in one year, there is concern that sedimentation and bedload movement associated with bank erosion and channelization may be increasing (Holtby and Hartman 1982).

Introduction of sediment into streams is an inevitable consequence of many logging activities, but best management practices can minimize the duration or amount. Activities can also be timed to avoid sensitive periods for fish or take advantage of the stream's capacity for flushing the sediments from spawning gravels.

Research on the impacts of sedimentation on fish is on-going in the region. Sheridan (1982) has recommended an assessment of numbers of spawners, egg deposition, number of pre-emergent fry, sediment levels in the gravels in selected portions of the stream, and evaluation of the effects of climatic variability on embryo survival to assess the impact of logging.

Current methods of sampling gravel use the single or triple freeze core technique (Everest et al. 1981) which was developed to reduce sample size variation. The U.S. Forest Service Forestry Sciences Laboratory in Juneau has studies in progress designed to measure seasonal changes in gravel substrate of pink salmon spawning streams and to further understand the relationship of fine sediment and emergence of fry. An instrument is also in the final stages of testing by the laboratory that will be able to measure intergravel water flow. This instrument will greatly enhance the efficiency of the study of survival of fry in the gravel by providing measurements of the most important single physical parameter of the gravel environment (Meehan 1984). The understanding of stream sedimentation dynamics in salmon streams is increasing, but is not at a level that "trade-off" discussions in fish-forest management can be discussed. In the meantime, Sheridan et al. (1984) recommends that stringent guidelines governing logging practices can minimize the addition of sediments into streams.

Logging Slash and Debris Deposition

Clearcutting to or across small streams frequently deposits large quantities of woody debris such as limbs, boles, and non-merchantable timber. Logging debris is generally smaller and accumulations more dense than naturally occurring debris. Bryant (1983) showed that, on Prince of Wales Island, logging can produce as much as seven times the amount of debris occurring in unlogged streams.

Hall and Baker (1975) summarized beneficial and adverse effects of deposits of organic debris on fish habitats. Most adverse effects arise from water quality impacts such as increased biological oxygen demand (BOD), decreased instream and intragravel oxygen (Hall and Lantz 1969; Berry 1974; Ponce 1974), and toxic leachates (Buchanan et al. 1976). Water-soluble leachates of the western red cedar (Thuga plicata) which is logged in some portions of the region have been shown to be toxic to juvenile coho salmon at 0.33 mg/L for foliage terpenes and 2.7 mg/L for tropolones (Peters et al. 1976). However, neither BOD problems nor toxic leachate concentrations resulting from timber harvest activities have been documented in southeast Alaska.

Debris jams, whether natural or caused by human activities, can prevent or delay upstream migration (Merell, 1951; Narver, 1971). One study showed a 75% decrease in spawning salmon in a stream because of debris blockage (Chapman, 1962). Elliott (in press) also found that removal of logging debris improved access for adult pink salmon and provided new spawning habitat. However, it is important to note that large organic debris (LOD) can be an important habitat feature beneficial to fish. Reiser and Bjornn (1979) recommended that all debris jams should be evaluated before they are removed.

Removal of logging residue from streams can also have impacts on fish habitat. Removal is a common practice and has been conducted on many streams in southeast Alaska, but with no evaluation of its effects on fish or other biota. On the other hand, Cardinal (1980) and Dolloff (1983) found that juvenile Dolly Varden char and coho salmon are both highly associated with logging debris, and that densities in littered streams are similar to that of both species in pristine streams. Furthermore, Cardinal (1980) predicted that removal of logging debris would have a detrimental effect on abundance of rearing salmonids. Elliott (unpublished) found that removal of logging debris caused an 80% reduction in the abundance of juvenile Dolly Varden, a temporary reduction in benthos numbers, and speculated that it might result in a long-term destabilization of the char population. Bryant (1983) summarized these and other findings and developed concise guidelines for conditions under which debris is to be removed, the goals of debris removal, and procedures for debris removal.

The impacts of debris deposition and removal on physical habitat structure is discussed in the next section of the report.

CHANGES IN THE PHYSICAL STRUCTURE OF THE HABITAT

Juvenile Fish Habitat

Two important stream habitat functions are directly related to the carrying capacity, or maximum density of stream dwelling salmonid fishes in a stream: 1) the stream must include foraging habitat where fish can reside in low-velocity water "pockets" from which they venture out to perform various life functions and 2) the stream must include refuge habitat where fish can seek concealment when disturbed, e.g. undercut banks (Bachman 1984). Habitat requirements change with age, size, and season (Bachman 1982; 1984).

The habitat required by adult salmon during their brief spawning period is much more limited than habitat required by rearing juvenile salmon and resident salmon and trout.

Declining water temperatures during the fall reduce metabolic activity and swimming performance (Brett 1964), and habitat may be selected that provides shelter for fish from floods (Bustard and Narver 1975a and b). Winter habitat is considered by many researchers to be the most critical factor in determining the annual abundance of juveniles during their freshwater life, for in the absence of suitable winter cover, populations can be greatly reduced by floods (Tschaplinski and Hartman 1983; Mason 1976).

In southeast Alaska coastal streams, optimum habitat for juveniles is formed by the hydraulic action of water plunging over or moving around large organic debris (LOD) such as logs or root boles. The cutting action of the stream scours out pools and provides quiet areas free from the velocity of the main current. About 70% of the stream habitat structures that are used by juveniles are formed by the influence of LOD (Murphy and Koski in press; Elliott unpublished) making it the single most important feature characterizing rearing salmonid habitat.

Timber harvest affects summer and winter habitat in several ways: 1) LOD can be removed mechanically, 2) undercut banks can be broken down, 3) streams can be "overcleaned" of LOD if logging debris is removed, and 4) the growth of streamside vegetation can be enhanced. Stream banks, more than any other habitat component, are susceptible to direct affects from logging activity. Felling trees across streams, yarding trees through or across streams, operating heavy machinery adjacent to streams, and removing vegetation which has roots that strengthen stream bank soil structure, all can potentially drastically affect the integrity of stream banks. Water table increases in riparian zones also weaken stream bank structure (Chamberlain, 1982). Cross-stream yarding can dislodge and destabilize in-stream debris, often moving it to near-shore areas. Yarding of logs parallel to, or up stream channels, is particularly destructive. Removal of logging debris, even by experienced crews, frequently results in overcleaning of LOD from streams with much natural debris being removed in the process (Murphy and Koski in press). These adverse impacts, however, appear to be limited to site-specific and localized situations. Elliott (unpublished) found no significant difference in the amount of debris in a sample of logged and forested streams in the northern Tongass forest.

Cutting and yarding operations can collapse undercut banks, eliminating valuable cover for juveniles, if equipment operates adjacent to the banks or drags logs across them. Murphy and Koski (in press) and Elliott (unpublished) have found undercut bank habitat to be reduced by 50% following logging. Streamside logging can also destabilize undercuts, which contributes to their collapse during freshets and resultant reduction in coho abundance (Tschaplinski and Hartman 1983).

Removal of the forest canopy can have a positive effect on fish habitat through stimulation of profuse growth of streamside vegetation. Vegetation can form valuable cover for juveniles, especially when it overhangs pools or other quiet areas, although it is not universally important as cover in all locations. Overhanging vegetation, especially when in flower, is important in attracting numerous terrestrial insects which contribute to the food supply of juvenile fish (Meehan et al. 1977).

The effects of logging on coho salmon productivity and proper streamside zone management is an area of active research in the region. Earlier researchers documented that low levels of algal production in forested streams was related to the poor light conditions found under the dense timber canopies (Stockner and Shortreed 1975). Primary productivity of small streams has been shown to increase after clearcutting to the edge of stream banks, primarily due to improved sunlight penetration. Increases in nutrients and temperature are other factors thay may also contribute to increased primary productivity (Bormann and Likens 1970; Hansmann and Phinney 1973; Murphy and Koski in press). Additionally, in one study area, Murphy and Koski (in press) found a strong correlation between increased algal production in clearcuts and elevated levels of aquatic benthos production. They concluded that these factors are responsible for the increased abundance of age 0 coho fry in logged streams, relative to coho fry abundance in forested streams. These findings corroborate the conclusions of others and the observations that the density of juveniles may be limited by food supplies and that juveniles frequently respond to increases in food supply with an increase in rearing density (McFadden 1969; Mason and Chapman 1965; Hunt 1969). Not only are fry more numerous but they appear to be slightly larger in size (Elliott unpublished). Increased size is thought to be a response to longer growing seasons rather than increased food supply (Tschaplinski and Hartman 1983; Scrivener and Andersen 1984). Murphy and Koski's most recent data analysis (unpub.) has correlated this fry response with a specific geographic area of the region with a characteristic limestone bedrock geology. Thus, the response is variable, but the factors responsible for variability are just beginning to be understood.

Under some conditions, larger fry can result in better survival, more smolts, and presumably higher adult salmon returns (Hartment et al. 1982), however winter habitat is considered the limiting factor in many southeast streams, so that larger fry and larger fry populations may not result in higher productivity and salmon harvests. Fry populations in pristine settings can be extremely ephemeral, sometimes rapidly decreasing in number during their first year in fresh water (Chapman 1965; Crone and Bond 1976). As they grow, demands for food and space increase and populations adjust by decreasing their density, usually through emigration of the least fit individuals (Chapman 1966). However, when food is abundant relative to fry recruitment, space requirements decrease (McFadden 1969; Mason 1976) permitting higher densities of fry, a condition that has been observed in Oregon clearcuts (Murphy and Hall 1981) and in some southeast Alaska clearcuts (Murphy and Koski in press). Experiments by Mason (1976) demonstrated that supplemental feedings of fry increase the number and biomass of coho fry by 6-7 times that found in natural streams. However, he showed that the increased number of coho do not survive the winter and emigrate (during fall-winter floods) due to the lack of suitable winter cover required to support the population at elevated levels. Mason (1976) concluded that "a 6-7 fold increase in potential smolt yield induced by a supplemental feeding strategy during the summer was nullified by the natural carrying capacity of the stream over winter." This conclusion is further supported by findings that habitat used during the summer, which can support large numbers of fish, is not necessarily beneficial during the winter. The behavior of juvenile coho salmon changes at the onset of fall and they move deeper in pools and to recesses provided by LOD (Bustard and Narver 1975a).

As noted earlier, the amount and quality of LOD is probably the most critical factor in determining the suitability of winter habitat; Heifetz et al. (in press) showed that habitat with LOD is used extensively by wintering coho and steelhead but the same types of habitat without LOD are not used. Thus, the above findings strongly suggest that winter habitat is limited to stream structures with specific characteristics and that smolt yield is directly related to the amount of winter habitat. Furthermore, though clearcutting may produce an abundance of fry during the summer in some streams, there is evidence that these fish may not survive and contribute to smolt yield over and above that dictated by winter habitat.

Channel Morphology

Because logging debris is more densely concentrated (up to seven times) than most natural accumulations, it can severely constrict flows. The results may be rapid stream bed and stream bank cutting and destabilization of all woody material (Bryant 1983). When logging debris enters a stream, it is loose and floats easily. Thus, it will move in channels during floods, and dislodge more stable accumulations, release sediment, and increase channel instability. Large concentrations of unstable material can have adverse effects on channel morphology and the general suitability of streams for salmonid spawning and rearing. As organic material and sediment shift along the stream, gravel bars are formed, erosion occurs around piles of large organic debris, and channels become unstable. Heavy loading of debris in streams of more than 10% gradient can cause debris torrents that scour out entire channels and deposit massive jams downstream.

Research at Carnation Creek, British Columbia, also demonstrated that logging to or across streams can destabilize channels and streambanks, increasing erosion, sedimentation, and bedload shift (Holtby and Hartman, 1982). These logging impacts have been implicated in declining egg-fry survival of salmonids at Carnation Creek. Stream destabilization after logging has been documented at Harris River (Bryant, 1980) and elsewhere in southeast Alaska. Consequently, it is reasonable to assume that decreased egg-fry survival as a result of streamside logging may be occurring in Alaska as well. Research is needed to determine the extent and severity of these effects.

LONG TERM EFFECTS ON FISH HABITAT

STREAMFLOW AND HYDROLOGICAL DYNAMICS

Timber harvesting usually does not alter the total amount of rain or snow falling on a watershed basin (Troendle, 1980), except where foliage intercepts significant quantities of fog (Harr, 1980). This exception has not been shown to be an important part of the water cycle in southeast Alaska.

Removal of the forest canopy does, however, result in dramatic changes in the distribution of water and snow on the ground through changes in the amounts intercepted or evaporated by foliage, the rates of snow melt or evaporation from snow, the amounts that can be stored in the soil or transpired from the soil by vegetation, and the physical structure of the soil, which determines the rate and routes of water movement to stream channels (Chamberlain, 1982).

Clearcut areas alter wind patterns, resulting in more snow being trapped in them. Winds can often be more intense in forest openings, which will also augment snow melt. Because the soil in forest openings is wetter and nearer its saturation level, meltwater comes out faster, which can result in earlier and higher peak flows (Swanson and Hillman, 1977; Gary, 1979; Troendle, 1980). Whether or not increased flows from a specific logged area actually cause a change in the runoff for an entire basin depends on the distribution of openings in the basin, their aspect, elevation, and distance from stream channels.

Removal of trees from a forest area eliminates countless leaves and stems that would have intercepted, stored, and reevaporated rain and snow. The death of tree roots also reduces the amount of water that can be transpired from the soil and removed from runoff. Other effects of timber harvest related to hydrological cycling can include an increase in ground water levels and content of water in soils which also weakens soil strength and leads to increased rates of slope mass movements after timber harvesting (O'Loughlin, 1972; Swanston, 1974). The amound of roading in a watershed can also affect peak streamflows by increasing the rate of runoff and decreasing soil storage capacity (Gilleran, 1968; Harper, 1969; Hsieh, 1970; Harr et al., 1975).

The net effect of timber harvesting on streamflows has been shown to be increased flows immediately after clearcut logging (Rowe, 1963; Rothacher, 1965, 1970, 1971; Berndt and Swank, 1970; Meehan et al., 1969), with streams of low discharge being affected more than larger streams (Riggs, 1965).

The effects on streamflow patterns in southeast Alaska that will result from the replacement of old-growth forests with second-growth forests are not known. In rapidly growing second-growth forests stands (greater than 20 years old) water requirements for vegetative growth may be greater than in either forested or newly clearcut watersheds. Lower soil water content, less runoff to streams, and lowered minimum flows have been documented through limited studies in second-growth forests in regions other than southeast Alaska (Berndt and Swank 1970, Myren and Ellis, 1984). Thus, the most significant effects on salmonids may occur in the long-term when forests begin to return rather than immediately following logging.

BARRIERS TO FISH PASSAGE

One of the greatest impacts to anadromous fish from activities associated with timber harvest is the improper placement of culverts where logging roads cross streams. If improperly placed, road culverts can restrict upstream access for fish by the creation of outfall barriers (waterfalls), excessive water velocities through the culvert, insufficient water in the culvert, the lack of resting pools below the culvert, or any combination of the above conditions (Yee and Roelofs, 1980). In addition to improper culvert placement, logging debris from hillsides can, over time, collect at the heads of culverts, causing fish blocks (Chamberlain, 1982).

NUTRIENT CYCLING

Dramatic increases in levels of nitrate, phosphate, and organic carbon have been documented in streams after nearby logging and slash burning, however, there is no evidence that this affects fish deleteriously. However, if nutrient enrichment results in algal blooms, algae could clog gravel interstices which could be detrimental to fish production (Chamberlain, 1982).

In forested streams where there is little sunlight, energy enters aquatic communities from leaves, twigs, needles, etc., which also provide sources of carbon, nitrogen, and other nutrients. Organic particulates are consumed by aquatic invertebrates, which in turn are consumed by juvenile salmonids. This process (the heterotrophic energy pathway) occurs to a greater degree in headwater sections of streams where light penetration is poor. In downstream sections of streams, where the canopy is more divided, permitting more light to reach the water, stream communities utilize a mixture of autotrophic and heterotrophic energy pathways. In other words, energy is accumulated via photosynthetic (light-fixing) processes and from organisms extracting energy from fine particulate detritus transported downstream from headwater sections.

Clearcutting shifts the energetic character of headwater sections to that which is more representative of downstream sections. This shift, however, occurs without the benefit of upstream carbon input and could, therefore, affect the diversity of aquatic communities and their functions. It is not known how these effects will impact fish communities, but, presumably, community function will gradually revert to conditions similar to pre-logging conditions after 40 to 60 years, when the second-growth forest develops into a pole stand along the stream margins.

PHYSICAL HABITAT STRUCTURE-RECRUITMENT OF INSTREAM WOODY DEBRIS

As described under short-term impacts, woody debris from forest sources is a critical feature of stream habitat in coastal Alaska, providing foraging and refuge sites for juveniles during summer and protection against floods during winter. Long-term changes may occur in the quality and quantity of LOD and LOD-formed habitat after clearcutting. Natural stream processes such as mechanical abrasion, biological activity, and especially floods, gradually reduce and transport woody debris downstream. In forested streams, the downstream transport and replacement from the forest through windthrow, etc. is a continuous cycle and debris formed habitat remains at relatively constant levels over time. But where clearcutting occurs adjacent to streams, the source of debris is eliminated and stream processes, uninterrupted, will continue to remove debris but will do so without any replacement occurring. Using data from old forest fires, Swanson and Lienkaemper (1978) estimated that debris gradually disappears from streams, and that after 110 years, instream debris is reduced to 50% of former levels.

Second-growth forests begin to contribute debris at about 110 years and debris loading is estimated to return to natural levels by 150+ years after source removal. Sedell and Triska (1977) suggest an even slower rate of debris accumulation in streams. They found that accumulation of debris is asymptotic and requires about 450 years to recover to natural levels in streams where all native material was removed.

The rate at which stream processes remove debris is unknown. Decay and removal rates in fresh water appear to be very slow because of low biological activity. Even on land, where decay rates are more rapid, downed logs can last from 100-200 years and large logs have been found that have been on the ground for more than 450 years (Franklin et al. 1981). The rate of removal in streams is probably dependent on stream size as material may be very persistent in small channels but more temporary in large channels.

Rearing salmonids are strongly associated with LOD and LOD-formed habitat. This relationship permits the calculation of the density of juveniles per volume of LOD with fair accuracy. Assuming a maximum loss of 50% of LOD in the first 110 years after clearcutting, equations developed by Elliott (unpublished) predict a loss of about 30% carrying capacity for juvenile coho during the summer. Since juveniles are even more strongly associated with LOD during winter (Heifetz et al. in press) the total loss in annual carrying capacity could be as high as 50%.

Streamside logging at Carnation Creek has led to gradual and accelerating changes in stream morphometry caused by bank erosion and channelization due to the cutting of streamside trees and from debris transport caused by general logging techniques. These factors may cause continued degradation of habitat quality which will eventually compromise overwinter survival (Holtby and Hartman 1982) and may undercut increases in summer production (Mason 1976).

If left to themselves after clearcutting, streams will in time gradually repair themselves. However, by 110-150 years after the first cutting, the forest will again be harvested. This will occur at a time when instream debris may not have recovered sufficiently to support optimum densities of juveniles. The result of this scenario is a gradual and perhaps permanent debilitation of stream habitat and a decrease in the yield of salmonid smolt.

BUFFER STRIPS

Buffer strips of undistrubed streamside vegetation have long been advocated by fishery managers as a technique to preserve fish habitat during and after logging. Buffers provide shade preventing increased water temperature during the summer months (Brazier and Brown 1973, Meehan 1970). Streamside canopy is also thought to moderate winter low temperatures although the mechanisms involved are poorly understood and existing data inconclusive. Buffer strips prevent sedimentation by preserving and maintaining streambanks and filtering run-off to streams. Finally buffer strips provide overhead cover for rearing juveniles, provide energy via allocthonous detritus, provide food through terrestrial insect contribution (Meehan et al. 1977), and most importantly, provide a source of large woody debris needed to stabilize channels and provide instream habitat structures for summer and winter rearing (Grette 1985, Heifetz 1985, Lammel 1972).

Buffer strips are an integral part of streamside management strategies in British Columbia (Moore 1977) and in Washington (Gillick and Scott 1975). Buffer strips, however, are not widely used in southeast Alaska, primarily because of their susceptibility to blow-down during storms. However, Murphy et al. (in press) demonstrated that blow-down within buffer strips often forms beneficial winter habitat and juvenile coho densities can be greater in these areas compared to other reaches of stream. If the potential for blow-down is high, buffer strips can be thinned or designed to resist winds (Moore 1977, Steinblums et al. 1984).

Where buffer strips are impractical due to potential wind-throw, other methods of habitat management are possible. These include the addition of large woody debris to anchor stream channels and to provide habitat for juveniles. Management of stream habitat by manipulating debris must take into account the specific habitat preferences of juveniles, particularly for winter habitat. Debris management has had mixed success in Oregon and Washington; introduced structures often wash out during freshets and some are ineffective in forming habitat. Debris management projects are also planned for southeast Alaska. These projects, however, suffer from inadequate experimental design and the lack of long-term evaluation of effects of introduced debris on stream channels and fish populations. Research is needed to assist land and fish managers in designing criteria and standards for debris management over a wide spectrum of stream and channel types and in respect to the varied requirements of different salmonid species.

CONCLUSIONS

We reviewed recent scientific investigations being conducted in southeast Alaska on the effects of logging on fish. Although there are areas of needed additional research, a significant body of knowledge has been developed. The following is a summary of the more pertinent findings.

Stream Flow:

1) Streamflow generally increases after logging. Variations in streamflow between watersheds after logging appear to be due to the amount of area harvested and the amount of roads. Potential effects of increased streamflows include:

   -- An increase in the amount of rearing area and an increase in the production of rearing salmonids.

   -- Increased bank erosion and sedimentation causing lower egg-fry survival.

   -- Exacerbation of sedimentation by shifting of destabilized woody debris.

2) Conversion to second-growth forests may cause a reduction in streamflow relative to pre-logging flow regimes, however the applicability of limited studies to southeast Alaska is not known. Potential effects of decreased flows include:

   -- A reduction in rearing salmonid carrying capacity by a reduction in rearing area.

   -- Warmer water temperatures, although this may be offset by improved shading.

   -- An increase in the frequency of adult "die-offs" during mid-summer drought conditions.

Temperature:

1) Temperature increases in proportion to the amount of streamside canopy removal. Temperature should revert to normal regimes when second growth canopy develops to a height capable of shading the stream.

2) Increased temperature can persist through the winter and shorten the development time of incubating salmon eggs and alevins, causing earlier emergence. Early emerging pink and chum salmon fry may enter the estuary prior to spring blooms of marine plankton and experience a food shortage. Early emerging coho and other rearing species enter streams at a time when floods are more common and may be swept downstream and lost to the system, causing reduced rearing density. Elevated primary productivity and longer growing season results in higher growth rates and

larger fish. Larger fish can have greater summer and winter survival rates, in some streams, yielding more smolts of a larger size, which increases adult return. These effects are short-lived, however as second growth should reduce temperatures to pre-logging levels 15-20 years after cutting.

The timing of pink salmon runs is correlated with stream temperature. Changes in watershed temperature could inhibit upstream migration of adult pink, chum, and coho salmon.

Sedimentation:

1) Sedimentation can increase over natural levels as a result of catastrophic incidents attributable to human error, poor planning, or improper design and layout. Streamside logging leads to gradual, but accelerating, changes in stream morphology with increasing rates of sedimentation and bedload movement. Chronic sedimentation can occur as a result of increased streamflow and accelerated erosion, bank destruction, destabilization of mid-stream woody debris, destabilization or loss of debris that anchors streambanks, and the death of tree roots that support or strengthen streambanks. Potential effects of sedimentation include:

   -- A decrease in egg-fry survival of salmonids.

   -- Intense pulses of sediment affecting rearing salmonid behavior and decreasing feeding and growth rate.

   -- A reduction of benthos diversity and abundance, thus changes in fish food supplies.

   -- A reduction in pool habitat and habitat carrying capacity.

2) If sources of sedimentation are arrested, most fines are flushed from the system during freshets and are usually removed within one year.

Light Levels and Nutrients:

1) Solar penetration increases with timber canopy removal and, in conjunction with increased temperature and nutrients, leads to increased primary production, elevated benthos production, and (where nutrients are abundant) increases the density of coho fry during the summer.

2) Changes in stream productivity are presumed to be, in part, responsible for higher growth rates and earlier smolt age of juvenile coho. Increased production in some studies has been nullified by the winter carrying capacity, which is regulated by the amount of winter habitat.

Stream Habitat Structures:

1) In coastal forest streams, habitat is formed by the influence of streambank conifers and the introduction and incorporation of large woody debris. Woody debris and the low-velocity conditions it creates are essential for optimum rearing production.

2) Logging can overload streams with introduced debris. In large streams, debris is transported downstream where it can dislodge natural accumulations and cause channel modification and sedimentation. Debris in large streams generally does not create barriers to upstream migrants since streams scour passages under or around large jams.

3) In small streams debris remains in place. Fresh green material can potentially cause a decrease in dissolved oxygen and its leachates can create conditions toxic to fish. Slash in small streams is dense and interlocked and can create barriers to upstream migrant adults.

4) Dense logging debris loses most of its leachates after one year and does not constitute a water quality problem thereafter. Dense accumulations do not inhibit rearing salmonid production; in some cases, production may actually be increased by providing greater amounts of cover.

5) Overly zealous clearance of logging slash often removes natural as well as introduced material. Removal of too much debris deprives juveniles of cover and populations can be seriously reduced during fall freshets. Populations remain unstable for years afterward until stream habitat is rehabilitated.

6) Loss or destabilization of mid-stream woody debris, disturbance of debris that anchors streambanks, or death of tree roots that support bank structures can reduce the amount of high-quality rearing habitat. This reduces summer and winter carrying capacity and may affect smolt yield. Losses in smolt yield resulting from habitat degradation may nullify increases in summer productivity or, in conjunction with severe winters, may cause a net loss of smolt relative to pre-logging levels.

7) Long term effects on habitat quality may result from stream destabilization as observed in Carnation Creek, British Columbia, and from lack of recruitment of woody debris upon removal of streamside timber. Data suggests a 30-50% decrease in carrying capacity occurring 80 years after initial cutting of streamside conifers.

8) Stream protection and mitigation techniques should be applied during logging as the key to preserving the productive capacity of streams over the short and long term. The two most promising techniques are buffer strips and debris management but design criteria for these techniques need to be determined through applied research before maximum benefit can be gained from their use. Design criteria should address:

a) Buffer strip design and the number and type of trees that should be left in buffer strips to prevent severe windthrow and to maintain the benefits to salmonids.

b) The application of techniques for managing large woody debris in streams that have been clearcut logged to streambanks.

9) Additional research should be conducted to:

a) Determine if changes in winter temperature regimes occur in southeast Alaska as a result of timber harvest and how winter temperature changes affect salmonid stocks.

b) Determine the extent and severity of streamside destabilization caused by logging and how salmonid stocks are affected. Research should be conducted in three phases: (1) survey watersheds to document the number of streams affected; (2) determine if decreased egg-fry survival is occurring in the affected streams; (3) develop techniques for rehabilitating affected streams.

c) Correlate intergravel water flows to fry survival.

10) Stringent guidelines should be implemented to minimize the addition of sediment to streams from logging-related activities.

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A Regional Overview of Fish and Wildlife Use in Southeast Alaska

By Marilyn Sigman

Report No. 85-4

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Division of Habitat
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ERRATA SHEET

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Please note the following corrections:

1. Page 5, paragraph 6: The Forest Service is an Ad Hoc member of the northern and southern Southeast Alaska Planning Teams.

2. Table 1 contained errors. A corrected table is attached.

Attachment

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

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INTRODUCTION

Southeast Alaska provides substantial fish and wildlife harvests to its residents and to visitors from other regions of the state and from outside the state. The abundant fish and wildlife are also an important attractant for the tourist industry in the region. Fish and wildlife resources thus support two of the major types of employment in the region.

The following is intended as a general description of the magnitude and types of fish and wildlife harvests and, where information is available, the economic value of the regional harvests. Quantitative information on nonconsumptive use of fish and wildlife and revenues generated in the tourist industry specific to the region are not currently available.

More specific information on local fish and wildlife use patterns is available in Coastal Zone Management planning documents for Haines, Skagway, Juneau, Yakutat, Petersburg, Kake, Ketchikan, Annette Island, Craig, Klawock, Hydaburg, Sitka, Pelican, and Hoonah. In addition, resource use summaries have been completed for the Southwest Prince of Wales area (ADFG 1984a) and the Haines area (ADFG 1984b).

COMMERCIAL FISHERIES

Southeast Alaska provides a significant portion of the commercial fish catches in Alaska. Alaskan catches, in turn, are significant in terms of total United States catches, with Alaska being the leading state in terms of the total value of fishery landings. Fishing is one of four principal sources of employment in the region and in many communities is the dominant and sometimes only significant means of livelihood. Employment in fish harvesting has been relatively stable following enactment of a limited entry permit system for all salmon fisheries; however, fishing effort for shellfish, herring and herring roe, halibut, and groundfish is increasing to supplement salmon fishing during other seasons. Considerable information exists on the magnitude and value of the region's fish harvest, particularly of the salmon harvest.

SALMON HARVEST AND RETURNS TO FISHERMEN

The salmon fishery accounts for most of the harvest activity in the region. The five species of Pacific salmon (pink, chum, coho, chinook, and sockeye) are all harvested by a variety of gear types and managed by a variety of harvest/stock maintenance strategies. A detailed discussion is beyond the scope of this report but can be found in the regional salmon plan documents prepared for southern and northern southeast Alaska (JSARPT 1980) and for Yakutat (ADFG 1984c).

The most important species, in terms of number of fish caught, is the pink salmon, which has accounted for 75-90% of the salmon harvest since the early 1900's. Although the contribution in numbers for the other four species is relatively small, they are of much higher economic value on a per-pound basis, and they therefore contribute significantly to the total economic value of the catch. For example, in 1977-78, the average ex-vessel value for one chinook salmon was $26.33 compared to $1.36 for one pink salmon. The different species also have different importance to the fishermen using different types of gear, with trollers targeting and harvesting the majority of chinook and coho salmon, purse seiners the majority of pinks and chums, and gillnetters the majority of sockeyes and chums.

The salmon landings in the Southeast Region are an important part of the statewide landings. Table 1 illustrates the contribution of the harvest of each salmon species to statewide totals in one year. In 1984, 23% of the statewide total was caught in Southeast. Historically, the contribution has ranged from 16 to 25% during the 1979-83 period and from 20 to 50% between 1970-75.

As can be seen, regional catches of chinook, coho, and pink salmon contributed a higher percentage than the average 25% in 1983.

It is difficult to estimate the amount of the ex-vessel value of fish (amount paid at dockside) that is a net return to fishermen and their crews once fishing expenses are subtracted. Based on two studies of fisherman income for the herring and salmon fisheries (Larson 1980) and for the shellfish fisheries (Queirolo et al. 1979), Kreinheder and Teal (1982) estimated that total net income for a skipper and crew would be roughly 47 to 57% of gross earnings. Based on an ex-vessel value of $59 million in 1983, return of $28 to 34 million to fishermen in net income can be calculated. The ex-vessel values shown in Table 1 represent the gross earnings by fishermen.

Table 2 shows salmon harvests in terms of numbers of fish, by species, from 1970 to 1984. The catch is increasing, with the exception of chinook salmon. The current strategy of salmon management is to rebuild the stocks that spawn in some streams in the region from the low levels to which they declined in the 1950's and early 1970's. Regional comprehensive salmon plans (JSARPT 1980, ADFG 1984c) have targeted increased production of more salmon by the year 2000. The strategy adopted assumes that the natural productivity of streams will be maintained through stream-habitat protection.

Although recent salmon harvests have been high, they do not approach the historical record harvests that occurred in the 1940's prior to intensive fishing with fish traps.

Table 3 illustrates the fluctuating nature of harvests and ex-vessel values over the 10-year period from 1974 through 1983. Larger harvests may be worth less if fish prices are low. The ex-vessel values shown in Table 1 for 1983 represent a period of extremely low prices relative to the 10-year period.

Table 1. 1983 Regional Salmon Catch and Ex-Vessel Value

Salmon Species	lbs Landed	Ex-Vessel Value ($)	% of Statewide Ex-Vessel Value
Chinook (king)	4,627,000	15,683,000	46
Sockeye (red)	9,544,000	305,661,000	4
Coho (silver)	13,672,000	26,890,000	59
Pink (humpy)	117,133,000	193,977,000	59
Chum (dog)	10,695,000	79,186,000	16
TOTAL	155,677,000	59,255,000	25

Source: ADFG 1984d.

Table 2. Southeast Alaska Region Annual Commercial Salmon Catches in Numbers by Species, 1970 to Present (ADFG 12/18/84)

Year	Chinook	Sockeye	Coho	Pink	Chum	Total
1970	322,370	667,909	758,911	10,657,293	2,446,110	14,852,593
1971	333,997	623,269	914,423	9,344,830	1,946,105	13,162,624
1972	286,834	916,720	1,508,677	12,399,807	2,942,311	18,054,349
1973	343,834	1,011,595	836,400	6,455,488	1,832,215	10,479,532
1974	346,570	687,422	1,276,941	4,888,711	1,684,315	8,883,959
1975	300,707	245,191	424,657	4,026,520	686,615	5,683,690
1976	241,803	595,259	821,801	5,329,598	1,030,877	8,019,338
1977	285,220	1,085,143	943,138	13,843,562	738,723	16,895,786
1978	401,424	788,319	1,714,508	21,243,378	868,963	25,016,592
1979	367,620	1,073,885	1,278,742	10,977,908	888,276	14,586,431
1980	323,296	1,120,416	1,136,685	14,478,306	1,651,407	18,710,110
1981	271,891	1,079,630	1,407,734	18,967,933	849,821	22,577,009
1982	299,531	1,493,585	2,137,826	24,248,533	1,351,553	29,531,028
1983	292,445	1,568,912	1,989,112	37,511,248	1,195,603	42,557,320
Average 1970 to 1983	315,539	925,518	1,224,968	13,883,794	1,436,635	17,786,455
1984 Prelim.	273,481	1,207,213	1,934,448	25,830,351	4,054,878	33,300,371

Source: ADFG 1985.

Table 3. Ten-year Comparative Production in Thousands of Pounds and Value in Thousands of Dollars of Salmon Harvested in Southeastern Alaska

	Roe		Chinook		Sockeye		Coho		Pink		Chum	
Year	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1974	1,542	4,916	3,027	3,801	3,008	5,401	6,431	7,540	13,567	18,980	11,053	12,369
1975	194	634	2,748	4,247	2,136	2,389	2,417	3,041	10,430	13,535	8,459	9,489
1976	1,461	5,147	2,652	5,945	3,738	5,843	4,557	8,092	14,883	19,930	7,691	10,005
1977	1,857	8,099	3,918	12,602	4,941	8,983	6,122	12,838	35,495	43,969	4,387	5,671
1978	2,136	8,811	5,923	14,437	5,202	10,328	10,381	23,671	35,910	43,397	5,184	6,837
1979	2,037	9,878	4,841	15,684	5,108	11,074	6,714	19,124	23,170	30,841	5,497	9,940
1980	2,235	7,306	4,551	14,141	4,474	9,763	5,916	14,197	31,716	48,683	10,367	14,518
1981	3,341	12,054	4,045	12,739	4,805	11,238	8,135	18,503	47,954	70,423	5,513	7,538
1982	3,328	9,578	4,121	14,491	7,638	14,517	12,474	24,922	50,797	54,700	9,312	11,490
1983	3,847	8,563	4,296	12,257	7,093	12,907	12,016	21,404	67,098	85,025	7,756	9,150

Source: ADFG 1984*d*

HARVEST OF NON-SALMON SPECIES AND RETURNS TO FISHERMEN

Harvests of fish and shellfish other than salmon are significant. Table 4 summarizes the catch and value of other fish besides salmon in southeast Alaska in 1983 (ADF&G 1984d). In addition, some 8.8 million pounds of halibut were landed at southeastern ports.

Several 1983 harvests were a significant portion of statewide harvests. Sixty-seven percent of the total flounder and sole, 97% of the total rockfish, 90% of the total sablefish, 32% of the total herring sac roe, 25% of the total herring, 100% of the total abalone, 36% of the total Dungeness crab, and 35% of the total shrimp harvested in Alaska were harvested in southeast Alaska.

Table 5 summarizes 10 years of regional production and value from selected shellfish species. Based on the assumption of 47-57% net return to fishermen (Kreinheder and Teal 1982), the $81 million ex-vessel value in 1983 would return $38 to $46 million to the fishermen.

ECONOMIC RETURNS TO PROCESSORS, WHOLESALERS, AND OTHER SECTORS OF THE ECONOMY FROM COMMERCIAL FISH HARVESTING

Estimates of processor returns are not available. Table 6 provides an estimate of the wholesale value of the 1983 harvest, by species. This wholesale value is in addition to the ex-vessel value to fishermen.

The economic analysis contained in the regional Comprehensive Salmon Plan (JSARPT 1980) provides a multiplier factor of 1.45 for money respent within the region or state on diverse goods and services. Thus, the $59 million ex-vessel value in 1983 would translate to $86 million, and the $149 million wholesale value would equal $216 million.

COMMERCIAL FISHING INDUSTRY EMPLOYMENT

Harvesting Employment

Fish-harvesting employment is difficult to quantify because no reporting requirements similar to those for other industries exist. Monthly employment statistics for other types of nonagricultural employment are based on one specific week of the month as representative of the month, which could entirely miss the fishing activity for the month. Instead, vessel landings and average crew sizes for each type of vessel have been used as an index to employment in Alaskan fisheries. The Alaska Department of Labor (ADL) compiled statistics for the 1977-81 period (ADL 1983) and for the 1981-82 period (ADL 1985). More recent statistics are not available.

Table 4. Catch in Thousands of Pounds and Value in Thousands of Dollars to Fishermen of Harvests Other Than Salmon, Southeast Region, 1983

	Lb	Value
Finfish		
Cod, Pacific	40	15
Flounder & sole	549	101
Rockfish	877	389
Perch, Pacific Ocean	0	0
Pollock (whiting)	---	---
Sablefish	5,232	2,852
Other groundfish	88	31
Herring, roe-on-kelp	---	---
Herring, eggs	---	---
Herring, bait	1,749	249
Herring, sac roe	18,511	8,685
Herring, food	84	819
Trout & char	42	24
Whitefish & smelt	17	8
Other miscellaneous	2	1
Fishery Total	27,191	13,175
Shellfish		
Clams	0	0
Scallops	1	2
Abalone	47	131
Crab, Dungeness	4,711	4,401
Crab, king (general)	3	10
Crab, red king	282	1,131
Crab, blue king	37	135
Crab, brown king	572	1,882
Crab, Tanner (General)	18	20
Crab, Tanner (*Bairdi*)	154	180
Crab, Tanner (*Opilio*)	---	---
Crab, horsehair	---	---
Shrimp	2,414	1,313
Other shellfish	8	4
Deadloss - shellfish	31	0
Fishery Total	8,279	9,210
State Total	191,330	81,640

Source: ADFG 1984d.

--- No data were available.

Table 5. Ten-year Comparative Production in Thousands of Pounds and Value in Thousands of Dollars of Fish Harvests Other Than Salmon, Southeast Region

	Dungeness Crab		King Crab		Tanner Crab		Shrimp		Abalone	
Year	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
1974	751	1,004	181	431	242	421	1,270	773	---	---
1975	789	682	501	575	358	609	844	752	---	---
1976	515	738	203	467	207	422	800	1,833	---	---
1977	31	83	91	381	217	436	768	1,586	12	34
1978	606	996	215	1,026	285	698	1,333	1,700	136	278
1979	647	805	273	867	214	644	459	1,030	65	145
1980	92	346	191	1,713	272	950	670	1,640	181	291
1981	2,882	5,588	646	2,898	242	735	1,457	3,385	199	636
1982	4,548	8,903	684	5,133	403	1,269	2,185	7,086	81	249
1983	2,606	7,207	565	4,686	649	2,703	112	278	26	101

Source: ADFG 1984a.

Table 6. Production in Thousands of Pounds and Wholesale Value in Thousands of Dollars of the Fish Harvest, Southeast Region, 1983

Species	Pounds	Value
Salmon		
Salmon, roe	3,847	8,563
Chinook (king)	4,296	12,257
Sockeye (red)	7,093	12,907
Coho (silver)	12,016	21,404
Pink (humpy)	67,098	85,025
Chum (dog)	7,756	9,150
Fishery Total	102,105	149,308
Other Finfish		
Cod, Pacific	34	23
Flounder & Sole	275	78
Rockfish	650	518
Perch, Pacific Ocean	---	---
Halibut	8,829	13,936
Pollock (whiting)	---	---
Sablefish	4,186	4,047
Other groundfish	53	42
Herring, roe-on-kelp	---	---
Herring, eggs	4	17
Herring, bait	385	150
Herring, sac roe	17,404	14,515
Herring, food	84	21
Trout & char	29	46
Whitefish & smelt	9	7
Other miscellaneous	---	---
Fishery Total	31,941	33,397
Shellfish		
Clams	---	---
Scallops	---	---
Abalone	26	101
Crab, Dungeness	2,606	7,207
Crab, king (general)	535	4,452
Crab, red king	25	194
Crab, blue king	2	17
Crab, brown king	3	23
Crab, Tanner (general)	10	40
Crab, Tanner (Bairdi)	102	238
Crab, Tanner (Opilio)	---	---
Crab, horsehair	---	---
Shrimp	649	2,703
Other shellfish	2	2
Fishery Total	3,959	14,977
State Total	138,005	197,683

Source: ADFG 1984d.

--- No data were available.

Salmon Harvest Employment

Commercial salmon was the leader in annual average employment (68% of the region's fish-harvesting employment in 1982), as well as in volume and value of the fishery. Average annual employment in southeast Alaska peaked at 1,750 harvesters (excluding tenders, packers, and processors) in 1978 and declined to 1,400 in 1981, as entry to the fishery was limited, and then increased to 1,519 in 1982. Fish-harvesting employment increased 8% in 1982, a greater rate of increase than in other areas of the state. Employment in the purse seine gear type increased 23% over that in 1981, and the salmon troll fishery employment had more fish harvesters than any other gear type. Peak monthly employment, which occurs in July or August, ranged from 4,800 to 5,900 from 1978 through 1982.

Table 7 shows monthly peak employment for salmon and other major species fished and the peak average annual employment. As can be seen, different harvests peak at different times of the year, providing opportunities for periods of seasonal employment.

Regional commercial fishing employment is a significant portion of statewide fisheries employment, ranging from 25 to 30% of average annual employment during the 1977-82 period.

Non-salmon Harvest Employment

Employment in harvests for fish species other than salmon are also reported by the Alaska Department of Labor (ADL 1983, 1985). Employment in shellfish harvest grew from 4% of the statewide total in 1977 to 12% in 1982, and to 41% of the statewide total from 1981 to 1982. The share of the statewide total is expected to increase as shellfish stocks are declining in areas that formerly provided the bulk of the harvest. Twenty-eight percent of southeast Alaska's shellfish employment in the late 1970's was shrimp harvesting. Peak monthly employment occurs in the fall, and the highest year was 1980, with 300 employed. The peak average annual employment in the 1977-82 period was 202 in 1982.

Employment in the halibut fishery and income to fishermen has fluctuated with the trend toward shorter openings and the fluctuating price of halibut. Participation in the fishery peaks in May or June and it has ranged from 1,250 fishermen in 1977 to 3,550 in 1981. In 1979, a high-income year, 7 million pounds were caught, with a gross value of 13 million dollars. The highest average annual employment was 450 in 1979.

The herring fishery has grown steadily over the years. Twenty-five percent of the statewide herring employment occurred in southeast Alaska. Herring harvest periods are short, and consequently average employment figures are low relative to more sustained fisheries. However, the value of herring roe taken during an opening is substantial. Peak monthly employment occurs in April, with a peak monthly employment of 500 in 1982 and a peak average annual employment of 77 in 1981 during the 1977-82 period. Herring harvest employment increased 22% between 1981 and 1982.

Table 7. Peak Employment from Southeast Alaska Fisheries, 1977-82

Fishery	Month of of Occurrence Monthly Employment	Peak Monthly Employment	Peak Average Annual Employment
Salmon	July or August	5,900 (1978)	1,750 (1978)
Shellfish	Sept. - Dec.	300 (1980)	202 (1982)
Halibut	May or June	3,714 (1982)	446 (1979)
Bottomfish/ sablefish	July	221 (1982)	105 (1980)
Herring	April or March	500 (1982)	77 (1981)
TOTAL	June, July, or August	6,696 (1979)	2,220 (1982)

Source: ADL 1983, 1985.

Employment in groundfish harvest has grown substantially as the state has funded an extensive effort to promote increased participation. Employment increased 220% from 1977 to 1981, with the greatest portion of the employment occurring in southeast Alaska. The fishery provides year-round harvesting but peaks in September, with a peak monthly employment of 221 in 1982 and peak average annual employment of 105 in 1980.

Fish-Processing Employment and Wages

Forty-three companies employed a peak of 2,813 employees in 68 land-based facilities within the region in 1983. In addition, the same number of companies employed a peak of 811 employees in 81 processing vessels (ADFG 1985). Employment is increasing with the trend to expansion of fisheries products. Average annual employment increased from 857 to 1,241 from 1979 to 1983, a 45% increase (ADL 1983). Average annual employment dropped from 2,068 in 1981 to 1,541 in 1982, a 25% decrease, due to a number of factors, including a high 1981 canned salmon inventory carried over into 1982 and a recall of salmon following reports of botulism (ADL 1985).

ADL (1985) reported \$26.7 million in wages paid to fish processors in 1981 and \$22.7 million in 1982. Average monthly wages were \$1,074 in 1981 and \$1,227 in 1982.

Employment in Other Sectors

The Comprehensive Salmon Plan for Southeast Alaska (JSARPT 1980) economic analysis section provides an estimate of employment in other sectors that are indirectly sustained by the fishing industry. According to the best estimates of the Department of Commerce and Economic Development, every 10 fish-processing jobs in Southeast generated three jobs in other sectors of the economy.

Thus, in 1983, the average annual employment in other sectors was 372 as a result of the average annual employment of 1,241 processors. Peak employment levels of 3,624 processors also provided employment in other sectors and returns to local economies.

COMPREHENSIVE SALMON PLANNING AND PROJECTED ECONOMIC RETURNS AND EMPLOYMENT

As required by state statute AS 16.10.375, regional planning teams consisting of representatives of aquaculture associations and the department have completed a 20-year (1980-2000) comprehensive salmon plan for northern and southern southeast Alaska (excluding Yakutat). The Forest Service (FS) has also been a full participant on the planning team. The plan set harvest objectives considerably higher than then-current (1980) production and potential harvests from existing hatcheries and increased natural production. Harvest gaps of 180,000 chinook, 1.4 million sockeye, 1.1 million coho, 13.9 million pink, and 4.3 million chum salmon were identified to reach a goal of equalling or exceeding the high 30-year average harvest. Four strategy options for harvest management, protection, enhancement, and rehabilitation were identified.

A preliminary evaluation of employment and economic benefits resulted in a projected 1,531 year-long equivalents of seasonal job opportunities from processing and nonprocessing jobs (versus 683 in 1977-78). Average annual ex-vessel receipts would increase to $163 million and to $341 million wholesale value in 2000, using 1977-79 dollar values (JSARPT 1980). With a multiplier to other segments of the economy of 1.45, this would translate into a $495 million annual contribution.

A separate planning process was completed for the Yakutat area. An increase in average annual production of 4,000 harvestable chinook, 27,000 harvestable coho, 66,000 harvestable sockeye, 2,000 harvestable chum, and 30,000 harvestable pink salmon was targeted. These targets represented 36% less than historical average levels for chinook salmon and 43% less than historical levels for sockeye salmon. Historical annual harvests of cohos and chums would be equalled, and pink harvests already currently exceed historical harvest levels. The same strategy options were identified as for other areas of southeast Alaska.

The projected adjusted gross value of the Yakutat salmon fishery would increase by $880,000, to $3.9 million in the year 2000 (compared to $3.0 million in 1981). Longer-range goals would represent a $1.8 million increase. Increases in employment have not been estimated (ADF&G 1984c).

SPORTFISHING

PARTICIPATION AND MAGNITUDE OF HARVEST

Sportfishing is an integral part of the southeast Alaskan lifestyle. Not only is it one of the most important recreational activities for residents of the region, but the fishing opportunities attract thousands of visitors annually.

There is a broad spectrum of participants engaging in sportfishing, from those whose sole interest is catching fish for the fun of it, to those seeking sources of food. Nearly 31,000 of the region's residents engage in sportfishing, and the number is increasing by 10% annually. More than 320,500 angler-days were expended during 1983 in Southeast by residents and visitors, compared to 225,000 in 1979 (Mills 1984). Approximately 400,000 fish were harvested during 1983 and the Southeast harvest over the last seven years has represented 16 to 21% of the annual statewide harvest. The trend in Southeast is toward increased harvests for most species.

Five species of salmon and four species of trout are harvested, as are halibut, rockfish, a variety of other bottom fish, smelt, herring, grayling, and razor clams. Table 8 summarizes the regional sport fish harvest from 1977 through 1983.

Table 8. Southeast Alaska Sport Fish Harvests by Species, 1977-83

Species	1977	1978	1979	1980	1981	1982	1983
Chinook salmon	17,449	16,639	16,581	20,213	21,300	25,756	22,321
Sea-run coho salmon	36,152	48,508	23,112	32,808	28,158	53,436	55,403
Land-locked coho/ chinook salmon	0	0	0	0	0	0	1,301
Sockeye salmon	5,803	5,890	3,479	4,175	3,173	4,146	5,701
Kokanee salmon	574	181	645	439	288	492	73
Pink salmon	34,031	43,006	31,351	34,561	33,717	53,581	51,815
Chum salmon	1,116	4,431	1,398	2,084	2,607	1,567	3,270
Steelhead	1,750	1,618	1,424	2,769	1,537	2,368	3,469
Rainbow trout	7,741	6,220	4,071	6,542	3,600	3,722	4,672
Cutthroat trout	23,377	23,188	19,345	24,433	16,436	22,816	18,605
Brook trout	759	1,691	672	2,273	861	818	1,606
Lake trout	0	0	0	0	0	0	0
Dolly Varden/ arctic char	34,734	34,919	31,405	44,175	33,398	37,524	49,752
Arctic grayling	775	669	281	129	49	482	947
Northern pike	0	0	0	0	0	0	0
Whitefish	0	0	118	551	0	524	31
Burbot	0	0	0	0	0	0	0
Sheefish	0	0	0	0	0	0	0
Smelt	55,034	14,431	80,006	20,306	1,468	1,531	62,708
Halibut	5,832	6,131	13,102	24,862	21,842	37,160	41,995
Rockfish	8,962	16,886	30,981	41,791	45,671	51,602	50,268
Razor clams	10,309	9,576	13,393	8,606	8,597	4,684	8,791
Other fish	11,456	7,259	11,979	31,502	20,306	29,602	19,590
Total	255,854	241,243	283,343	302,219	243,008	331,811	402,318

Source: Mills 1984.

Seventy-six percent of the regional sportfishing occurs in saltwater, and two-thirds of the fishing takes place in marine-boat fisheries adjacent to urban centers. However, remote fishing, both freshwater and saltwater, is an extremely important component of the regional fishery. A remote cabin system on the Tongass National Forest provides diverse opportunities for fishing in wilderness or near wilderness settings.

More than 40% of southeast Alaska residents use these cabins, and good fishing is ranked as an important reason for using these cabins (Alves 1981).

The FS maintains information on use of these cabins; however, it is difficult to interpret. Schwan (1984) summarized cabin use in 1982 for well-known sportfishing areas. Excluding data that appeared unrealistically high, 31,200 visitor days were reported. In response to a survey, most anglers reported that "being in an uncrowded situation" was a very important factor contributing to a quality angling experience, followed by being in a wilderness setting, and third in importance, catching lots of fish (Schwan 1984).

A final very important form of sportfishing occurs in close proximity to small communities. Local fisheries provide an important food source and recreational opportunities.

ECONOMICS OF SPORT FISHERY

The current economic value of the recreational fishery of southeast Alaska has not been adequately inventoried. It can only be roughly estimated from data collected over a decade ago. Harmer (1974) estimated an average annual expenditure by a Southeast angler, which included expenditures for boats. Harmer estimated the average total expenditure during 1973 by a Southeast angler to be $415. Mills (1984) estimated that 31,671 recreational anglers fished in Southeast Alaska in 1983. By inflating the 1973 expenditures to 1983 dollars (Anchorage-based CPI July 1983), we estimate that roughly $29 million of expenditures were made by recreational anglers during 1983. This estimate is likely low.

No detailed current economic data pertaining to recreational fisheries is available for the region. This information is needed in order that the economic magnitude of the recreational fishery can be seen in its proper perspective and the economic effects on the fishery from unrelated activities can be assessed.

HUNTING AND TRAPPING

PARTICIPATION AND MAGNITUDE OF HARVEST

The methods for gathering data on harvest levels and number of hunters vary from species to species, as does the extent of information available. Data collected from permit and registration hunts, sealing records, and hunter questionnaires provide recent harvest estimates for 14 species or species groups in southeast Alaska (Table 9). Harvest estimates for muskrat, mink, marten, weasel, red fox, raccoon, red squirrel, grouse, hare, ptarmigan, and marmot are lacking or less accurate. A discussion of the magnitude of harvest for individual species is given below.

Deer

Deer comprise over 90% of the total big game harvest in southeast Alaska. Prior to 1969, deer hunting was well-distributed from the Admiralty-Baranof-Chichagof Islands Area to Ketchikan, with an annual kill of 10,000 to 12,000 deer (Johnson and Wood 1979). In the late 1960's and early 1970's, the deer population crashed throughout the Panhandle, and the harvest declined to an average of about 5,000 deer from 1969 to 1974 (ibid.).

Deer recovered quickly in the Admiralty-Baranof-Chichagof Islands Area, but have increased very slowly on the islands south of there. Presently, the deer populations are high in Game Management Unit (GMU) 4, very low in most of the Stikine Area, with a closed season in much of the Petersburg Ranger District, and moderate and apparently increasing in the Ketchikan Area. Deer harvests and number of hunters have been estimated from hunter surveys in 1980, 1982, and 1983. An average of 7,000 people hunting an average of 43,200 days killed an average of 8,100 deer in those years. These surveys also show a 94% increase in harvest and a 74% increase in the number of hunters from 1980 to 1983.

During 1980 to 1983, over 80% of the Ketchikan Area deer harvest was on Land Use Designations (LUDs) 3 and 4 and Native-select areas, excluding special LUD 3 areas, where timber harvesting is not scheduled under the Tongass Land Management Plan (TLMP)(e.g., Gravina Island). About 55 to 60% of the harvest in GMU 4 was on LUDs 3 and 4, including those bordering Native-select areas. The harvest locations in GMU 3 do not reflect the historical abundance of deer and hunting activity because of the present low deer numbers and restricted hunting. However, we estimated that about 80% of the historical deer harvest in the Stikine Area occurred in Value Comparison Units (VCUs) TLMP has classified as available for timber harvest.

Brown and Black Bear

Based on sealing records, an average of 105 brown bears have been taken by sport hunters each year from 1961 through 1984, while a yearly average of 217 black bears have been harvested from 1972 through 1983 in southeast Alaska. Bear hunting is the major activity of hunting guides in southeast Alaska, and 49% and 33% of the brown bear and black bear sport harvest, respectively, is by nonresidents. The annual brown bear harvest has fluctuated over the past 10 years but has shown no increasing trend. The number of nonresident guides

Table 9. Recent Annual Reported Harvest and Number of Hunters in Southeast Alaska, by Species

Species	Season	Total Kill	Hunters
Deer	1983	11,050	8,900
Brown bear	1984	160	---
Black bear	1983	340	---
Mountain goat	1984	205	600
Moose	1984	203	1,100
Wolf	1983-84	111	---
Wolverine	1983-84	29	---
Otter	1983-84	438	---
Beaver	1982-83	41	---
Lynx	1983-84	18	---
Waterfowl	1983-84	21,630	14,433[a/]
Dabbling and diving ducks	1983-84	15,928	---
Sea Duck and mergansers	1983-84	3,217	---
Geese	1983-84	1,640	---
Snipe	1983-84	831	---

Source: Unpub. ADFG harvest information summaries. Campbell and Rothe (1985).

--- No data were available.

a/ Data expressed as hunter-days. All waterfowl figures are for only GMUs 1 - 4.

has been reduced through voluntary self-regulation by the industry in some areas. Hunting seasons have also been regulated and shortened in recent years. The yearly average kill was 120 for both 1975 through 1979 and 1980 through 1984. By contrast, the black bear kill has been increasing steadily under liberalized seasons. The average black bear harvest for southeast Alaska was 225/yr from 1975 through 1979 and 300/yr from 1980 through 1983.

Nearly 70% of the brown bear kill has come from GMU 4; about 45% of the harvest in GMU 4 has occurred on LUDs 3 and 4 and adjoining Native-select areas.

Moose

Approximately 200 moose were taken in both 1983 and 1984 by about 1,100 hunters in southeast Alaska. There are seven major hunting areas (Haines, Yakutat Forelands, Stikine River, Berners Bay, Thomas Bay, Taku River, and Malaspina Forelands) and numerous other areas where one to five moose are taken yearly (e.g., Unuk River, Endicott River, St. James Bay, Farragut Bay, Aarons Creek). Of the seven major areas, Thomas Bay and Yakutat Forelands are on FS lands scheduled for intensive timber harvest by TLMP.

Moose hunting is extremely popular in the local areas, and the demand for high-quality moose hunting in southeast Alaska clearly exceeds available opportunity.

Mountain Goats

Mountain goat harvests have averaged 245 animals/yr from 1980 through 1984, and from 600 to about 750 people hunt goats each year, based on registration permits.

Waterfowl

Waterfowl hunting estimates are based on statewide surveys conducted by the ADFG and the USFWS. southeast Alaska accounts for about 16 to 20% of the statewide duck harvest. Over 22,000 waterfowl birds were harvested in southeast Alaska in 1983-84, including over 16,000 game ducks, 1,700 geese, 850 snipe, and 3,300 sea ducks and mergansers (Campbell and Rothe 1985); 15,000 hunter-days were spent waterfowl hunting. Waterfowl-hunting activity appears to be steadily increasing statewide since the 1970's when surveys were initiated.

Furbearers

Harvest estimates of furbearers are poor except for sealing records for wolves, wolverines, otters, beavers, and lynx (Table 9) and the magnitude of trapping activity is uncertain because of the lack of trapping harvest surveys. Trapping occurs throughout southeast Alaska and mink and marten are the most common furbearers taken. A recent marten-sealing requirement for the 1984-85 season will begin to provide harvest estimates for this species.

Upland Game Birds

There are no good surveys on the harvest of grouse and ptarmigan, although it appears that hunting these game birds is a popular sport throughout southeast Alaska.

SUMMARY

The data given above is generally considered to be conservative for all species and probably does not accurately reflect the magnitude of harvest in the more remote areas of southeast Alaska. In particular, rural subsistence take may be under-represented in these surveys. The harvest levels of deer, black bear, and waterfowl all appear to be increasing substantially in recent years.

ECONOMIC VALUE OF HUNTING AND TRAPPING

Hunting and trapping provide revenues to the state through license, permit, and big game tag sales. Hunters and trappers buy equipment and supplies locally and also contribute to the economy through expenditures for travel and lodging. Finally, hunting and trapping contribute to maintenance of a subsistence economy, which cannot be measured in strictly economic terms but is important in terms of cultural and community continuity.

The sale of licenses, permits, and big game tags has steadily increased during recent years, as indicated by the increasing numbers of hunters described above. Statewide revenues totalled 2.8 million in 1983. These fees are especially important as the main source of matching funds for revenue from the Federal Aid in Wildlife Restoration Program.

The department has initiated surveys of goat and moose hunters to provide an estimate of average annual expenditures for equipment, supplies, travel, and lodging. A similar survey is planned for deer hunters.

Nonresident hunters are required by law to be accompanied by a licensed guide to hunt brown bear. Nonresidents and residents also hire guides for black bear, goat, and occasionally, for deer hunts. Twenty-two master and registered guides are licensed and actively guide within the region. Most hire two or more assistant guides and other seasonal help.

A recent survey (Beier 1984) estimates the revenue generated annually in the state to be between $450,000 and $1,000,000. An average guided brown bear hunt lasts 12 days and costs about $600 in guide fees. Additional expenditures for licenses and tag fees result in total direct annual expenditures for guided brown bear hunting of approximately $500,000. Other costs for air travel for nonresident hunters, taxidermy fees, and incidental expenses are in addition.

Hunt aesthetics are an important aspect of guided hunts, and timber harvesting has already resulted in avoidance of areas by guides. The guides have requested a voluntary reduction of the number of joint exclusive guiding permits from 13 to 6 in the game management unit encompassing Admiralty, Baranof, and Chichagof islands because of reduced guiding areas and numbers of bears.

The economic contribution of trapping is also difficult to evaluate because of incomplete information on harvests and annual fur prices. Participation in trapping is often much higher than the animals harvested or furs sold would indicate because much trapping is recreational in nature and furs are sometimes kept for home use so no reporting is required. Trapping is likely an important source of income for some individuals and an important recreational and subsistence activity for many more.

The use of game and furbearers for subsistence purposes is described in the next section.

SUBSISTENCE HUNTING, FISHING, AND GATHERING

Subsistence harvesting activities take place throughout southeast Alaska in a variety of cultural contexts, according to harvest regulations that also are highly variable in the region. Subsistence activities are probably engaged in by residents of all communities in Southeast, in one form or another. Resources harvested for subsistence purposes by Southeast residents include deer, moose, salmon, halibut, bear, shellfish, other marine fish, seaweed, berries, sea mammals, and waterfowl.

Subsistence hunting regulations have been developed for all game species that are used for food in the region. Although most of these duplicate general hunting regulations, several moose hunts are being conducted under "Tier Two" requirements of the state subsistence law. For these moose hunts, a preference in the issuance of permits is given to persons residing near the hunt area, demonstrating a dependency on the resource, and having few available alternatives.

The contribution of hunting and trapping to a subsistence economy is difficult to assess accurately. A survey of southeast Alaska residents (Alves 1981) resulted in a general description of the participation in food-producing activities. Eighty to eighty-five percent of the region's adult population (a somewhat higher percentage in smaller communities) participated in gathering food, of which 75% were successful. Deer hunting had 25% participation, and waterfowl and small game hunting were enjoyed by more than 10% of the population. Male participation was much higher than female, with approximately 50% participation in deer-hunting, 9-13% in moose hunting, 30-40% in waterfowl hunting, and 8-26% in other small game hunting by residents of Native and "small, rural, predominantly non-native communities." Food-gathering produced an average of 20% of household meat and 80% of household food. Households harvesting less of their share received food through sharing, so that the benefits of local food resources reached 90% of all households.

Deer was the wildlife species upon which users were most dependent. Use of deer to provide household meat varied from 5-6% for urban communities, to 13% for Native villages, to 14% for logging camps, and to 17% for small, rural, predominantly non-native communities. Deer hunting was most often considered a subsistence (vs. recreational) activity. Deer hunting produced more food per unit effort than any other food-producing activities. Provision of food was only one reason for participating in food-producing activities. However, those surveyed who considered their activities to be subsistence-oriented described providing food as the single most important reason for engaging in the activity. Developing skills and abilities and identifying with the Alaskan heritage were also important reasons for their participation.

Subsistence salmon fishing takes place according to a permit system in which restrictions such as bag limits, effective dates, and methods of harvest are specified by ADFG biologists, who make these determinations in accordance with biological information on the condition of particular salmon stocks. All salmon species may be taken in subsistence fisheries, subject to local permit requirements, although coho salmon are specifically permitted to be taken only in the Chilkat River and in Salt Lake, near Angoon, and chinook salmon may be taken only in the Chilkat River.

Tables 10 and 11 summarize the yearly subsistence salmon effort and species harvest from 1961 through 1983 for the Southeast Region and for 1975 through 1983 in the Yakutat area (ADF&G 1984a).

In addition to salmon, many other marine and freshwater fish are used for subsistence purposes in the region; harvest of species other than salmon takes place under sportfishing regulations. Shellfish, including crabs, clams, shrimp, and abalone, are harvested in the region under "subsistence - personal use" regulations, and there are no sport regulations for these species.

Fish, particularly salmon, provide an important contribution to household food. Based on responses to the Alaska Public Survey, on average, fishing provided 10% of household food for southeast Alaska residents. The percentage was considerably higher for Native villages, logging camps, and "small, rural, predominantly non-native communities," averaging 22%, 21%, and 18%, respectively. When asked what percentage was provided by salmon alone, the response was an average of 6% for all Southeast residents, 16% for Native villages and logging camps, and 14% for small, rural, predominantly non-native communities (Alves 1981).

Research conducted by the ADF&G Division of Subsistence also reflects the relative importance of freshwater and marine fish and shellfish in meeting the subsistence needs of Southeast residents. For example, in 1983 100% of the residents of Petersburg reported that they used halibut that year. Responses from both Haines and Hoonah indicated that 73% of the population of those communities used halibut (Cohen

Table 10. Southeast Alaska Yearly Subsistence Effort and Species Harvest, 1961-83

Year	#Permits Issued	Harvest					Total
		Sockeye	Pink	Chum	Coho	Chinook	
1961	554	---	---	---	---	---	14,826
1962	309	---	---	---	---	---	7,067
1963	696	---	---	---	---	---	6,514
1964	642	---	---	---	---	---	9,525
1965	665	---	---	---	---	---	10,303
1966	2,372	---	---	---	---	---	15,384
1967[a/]	632	7,238	482	4,059	489	6	16,286
1968[a/]	815	8,382	1,328	4,260	624	62	16,923
1969[a/]	774	6,305	1,771	3,180	70	9	13,479
1970	788	10,751	2,246	2,415	---	13	15,125
1971	1,067	9,598	3,648	6,123	---	---	19,369
1972	936	9,089	1,253	3,970	---	10	14,422
1973	1,031	7,584	2,675	6,799	63	6	17,127
1974	1,042	7,822	2,690	6,819	61	6	17,160
1975	944	9,454	11,428	5,277	96	---	25,755
1976	1,166	9,625	1,590	3,594	9	---	13,748
1977	888	6,484	1,963	3,007	68	---	11,522
1978	1,490	10,662	4,832	3,150	57	---	18,701
1979	1,611	17,078	5,585	4,001	60	---	26,724
1980	3,612	21,586	1,439	3,741	10	40	26,816
1981	2,751	20,268	6,065	4,512	129	1	30,975
1982	2,956	32,117	4,239	3,717	99	8	40,180
1983	2,763	15,877	1,859	2,559	211	38	20,544

Source: ADFG 1985.

--- No Data available

a/ District 113 data unavailable by species

Table 11. Yakutat Yearly Subsistence Effort and Species Harvest 1975-83

Year	#Permits Issued	Harvest Sockeye	Pink	Chum	Coho	Chinook	Total
1975	18	510	---	---	40	27	577
1976	35	1,060	---	---	55	83	1,198
1977	45	1,242	---	---	781	92	2,115
1978	127	870	---	---	912	59	1,841
1979	73	525	---	---	720	238	1,483
1980	68	961	---	---	1,507	284	2,752
1981	88	959	---	---	1,461	177	2,597
1982	71	1,645	---	---	2,180	255	4,151
1983	NA	1,055	---	---	360	253	1,668

Source: ADFG 1985.

--- No data were available.

1983). Mills et al. (1984) reported that Haines households spent a mean of 13.4 days per household fishing for all species of fish. Haines subsistence salmon-fishing households harvested over 470 lbs of fish per household in 1983, and Klukwan residents harvested nearly 700 lbs of fish per household that year (Mills et al. 1984).

Recent Division of Subsistence research, as well as local Coastal Zone planning, has also documented areas adjacent to communities in the region where subsistence harvesting takes place. Comprehensive resource-use studies have taken place in Sitka (Gmelch et al., in press), Haines, and Klukwan (Mills et al. 1984). Craig, Klawock, and Hydaburg were sites of a study of the use of abalone in 1982 (Mills 1982). Angoon was the site of a deer harvest study in 1983 (George and Kookesh 1983). Resource use studies are currently underway in Yakutat, Angoon, Tenakee, and Klawock, and additional studies are planned for Hoonah and Kake.

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A Review of Measures Implemented by the U.S. Forest Service to Protect Fish and Wildlife Resources of Southeast Alaska

By Joseph G. Doerr and Marilyn J. Sigman

Technical Report 86-1

Alaska Department of Fish and Game
Division of Habitat
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I. INTRODUCTION

The purpose of this report is to review those measures that have been implemented by the USDA Forest Service (FS) to protect fish and wildlife resources and their uses on the Tongass National Forest since 1979. It is one of three technical reports prepared by the Division of Habitat on behalf of the Alaska Department of Fish and Game regarding Section 706(b) of the Alaska National Interest Lands Conservation Act (ANILCA) of 1980. That section of the act specifies that beginning in 1985 and every two years thereafter, the FS is to report to Congress on the status of the Tongass National Forest. The State of Alaska is among those named in this act as a participant in the reporting process. Because of the Alaska Department of Fish and Game's (ADF&G) responsibility under the state Constitution and statutes to manage the state's fish and wildlife on a sustained yield basis, the department is uniquely qualified to help the state respond to the Section 706(b) reporting requirement that addresses ". . . measures instituted by the Forest Service to protect fish and wildlife in the [Tongass] forest . . ."

Protection of fish and wildlife and their uses on public lands includes many aspects of planning as well as project implementation. Federal law, executive direction, regulations, administrative budgets, and planning at the national, regional, forest, management area, and project level all influence the degree to which fish and wildlife are protected on national forest land. This report evaluates environmental documents concerning timber sales and management area analyses completed from 1980 through 1984, the initial period following the Tongass Land Management Plan (TLMP, implemented in 1979) and ANILCA (passed in 1980). Policies directing FS management at the time of TLMP include the National Forest Management Act (NFMA) of 1976 and the Southeast Alaska Area Guide (SAAG), which was finalized in 1977. The SAAG, a FS document outlining management practices for all resources, was incorporated into the TLMP in 1979 and into the Alaska Regional Guide (ARG) in 1983 as a regional or forest plan policy base (FS 1983). Although policy and management practices are continually subject to change, the accomplishments during 1980-84 should be a good reflection of how the FS is implementing these mandates and policies for managing fish and wildlife habitat.

The ultimate measure of implementation is the actual on-the-ground conformance of activities with those planned. Because of time limitations, no field review was undertaken in the preparation of this report. Instead, the report reviews the monitoring activities reported by the FS and their results.

Readers of this report will notice that considerable significance has been attached to the degree to which existing statutory, regulatory, or administrative policy direction has been discussed in FS environmental documents. The department recognizes that issues can be addressed in such documents without specifically making reference to applicable policy directives. We believe, nevertheless, that such reference is the most effective and readily understandable way of preparing environmental documents and of evaluating the degree to which they meet those requirements. Otherwise, too much is left to the reader to assume or surmise.

II. METHODS

A total of 37 timber sale environmental documents with decision notices or findings of no significant impact (Table 1) were carefully examined for compliance with policy and to determine what measures were initiated to protect fish and wildlife. A standardized evaluation form (Appendix A) was employed. Environmental document (ED), as used here, refers to all National Environmental Policy Act (NEPA) documents for a particular timber sale. For example, a NEPA management area analysis (MAA) and timber sale environmental assessment (EA) are considered one ED, if they are particular to a single sale. Specialists reports were used to the degree that they were tiered to the EA and available.

Contact was made with FS personnel at the Region 10 office, the Ketchikan, Chatham, and Stikine Supervisory offices, and the Thorne Bay, Wrangell, Ketchikan, Petersburg, Hoonah, Juneau, and Sitka ranger districts. Additional supporting information was gathered from these contacts, and clarification of seemingly conflicting or unclear statements in EDs was requested. Other information was obtained from these sources regarding the status of wildlife and fish enhancement projects, second-growth management, monitoring programs, and administrative studies. We are extremely grateful for all the information provided by the FS in this report but emphasize that the findings and conclusions are solely those of the authors.

The 37 sale EDs represent nearly all of the timber sales prepared on the Tongass during the indicated time period. Each ED varies with respect to the size of the sale, area of the sale, and associated impacts (Table 1). Readers should keep this in mind when results are expressed as a percentage of total EDs.

The review did not include a detailed analysis of the selection of log transfer locations and siting of log transfer facilities. Consolidated agency criteria and guidelines for site locations have been developed and receive periodic reviews by task forces that include representatives of state and federal regulatory agencies, the FS, and the timber industry.

While this report was being completed, several additional FS EDs were released to the state for review. Certain aspects of these EDs are summarized here because they support the continuation of present FS practices with regard to fish and wildlife protection or because they indicate a potential trend to deviate from present practices.

Table 1. Timber Sale Environmental Documents Evaluated for This Report

Sale	Mgmt. Area(s)	Volume (MMbf)[a]	Acres
Ketchikan Area			
LPK 84-89 EIS and EA	K01-04, K08-11 K14-15, K18, K32[b]	960	25,353
Forest Habitat Integrity Plan (FHIP)[c]	K14	34.3	986
East Carroll Inlet Management Plan	K35	123	5,176
Suemez	K20	97.5	3,452
Cherrumba Salvage	K11	3.5	---[d]
Angel Lake Planning Area	K15	18.2	840
Yahky Cove[e]	K07	2.5	67
Small Sales-Free Use	Areawide	- No limit specified -	
Stikine Area			
Sokolof Salvage	S18	8.2	315
Highbush	S25	4.8	231
Nesbitt	S19	25	1,082
South Wrangell	S25	38	1,520
Zarembo Lake Salvage	S19	8.2	360
Campbell	S31	14.1	675
Fritter	S19	23	822
Nemo Point	S25	6.4	292
Skip	S25	4.1	253
Cleveland	S33	31	1,509
Rynda Salvage	S18	5.4	180

(continued)

Table 1 (continued).

Sale	Mgmt. Area(s)	Volume (MMBF)[a]	Acres
Granite	S23	48	1,579
Todahl	S10	35	1,081
Toncan	S13	31.9	1,470
PRD Small Sales	all PRD[f]	9	979[g]
Bohemia	S10-11	24.1	1,273
Mitkof Flyer	S16-17	10.7	---
Cabin	S16-17	22	828
Totem	S11, S13, S20	46.7	2,404
<u>Stikine-Chatham</u>			
ALP 81-86	S09, C29-31, C34, C36-37, C43	641[h]	22,416
Port Houghton	S01, C14	45.1	1,721
<u>Chatham</u>			
Cowee-Davis	C03	26	1,250
Couverden	C18-19	48	1,629
Yakutat Salvage	C53-54, C61	47	3,067[i]
Yakutat Blowdown #2	C53-55	12.6	494
South Windham	C31	24	914
Homeshore Blowdown	C19	5	---
Gilbert Bay	C10, C12	30	1,000
Corner Bay Salvage	C37	11	276

a/ Volume shown is either volume scheduled for sale or first entry, whichever was identified and evaluated in the analysis.

b/ This sale represents 43% of the annual 450 MMBF scheduled for the Tongass NF and involves approximately 50 of 205 Value Comparison Units (VCUs) in the Ketchikan Area.

c/ Only the South Shaheen portion of the document that was selected in the final decision notice is evaluated in this report.

d/ --- means no data were available.

e/ This sale was analyzed under a categorical exclusion.

f/ PRD = Petersburg Ranger District

g/ Includes 775 acres of partial cutting.

h/ Total volume planned for harvest. 452 MMBF (16,080 acres) was anticipated new harvest needed to meet contract commitments thru 1986.

i/ Includes 1,293 acres of partial cutting.

The EDs are cited throughout this report by their sale name. Except for environmental impacts statements (EIS), the EDs are not formally published. However, the reader can obtain copies of all EDs by contacting the FS area where the report was prepared (Table 1).

III. REVIEW OF REQUIREMENTS FOR FISH AND WILDLIFE HABITAT PROTECTION

This section briefly summarizes some of the major requirements for fish and wildlife habitat protection on the Tongass National Forest, including to what degree the FS is constrained from maintaining or enhancing the production of desired fish and wildlife species by timber production goals on national forest (NF) lands. The section is divided into separate discussions for fish and wildlife.

A. Major Requirements for Management of FS Wildlife Habitat

Requirements of wildlife habitat management on FS lands during the planning and administering of timber sales can be subdivided into at least four broad categories: 1) those required under Federal laws, regulations, and executive orders, 2) those developed and specified in forest plans and regional guides, 3) those developed and prescribed as part of the interdisciplinary team (IDT) process during timber sale environmental analyses, and 4) those developed during administration of a particular sale. This report concentrates largely on the first three types of requirements in addressing implementation of measures to protect wildlife on the Tongass NF since ANILCA.

1. Cumulative Impacts

NEPA and associated Council of Environmental Quality (CEQ) Regulations require an assessment of cumulative impacts (40 CFR 1508.25). A cumulative impact is defined in the CEQ regulations as follows:

> the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

The scope of an EIS must include assessment of cumulative actions, "which when viewed with other proposed actions have cumulatively significant impacts and should therefore be discussed in the same impact statement" (40 CFR 1508.25).

2. Retention of Operable Commercial Forest Land (CFL)

The concept of retention was developed as a management policy on the Tongass NF in the 1977 SAAG (FS 1977). All land use proposals were to develop Wildlife Habitat Management Units (WHMU) and prescriptions through an IDT process. "Areas retained in natural conditions" is one type of prescription described to be included in all WHMUs "to partially meet wildlife habitat requirements" (p. 91).

In the development of the TLMP, about 273,000 acres of operable CFL (CFL physically and economically accessible and not otherwise unregulated, deferred, or withdrawn) were excluded from timber harvest areas in land use designation (LUD) areas 3 and 4 in order to provide protection for wildlife, fisheries, and visuals (FS 1984).

These acres include both normal-harvest CFL (timber which can be yarded with standard equipment such as highlead, A-frame, tractor, and skylines less than 2,600 feet) and non-standard CFL (timber which requires helicopter, balloon, long single-span skylines, or multi-spans). In practice, these retention acres were to be located during timber sale planning and could be established anywhere within the LUD 3 and 4 areas that would normally be scheduled for logging. These acres are referred to throughout this report as retention and allow forest managers the flexibility to preserve some of the best fish and wildlife habitat in LUD 3 and 4 areas. No commercial timber harvests were scheduled in retention areas in the adopted TLMP harvest schedule that provided an average yearly harvest of 450 million board feet (MMbf).

Retention was calculated for certain TLMP habitat categories that were located in operable CFL, which includes, by definition, both normal and non-standard CFL. It should be noted that only one-third of the non-standard operable CFL was considered for timber harvest due to technical reasons (FS 1984a). Thus, retention of non-standard CFL does not greatly increase the percentage of timber in this category that is excluded from harvesting.

The major benefit of retention is preserving key habitats of normally operable CFL that would otherwise be logged. Higher retention percentages were used in LUD 3 areas than in LUD 4 areas during TLMP harvest calculations (FS 1979, 1984a). If the TLMP habitat retention percentages are applied equally to TLMP-identified wildlife habitat in normal and in non-standard CFL, then about 263,000 acres of normally operable CFL in LUD 3 and LUD 4 areas would be permanently retained from commercial timber harvest (Unpub. analysis of TLMP S2K Data, Regional Habitat Division, ADF&G, Douglas). This amounts to about 24% of the normally operable CFL in LUDs 3 and about 10% in LUDs 4.

Since the TLMP, the FS has begun to clarify how the retention factors are to be applied. The TLMP Evaluation Report (FS 1984a) states (p. A-3) that "only the actual operable acres retained in the VCUs [Value Comparison Units] allocated to LUD III and IV in the TLMP are relevant in the planning of timber sales These acres can be selectively located and roughly mapped to establish where (and what kind of) operable CFL has been retained . . . [until TLMP is changed, these] factors can be considered as permanently retained, in the same sense that all the LUD III and IV CFL acres not retained or otherwise restricted can be considered permanently available." Application of retention factors was to occur during timber sale planning, but flexibility existed to select acres different from those identified during TLMP. Regional Forester Sandor advised the forest supervisors that "if field level investigations associated with timber sale planning show that different acres should be retained than those that were retained through use of the Retention Factor [TLMP] method, then this can be done. However, such changes will incrementally alter the land base underpinning the allowable timber sale quantity. Therefore, it is necessary to keep a careful record of such adjustments through an on-going monitoring process. The TLMP data base needs to be used as a reference base to gauge how plan implementation equates with the provisions of the plan. Areas should insure that the data base is kept current at all times" (memorandum from John Sandor, regional forester, to forest supervisors, 7/6/83). The implementation of retention is discussed in section IV (REVIEW OF MEASURES TO PROTECT FISH AND WILDLIFE RESOURCES AND HABITAT).

Despite the proposed use of retention, the TLMP EIS predicted declines in certain wildlife species that depend on old-growth or wilderness-type areas, as a result of the scheduled harvest, with the greatest impacts occurring in LUD 4 areas (FS 1979:87):

> "Cavity-nesting birds such as woodpeckers and certain owl will decrease dramatically in harvested areas, as will flying squirrels and other animals that make dens in hollow trees. Species more sensitive to human intrusion such as brown bears, wolves, and wolverines can be expected to decline. Of the fur species, marten will probably be affected the most by old-growth removal. In LUD 4 areas where most, or all, of the old growth is in the operable category and

> would be cut during the rotation, the impact on most wildlife species would be considerable."

The numbers of species present within the areas to be impacted were not expected to change, however (op. cit.).

3. National Forest Management Act (NFMA) Planning Requirements.

> "In LUD 4 areas where most or all of the old growth is in the operable category and would be cut during the rotation, the impact on most wildlife species would be considerable.

The TLMP EIS (FS 1979) states, "A revision [of TLMP] will be completed before 1983 to fully implement the requirements of the NFMA (Part II, p. 2)." Section 219.19 of the regulations implementing the NFMA (36 CFR 219) specifies a number of measures required during planning and monitoring phases.

Diversity, viable populations, and indicator species are three factors that are to be addressed in forest planning under NFMA, as indicated by the following statements:

> Forest planning shall provide for diversity of plant and animal communities and tree species consistent with the overall multiple-use objectives of the planning area. Such diversity shall be considered throughout the planning process. Inventories shall include quantitative data making possible the evaluation of diversity in terms of its prior and present condition. For each planning alternative, the [IDT] shall consider how diversity will be affected by various mixes of resource outputs and uses, including proposed management practices (36 CFR 219.26).

> Management prescriptions, where appropriate and to the extent practicable, shall preserve and enhance the diversity of plant and animal communities, including endemic and desirable naturalized plant and animal species, so that it is at least as great as that which would be expected in a natural forest and the diversity of tree species similar to that existing in the planning area. Reductions in diversity of plant and animal communities and tree species from that which would be expected in a natural forest, or from that similar to the existing diversity in the planning area, may be prescribed only where needed to meet overall multiple-use objectives. Planned typed conversion shall be justified by an analysis showing

> biological, economic, social, and environmental design consequences, and the relation of such conversions to the process of natural change (36 CFR 219.27).

The NFMA regulations define diversity as, "the distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan" (36 CFR 219.3).

Viable populations represent a minimum limit for the habitat management of all vertebrate species on FS lands, as noted by Title 36 of the U.S. Code of Regulations (219.19):

> Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area. For planning purposes, a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area. In order to insure 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 (36 CFR 219.19).

The NFMA regulations provide no assurance that vertebrate species will be present in sufficient numbers to be regularly seen or hunted however. They do require that the FS address the minimum needs of all species, including those species that depend on old growth.

The use of indicator species is primarily to:

1) evaluate the consequences of planning alternatives on selected species,
2) monitor the effect of habitat changes on select species, and
3) set habitat management objectives for these select species.

The NFMA regulations (36 CFR 219) regarding indicator species are given below:

> In order to estimate the effects of each alternative on fish and wildlife populations, certain vertebrate and/or invertebrate species present in the area shall be identified and selected as management indicator species [MIS] and the reasons for their selections shall be stated. These species shall be selected because their

population changes are believed to indicate the effects of management activities. In the selection of management indicator species, the following categories shall be represented where appropriate: Endangered and threatened plant and animal species identified on State and Federal lists for the planning area; species with special habitat needs that may be influenced significantly by planned management programs; species commonly hunted, fished, or trapped; non-game species of special interest; and additional plant or animal species selected because their population changes are believed to indicate the effects of management activities on other species of selected major biological communities or on water quality.

On the basis of available scientific information, the interdisciplinary team shall 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, measures to mitigate adverse effects shall be prescribed.

Planning alternatives shall be stated and evaluated in terms of both amount and quality of habitat and of animal population trends of the management indicator species.

Access and dispersal problems of hunting, fishing, and other visitor uses shall be considered.

Population trends of the management indicator species will be monitored and relationships to habitat changes determined. This monitoring will be done in cooperation with State fish and wildlife agencies, to the extent practicable.

In addition, all management prescriptions shall:

Provide for adequate fish and wildlife habitat to maintain viable populations of existing native vertebrate species and provide that habitat for [management indicator species] is maintained and improved to the degree consistent with multiple use objectives established in the Forest plan. (36 CFR 219.27[a][6]).

It should be noted that the NFMA regulations provide direction to the preparation of Forest Plans and Regional Guides. The Forest Plan and Regional Guide is to be adhered to during project implementation.

4. Threatened and Endangered Plant and Animal Species

The Endangered Species Act requires full protection of listed species. Eight species of endangered whales occur in southeastern Alaska and several species or subspecies of endangered and threatened birds are known to migrate through the area (FS 1985). There were no listed endangered or threatened plants on the Tongass National Forest during the period of our evaluation, although several species were under consideration for listing.

5. Wildlife Habitat Management Units

The SAAG policies and the Forest plan policies of the ARG (FS 1977, 1983) for wildlife state, "All [emphasis added] proposals for land use will require [an IDT] prescription or implementation plan. The plan will specify WHMUs and prescriptions necessary to meet goals of wildlife habitat." Prescriptions were to include, but not be limited to, the following unless the IDT prescribed more restrictive measures:

1) areas retained in natural conditions,
2) identification of opportunities for viewing and photographing wildlife, and
3) provisions for snag retention for wildlife.

In a practical sense, identified retention areas can be considered WHMUs whether or not they are referred to as such in the ED because they are essentially prescriptions to retain areas in natural conditions.

6. Deferral (Postponement) of Logging in Areas with High Wildlife Values.

Where retention is not implemented to preserve important wildlife habitat, the deferral of logging may provide a temporary protection. This practice has been described in the TLMP Evaluation Report (FS 1984a, p. A-7),

> Forest Managers also have other options besides the retention factors method to mitigate potential effects of timber harvest activities. Given that any single timber sale in a typical VCU or management area will normally result in the harvest of a fraction of the available CFL, then a prioritization of which acres are harvested that is sensitive to wildlife, fisheries, visual and other values is possible. The deferred acres can continue to serve the habitat needs of wildlife, for example, until (and if) they are harvested in the future.

The ADF&G has formally recommended that the FS defer roading and logging in 42 VCUs scheduled for logging under the TLMP until the TLMP can be revised (memorandum from ADF&G Commissioner Don Collinsworth to John Sandor, regional forester, 7/20/83). An additional 30 VCUs were recommended for deferral in which the TLMP had not scheduled logging (e.g., LUD 2 areas, special LUD 3 areas, and TLMP LUD 1 areas that were not selected for wilderness by ANILCA). These 72 VCUs are referred to as Class I VCUs.

It should be noted that the FS does not consider deferral to be a strict requirement, but rather a potential management tool to at least temporarily accomplish management objective.

7. Wetlands and Floodplains

Wetlands and floodplains on federal lands are given special protection under presidential Executive Orders (E.O.) 11988 and 11990. Under E.O. 11990 wetlands are defined as

> those areas that are inundated by surface or ground water with a frequency sufficient to support and under normal circumstances does or would support a prevalence of vegetation or aquatic life that requires saturated or seasonaly saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, river overflows, mudflats, and natural ponds. [Sec 7(c)].

Floodplains, as defined by E.O. 11988, are "lowland and relatively flat areas adjoining inland and coastal waters including floodprone areas of offshore islands, including at a minimum, that area subject to a 1 percent or greater chance of flooding in any given year."

The E.O.'s require that the federal agencies avoid undertaking or providing assistance for new construction (e.g. roads) located in wetlands/floodplains unless the head of the agency finds there is no practicable alternative and the proposed action includes all practicable measures to minimize harm to wetlands and floodplains.

The TLMP states that all management activities under the Proposed Action will conform to the directives of Executive Orders 11988 and 11990 (FS 1979:91).

8. Best Management Practices

During forest planning, environmental analysis, and the preparing and administering of timber harvest activities, there are often numerous prescriptions that can be applied to reduce impacts to wildlife. Forest plan policies indicate that prescriptions will be applied to WHMUs through an IDT process to a degree "necessary to meet the goals for wildlife habitat (established by the Guide or Forest Plan)"(FS 1977, 1983). It is further specified as forest policy (ibid.) that,

> the IDT process will also develop localized management and protection prescriptions based upon the characteristics and sensitivities of the area. Participation in prescription development will be invited from the Alaska Department of Fish and Game, the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. The prescriptions will provide for protection and enhancement of sufficient winter and summer range, browse and food sources, protective cover and migration corridors, nesting, feeding and resting sites. Other requirements necessary to meet the management goal for wildlife habitat will be met over the long run in view of relationships between logging and other land use activities and wildlife habitat needs. The prescriptions will also address the relative need to preserve mature and old-growth forests; to insure sufficient browse reproduction in second-growth stands; to avoid population decreases below predetermined levels as a result of displacement during forest development; to recalculate rotation periods or other silvicultural practices based on wildlife habitat needs; and to specify the percentage of an area to be cut during a given entry.

NEPA regulations require the IDT to develop measures to reduce undesirable impacts to the environment. These are to be displayed in environmental documents as mitigating measures.

The NFMA regulations initially restricted clearcut size in the spruce/hemlock forests to a maximum of 100 acres, except for windthrow and other salvage, unless 60-day public review and Regional Office (RO) approval is received for larger units. However, the regulations permitted larger units where "a more desirable combination of net public benefits" would result which was presumably the determination to be made by the Regional Office and public review. The ARG (FS 1983) raised the maximum size limit to 150 to 200 acres throughout the TNF in 1984. In addition, the ARG specifies that once a clearcut has trees five feet in height it is no longer considered an opening for the purpose of the size of openings that can be created by clearcutting. The ARG EIS provides flexibility and management direction to apply the criterion to all areas, including those where wildlife and visual considerations are of primary management importance. An alternative that would not apply the criterion in those areas was specifically rejected in the FEIS.

It should be noted that clearcuts in southeastern Alaska with trees five feet high are still in early stages of forest succession and ecologically function as openings from the standpoint of understory production, conifer seed production, snag production, tree development, vertical and horizontal diversity, wildlife habitat use, and overstory canopy structure and cover (ADFG 1985 a).

Several wildlife prescriptions have been given specific recognition in either the TLMP or other forest policy documents. These include maintaining forest buffers around eagle nests and providing for snags.

FS policy has been to retain a minimum 330-foot buffer around all trees (FS 1977, 1979, 1983) and to maintain the desired quality and quantity of eagle habitat and perch trees (FS 1977, 1983). The TLMP indicates that eagle perch trees will be protected generally, but that in LUDs 4, "there is more of a possibility that some perch trees will be lost and . . . for disturbance to nesting birds if timber is harvested near beach fringe habitat" (FS 1979:vii).

As noted in the previous WHMU section, it is FS policy that all proposals for land use develop prescriptions to provide for snag management (FS 1977, 1983).

9. Wildlife Habitat Enhancement and Second-Growth Habitat Management for Wildlife.

The concept of wildlife habitat enhancement refers to the use of man-made changes to increase the capacity of the land base to produce wildlife in general or specific species in particular. The TLMP assumed that this was a realistic management option and identified potential "wildlife habitat improvement" projects for over 100 VCUs, mostly on the Stikine and Chatham Areas (FS 1979). Many of these projects include management of second-growth stands to improve wildlife habitat. Eight VCUs were identified for "eagle nest tree development," six VCUs were to have general wildlife habitat improvement through browse release in clearcuts, primarily by thinning, and 35 VCUs were to have deer range improvement, including winter range improvement, largely through thinning of clearcuts. In addition, eight VCUs were identified for possible waterfowl nest platform construction work, four VCUs were identified for "moose range improvement," and a large number of potential "wildlife habitat improvement" projects cited in TLMP were not specific to the type of work envisioned.

The ARG provides further insight into the perceived role of wildlife habitat improvement by the FS (FS 1983, p. 2-18),

> Opportunities to improve wildlife habitats in Southeast Alaska need to be identified and the benefits to wildlife verified through research. The development of prescriptions for timber harvest and for precommercial and commercial thinning of second-growth stands may have good potential for improving habitat for deer and moose. Providing thermal cover and forage production through silvicultural prescriptions in key habitat areas may help mitigate reductions in old-growth forest habitat. It is important that research programs focus on the development of silvicultural methods to benefit wildlife and also provide information on species and habitat relationships. The opportunities for mitigation of habitat loss through second-growth forest management are being field tested on the Tongass National Forest. These tests will determine the suitability of these methods for more extensive application.

B. Major Requirements for Management of FS Fish Habitat

This section describes some of the major requirements for fish habitat protection on FS lands during the planning and administrating of timber sales. It is analogous to a previous section discussing major requirements for management of FS wildlife habitat.

1. Cumulative Impacts

The necessity to evaluate the cumulative impacts of timber harvesting on fish habitat is similar to that described in the previous section for wildlife.

2. Full Protection of Fisheries Production

The TLMP is unequivocal in stating that the management intent is to preserve the biological production of every fish stream on the Tongass (FS 1979), as is manifested in the following statements:

> Different interest groups may consider one or more of these variables [resources] as non-negotiable. On the other hand, the Forest Service views the biological productivity of fish streams as a value which cannot be compromised. Therefore, under any alternative, productivity of fish streams will be maintained (p. 49).
>
> Forest Service policy is that the biological productivity of fish streams will be protected in all allocation and management decisions (p. 52).
>
> the goal is to preserve the biological productivity of every fish stream on the Tongass (p. 92).
>
> It is assumed that even under LUD IV the biological productivity of these streams will be maintained through protective and rehabilitative prescription management. But the more amenity-oriented LUD III classification would provide greater latitude to avoid or mitigate unintentional biological damage (p. 92).
>
> Those fish streams in VCUs allocated to LUDs III or IV have a somewhat higher risk of impact due to the roading, timber harvest, and other management activities which will occur within these watersheds. Management direction and activity prescriptions for all LUDs emphasize full protection of the streams' biological potential. However, it's recognized that some unavoidable adverse impacts will probably occur at times. (p. 190).

The TLMP policy is in keeping with the NFMA, which prohibits timber harvest activities that "are likely to seriously and adversely affect water conditions or fish habitat. The NFMA further declares:

> Timber will be harvested from National Forest Systems lands only where protection is provided for streams, streambanks, shorelines, lakes, wetlands, and other bodies of water from detrimental changes in water temperatures, blockages of water courses, and deposits of sediment, where harvests are likely to seriously and adversely affect water conditions or fish habitat (U.S. Statutes 90:2954).
>
> Title 36 of the U.S. Code of Regulations (219.27[e]) specifies the following management requirements for riparian areas:

> Special attention shall be given to land and vegetation for approximately 100 ft from the edges of all perennial streams, lakes, and other bodies of water. This area shall correspond to at least the recognizable area dominated by the riparian vegetation. No management practices causing detrimental changes in water temperature or chemical composition, blockages of water courses, or deposits of sediment shall be permitted within these areas which seriously and adversely affect water conditions or fish habitat. Topography, vegetation type, soil, climatic conditions, management objectives, and other factors shall be considered in determining what management practices may be performed within these areas or the constraints to be placed upon their performance.

3. Retention of Operable CFL

Retention of operable CFL was a management tool formulated during development of the TLMP to protect fish habitat as well as wildlife habitat and visual quality:

> LUD III generally allows 30% of the operable old growth to be retained for fish, wildlife, and visual quality. LUD IV allows only an average of 13% (FS 1979, p. 189).
>
> As an approximation of one of the measures necessary to meet fishery goals, timber retention factors were developed for LUDs III and IV by the IDT . . . These retention factors will provide the latitude necessary to develop specific prescriptions at the project planning level, where each stream and watershed will be considered individually (ibid., p. 92).

During the formulation of the TLMP, no specific retention factors were developed for identified fish habitat, exclusive of wildlife and visuals (FS 1984a). However, retention factors of 4 and 5% (LUD 3 and LUD 4, respectively) for categories including "others" could directly be applied to fisheries needs, and other retention acreages could be used if needed to meet fisheries concerns.

4. NFMA Planning Requirements

The NFMA requirements for viable populations, diversity, and MISs, discussed previously for wildlife, also apply to all the management of habitat for all species of fish on NF lands.

5. Fish Habitat Management Units (FHMUs)

The SAAG policy (FS 1977) which has been incorporated into the ARG (FS 1983) states:

> All proposals for land use will require the completion of a (IDT) prescriptive plan . . . The plan will specify: (1) appropriate FHMUs, and (2) prescriptions necessary to meet the goal for fish habitat set forth in this section of the Guide [emphasis added].
>
> The [FHMU] will consist of all components of the fish habitat as identified through the IDT process. The unit may be as narrow as all trees within crown height of a fish stream; it may be widened in areas of high potential windthrow or unstable soils or as otherwise necessary to recognize the characteristics and sensitivities of the area to meet the management goal.
>
> Those waters determined not to be fish habitat but which influence fish habitat will be adequately protected to insure that the quality of freshwater and marine fish habitat downstream is not impaired. Such protection measures are described in the Soil and Water Accounts of this guide. [See following section on best management practices].

6. Deferral (Postponement) of Logging in Areas with High Fisheries Values

The same concept discussed in the previous wildlife section under a similar heading applies to the protection of fish habitat. As noted previously, deferral is not a strict requirement, but rather a potential tool to achieve, at least temporarily, a management objective.

7. Wetlands and Floodplains

The reader should refer to the corresponding heading in the previous wildlife section. Protection of floodplains and wetlands would directly protect certain critical spawning and rearing habitats for fish on the Tongass NF.

8. Best Management Practices (BMPs)

Biologists have long recognized the need to prescribe specific measures to protect fish habitat during logging and related timber harvest activities (e.g. road construction). Many of these measures were to be prescribed to FHMUs through an IDT process (FS 1977, 1983).

Such measures include specified buffer strips, directional tree falling away from the stream, suspension of logs over fish streams, removal of logging debris from streams, timing clauses on activities potentially affecting fish streams, assurance of fish passage at all locations where roads cross fish streams, and procedures to deal with unforeseen damage to fish habitat. Some of these measures are established FS policies as described in the SAAG and the forest plan policies of the ARG (FS 1977, 1983) as follows:

> Within the FHMU, timber management practices and other land use activities will be prescribed to the degree necessary to meet management goals for fish habitat. The method of logging within the FHMU will provide for protection of soils, duff and litter layers, shrubs and uncut trees. Special logging methods, streamside strips of uncut timber, cutting unit layout schemes and other appropriate approaches will be recognized as viable options to protect fish habitat.
>
> Localized management and protection prescriptions that are based upon the characteristics and sensitivities of the area and which will meet management goals will be developed by the IDT process. Input used by the IDT will include evaluation of present and potential spawning and rearing habitat for anadromous and resident fish of the main stream or lake and all tributaries. Unless other measures are specified by the IDT process, the prescriptions for all FHMU will include the following:
>
> > (1) All trees within crown height of a fish stream will be felled away from the stream except those which cannot be felled away from the stream for safety reasons and which are marked on the ground by a sale administrator. Any trees felled into or across a fish stream must be removed within 48 hours. Within areas designated for cutting, felled or windfallen trees must be bucked and limbed clear of the streamcourse debris entering the stream.
> >
> > (2) Significant quantities of limbs, branches, bark, sediment and other identifiable logging debris will be removed from fish streams and areas subject to

flooding to a point above the high water mark within 48 hours after such debris is deposited.

(3) Streambank brush, grass, and trees not designated for cutting will be protected to provide bank stability, shade and terrestrial insect habitat.

(4) All logs will be fully suspended when yarding across any designated fish stream. Fish streams will be identified on the project.

(5) Location of roads within an FHMU, parallel to fish streams and crossing fish streams will be permitted only where other locations are not feasible and the management goal for fish habitat can be met. Where roads are located near fish streams, introduction of sediment must be avoided; sidecasting and waste materials must not encroach upon the streamcourse; and as much undisturbed ground cover as possible shall be left between the road and the stream. Complete endhaul of waste material will be required where roads are located near fish streams when there is the probability of downhill movement of this material into the stream below. Fill will be placed into fish streams only when considered through the IDT process to be the best alternative. Fish passage must be assured at all locations where roads cross fish streams. Prescriptions will specify permissible uses of heavy machinery and the timing of road construction activities.

(6) The use of intertidal gravel as a source of borrow shall not be allowed in areas where pink and chum salmon spawn.

(7) Blasting that adversely affects fish spawning beds will be limited to times when eggs and alevins are not vulnerable. Safe times and distances will be determined on a site-by-site basis in conjunction with Alaska Department of Fish and Game, National Marine Fisheries Service, and U.S. Fish and Wildlife Service.

(8) Streamcourses may not be changed or diverted without written approval from the Forest Supervisor, who shall issue such

approval after consultation with Alaska Department of Fish and Game, National Marine Fisheries Service, and U.S. Fish and Wildlife Service and where it is clear that habitat impairment will not result.

(9) A plan and time schedule for falling and yarding timber within any FHMU will be developed and approved by the Forest Service and delivered to the operator before that unit is released for cutting.

(10) Where the IDT process determines that soil conditions, water temperatures, logistical problems or other factors are such that an activity cannot be carried out in conformance with the goals and policies of the Soil, Water and Fish Accounts of the Guide, those activities will not be permitted.

The Forest Service will insure that land use activities in or affecting Fish Habitat Management Units are carried out in full compliance with applicable plans and policies. Policies will be stipulated in appropriate contracts. Where significant violations or instances of damage or unforeseen problems occur, whether reported by Forest Service personnel or other agencies or individuals, the following remedial steps will be taken:

a. All agencies having responsibilities in the area of concern will be immediately informed by the Forest Supervisor that a problem situation has arisen. Specialists and other individuals with expertise applicable to the problem will also be contacted as soon as possible and brought to the scene if they may be of assistance.

b. If the situation arises in conjunction with a contracted or permitted activity, appropriate officers or individuals will be instructed to take immediate remedial action within the full limits of the contract or permit to protect the environment, to repair any damage, and to prevent any further recurrence. If it appears that the problem has arisen from a misassessment of the physical characteristics of the area, operations in the area will be suspended until an investigation by specialists is completed. The Forest Supervisor shall require that the contractee or permittee inform him of remedial measures which are within their capability and the time required to bring them into operation. Concurrently, the Forest Service will undertake all measures to protect and repair the environment which are within the capability of the contractee.

c. In the event the contractee or permittee fails to take corrective measures within its contract or permit responsibility, the Forest Service shall terminate operations in the area until there is compliance.

d. Where available as a remedy, restitution for impairment of habitat productivity will be sought in cooperation with other State and Federal Agencies.

e. Corrective measures shall be undertaken in consultation with a group of experts convened by the Forest Supervisor from the Forest Service and other State and Federal agencies. Once resolution of the problem has been accomplished, the groups will meet with the Forest Service staff to determine if additional policies and prescirptions need to be written for preventing recurrences, to identify the cause, and to refine procedures for dealing with such situations.

f. The Forest Supervisor shall develop and maintain a standard contingency plan for dealing with damage situations involving fish habitat.

g. All actions by the Forest Service shall insure that the fish habitat is returned to its previous condition as soon as possible. In the event of damage, a long-term plan for restoration and prevention of further or recurrent damage shall be developed if there is any potentiality for prolonged or recurring damage.

h. The Forest Service will undertake modification of timber sale and other contract and permit provisions to make available an optimum range of authorities and remedies for dealing with instances of fish habitat damage.

More specific measures for protecting fish habitat have been developed in various chapters of the FS Handbook for Region 10. The fish habitat management handbook is currently being revised to reflect new management concerns and recent research findings (FS 1984b).

Standard contract clauses, referred to as "C-clauses", have been developed to implement various stream protection measures. These are intended to be attached to sale contracts where appropriate to protect fisheries habitat management needs. In addition, the two long-term sal contracts with Louisiana-Pacific Corporation of Ketchikan (LPK) and Alaska Lumber and Pulp (ALP) [now Alaska Pulp Company (APC)] contain measures intended to provide some standard of fish habitat protection.

9. Fish Habitat Enhancement

As with wildlife habitat improvement, the TLMP identifies numerous fish habitat improvement projects (FS 1979). Enhancement projects identified by the FS include lake stocking, lake fertilization, stream clearance, construction of fishways and spawning channels, and manipulation of riparian vegetation (FS 1983).

IV. REVIEW OF MEASURES IMPLEMENTED TO PROTECT FISH AND WILDLIFE RESOURCES AND HABITAT

This section discusses the actual implementation of measures to protect fish and wildlife habitat during timber sale planning under the TLMP.

A. Wildlife

1. Analysis of Cumulative Impacts to Wildlife Discussed in NEPA Documents

This section discusses impacts to wildlife habitat suggested in environmental analysis of timber sales under the provisions of the NEPA. Impacts were usually assumed to be in direct proportion to the total habitat or habitat identified as important or critical for wildlife that would be clearcut, roaded, or otherwise impacted. (It should be noted that no "critical habitat" was identified in the sense of habitat necessary to maintain species listed as threatened or endangered pursuant to the Endangered Species Act of 1973.) This assumption was used in the TLMP and most timber sale EDs and was often necessitated by lack of other models to display impacts. We evaluated timber sale EDs with respect to their discussion of impacts in terms of sale impacts (habitat affected by selected alternative), past-plus-sale impacts (habitat affected by logging activities up to and including the selected alternative), and perceived end-of-the-rotation impacts from logging (such impacts can only be evaluated where retention and the total CFL to be logged over the rotation are determined). The results of this assessment (Table 2) include stated impacts, as well as impacts derived by the authors from information provided in the EDs.

Only six (16%) of 37 timber sales discussed the percentage of deer winter range (DWR) or other wildlife habitat that would remain at the end of the rotation. These sales are mainly in the Ketchikan Area, which has attempted life-of-the-rotation planning. Only four sales, excluding first entry sales with no previous logging, revealed the amount of important wildlife habitat that had been previously clearcut prior to the proposed sale, and 23 (62%) of 37 EDs did not reveal the percentage of important wildlife habitat scheduled for cutting by the proposed sale. These data clearly show that, except in the Ketchikan Area, the FS is generally not addressing the cumulative impacts of clearcutting at the project or management area level.

Among the timber sales with EDs that discussed the percentage of old-growth wildlife habitat lost, generally less than 15% of the habitat was clearcut by any particular sale (Table 2). Generally only a portion of the CFL in the study was clearcut by the given sale, and cumulative impacts were not assessed. The EDs usually concluded that the impacts of the sale to wildlife were relatively minor or the EDs did not provide any substantial discussions of the effects of the sale on wildlife (Table 2). It is essential that environmental documents for independent timber sales, five-year operating periods of long-term pulp sales, and forestwide planning guides address the cumulative effects of timber harvest on fish and wildlife in general and on old-growth-dependent species specifically. During the five-year period discussed here, the authors believe the record (Table 2) clearly shows that, in most cases, neither forestwide nor sale-specific environmental documents have characterized the long-term, cumulative habitat effects that can be expected as a result of logging over the life of the rotation and throughout the Tongass.

Because old-growth habitat is not renewable within a 100-year harvest rotation (ADFG 1985a), a display of end-of-the-rotation retention of old growth and cumulative timber harvest, similar to that displayed in certain Ketchikan timber sale EDs (e.g., LPK 84-89 EIS, East Carrol Inlet), is essential in evaluating the project-level effects of implementing the TLMP harvest

Table 2. Impacts on Wildlife Revealed in Timber Sale Environmental Documents Prepared Under the TLMP

Sale and Habitat	% Impacted by Clearcutting: Sale	Past-plus-sale	End of Rotation
Ketchikan Area			
LPK 84-89			
Deer severe winter CFL	4 a/	27 a/	56 a/
Deer average winter CFL	6	23	48
Beach CFL	4	28	59
Estuarine CFL	1	23	25
Streamside CFL	5	21	42
Lakeside CFL	4	13	28
Subalpine CFL	2	10	37
General Forest CFL	7	23	57
Total CFL	5	21	50
Total operable CFL	--- b/	---	82
East Carroll Inlet			
Deer critical winter CFL	1	25	25
Deer intermediate winter CFL	10	17	100
Mountain goat CFL	5	5	5
Beach CFL	2	24	--- c/
Estuarine CFL	3	24	--- c/
Streamside/lakeside CFL	12	21	--- c/
Subalpine CFL	23	24	--- c/
Total CFL	9	19	32
Total operable CFL	18	39	64
South Shaheen (FHIP EA)			
Deer critical winter range	--- d/	--- d/	--- d/
Angel Lake Planning EA	---	---	tiered to LPK 84-89 EIS
Suemez (first entry)			
Deer winter range	13	13	43
Deer intermediate range	---	---	71
General beach WHMU	---	---	27
Estuarine WHMU	---	---	28
Subalpine	---	---	0
Total CFL	15	15	67
Vol Class 30+ MBF/acre CFL	---	---	94

(continued)

Table 2 (continued).

Sale and Habitat	Sale	Past-plus-sale	End of Rotation
	% Impacted by Clearcutting		
Stikine-Chatham Areas			
Port Houghton			
"Important" wildlife habitat	7	7	---
Total CFL	7	7	---
ALP 81-86			
Total CFL	8	---	---
Operable CFL	13	---	---
Stikine Area			
Zarembo Lake Salvage			
Operable CFL	2	17	---
Mitkof Flyer			
"Important" wildlife habitat	1	---	---
PRD small sales			
Operable CFL	tr e/	20 f/	---
CFL in South Mitkof WHMU	tr	20	---
Fritter			
Total CFL	4	23	---
Deer winter range	0	48 g/	---
Toncan			
Deer winter range	11	---	---
Waterfowl and furbearer CFL habitat	10	---	---
Todahl			
Operable CFL	18	---	78
Deer winter range	7	---	53

(continued)

Table 2 (continued).

Sale and Habitat	% Impacted by Clearcutting sale	Past-plus-sale	End of Rotation
Campbell			
Brown bear, geese, goat important habitat	8	8	---
Operable CFL (by volume)	28	28	---
Sokolof			
Old-growth DWR	4	50	---
Cleveland			
Total CFL	14	14	---
Identified DWR	0	0	---
Cabin			
CFL	12	26	---
Granite			
Deer winter range	2 h/	---	50 h/
Totem			
Total CFL	12	---	---
Deer winter range	13	---	---
CHATHAM AREA			
Couverdeen			
Total CFL (by volume)	19	---	---
Important wildlife habitat	11	---	---
Beach fringe	1	---	---
Goat winter range	3	---	---
Streamside	6	---	---
Deer winter range	10	---	---
Gilbert Bay			
Total CFL	16	16	42
Cowee-Davis i/			
Critical wildlife habitat	---	---	14
Operable CFL	20	20	68

a/ Sale and past-plus-sale impacts shown only for VCUs within 84-89 LPK sale area. End-of-rotation impacts shown for all MAA covered by EIS evaluation. These impacts assume "inoperable" CFL will not be logged. Some logging has, in fact, been scheduled for "inoperable" CFL (see section IV.). CFL = Commercial Forest Land.

b/ --- means no data were provided.

c/ Calculation was not possible because the acres of inoperable CFL in WHMUs was not provided.

d/ The FHIP EA identified only 303 and 15 acres of critical deer winter range in VCUs 591 and 593, respectively. These figures, especially for VCU 593, are unrealistically low and conflict with other statements in the EA (i.e. "deer may also be wintering inland on south-facing slopes" [VCU 591] and "the shoreline timber is still considered excellent DWR" [VCU 593]). This discrepancy resulted from the fact that only timber stands with greater than 30,000 bf net inventory volume in beach and estuarine WHMUs were classified as critical DWR in the FHIP EA. The present definition of key DWR is broader and would have resulted in more acres of winter range being identified (memorandum from Michael A. Barton, regional forester, to ADF&G Commissioner Don Collinsworth, 1/22/86).

e/ tr = less than 1%.

f/ Includes all of Mitkof I.

g/ Assumes all previous cutting was in DWR.

h/ Percentages are for all of Etolin Island and include the TLMP designated wilderness area, which contains 50% of the estimated DWR.

i/ The following sale EDs did not discuss percentage of timber removed and habitat impacted: Yahky Cove, Cherrumba Salvage, Ketchikan Free Use - Small Sales, Corner Bay Salvage, Skip, Bohemia, Nesbitt, Nemo Point, Highbush, Rynda, South Wrangell, Yakutat Salvage, Yakutat Blowdown #2, Homeshore Blowdown, and South Windham.

schedule. The identification of retention is discussed further in the following section.

2. Retention of wildlife habitat

Only 13 (35%) of 37 timber sales under the TLMP identified CFL for retention (i.e. removal from the timber base) in the environmental analysis process. Deer winter range (DWR) was often identified for the purpose of delineating retention areas, however, as noted below, retention was also prescribed to protect the habitat of other wildlife species as well. These sales are discussed with respect to the area in which they occurred.

a. Chatham Area retention

The two timber sales in the Chatham Area that identified retention areas were Cowee-Davis and Gilbert Bay. Cowee-Davis developed retention areas during preparation of a management plan EA and incorporated the retention areas into the sale EA. Maps in both EAs document the areas, and retention apparently follows the "TLMP definition" of operable CFL retained from harvest indefinitely. About 32% (1,955 acres) of 6,000 acres of operable CFL was identified as retention to protect deer and goat winter range as opposed to 14% scheduled for retention in the TLMP harvest yield calculations (memorandum from W. Dale Heigh, FS regional director of timber management, to the regional forester, n.d. [ca. Feb. 1981]). This CFL was dispersed throughout the study area and accounted for 86% of the critical wildlife habitat identified by the FS on operable CFL within the study area.

The Gilbert Bay EIS identified retention as the "amount of [total] CFL removed from timber base to protect other resource values." A large estuary (Sweetheart Flats), with adjoining salmon streams and associated uplands, was placed in retention in order to protect important waterfowl, black and brown bear, furbearer, and fish habitat. This area totalled 1,500 land acres, including 650 acres of CFL (11% of the total CFL in the sale area). Planned roads avoid the retention area, and "harvests [in retention] would be prohibited unless it is determined that future harvests would not affect or would benefit wildlife."

b. Stikine Area retention

Only five timber sale EDs on the Stikine Area identified retention. These sales were Todahl, Toncan, Fritter, Nesbitt, and Totem, and the retention was connected with "tentative" (no NEPA analysis and verification) MAA direction developed by the Supervisory Office.

The Todahl EA established a WHMU area that was to retain a minimum of 1,300 acres including an average strip 500 ft wide along an approximately 9 mi stretch of beach. This was necessary to protect deer winter range (DWR) and a high-density eagle nesting area (5.1 observed nests/mi of beach). The 500 ft wide strip of beach fringe is in keeping with the TLMP, which established a 100% retention factor within 500 ft of the beach for shorelines with high eagle-nest densities.

The Fritter Timber Sale EA identified 4,000 acres of DWR on the sale area, placed the "primary" DWR in a WHMU, deferred logging in the DWR, and cited that this action was in keeping with MAA direction to retain at least 3,700 acres of total CFL for deer [on Zarembo Island]. The subsequent Nesbitt Timber Sale EA, in another area on Zarembo Island, developed a watershed WHMU and several beach fringe WHMUs containing DWR. The IDT recommended that 2,640 acres be retained until other cutover acres regain their carrying capacity [as DWR]. Although the EA is unclear, this recommendation, which was apparently adopted, relocated a portion of the retention target from the Fritter Sale Area (Richard K. Kohrt, Wrangell district ranger, pers. comm., 2/15/85).

The Toncan Timber Sale study area comprised a portion of the "South Lindenberg" management area on the Lindenberg Peninsula of Kupreanof Island. The "tentative" MAA direction for all of the "South Lindenberg" MAA was to retain 6,400 acres of DWR. The wildlife biologist on the IDT identified 2,451 acres of DWR within the Toncan Study Area and felt that retention of this acreage was essential to meet the 6,400-acre retention target for all of "South Lindenberg." The selected alternative indicated the highest harvest acreage of DWR (224 acres), established three WHMUs containing 755 acres of DWR, stated that the desired condition of the WHMUs was to "manage the forest [habitat] in a windfirm old-growth forest condition," and then scheduled about 50 acres in one WHMU for clearcutting without indicating this in the EA. In addition, the EA failed to classify for retention 1,522 acres of identified DWR within the Toncan study area outside identified WHMUs and proposed clearcuts and did not provide a method to resolve the potential shortfalls in DWR retention goals on "South Lindenberg."

The State of Alaska challenged this action during coastal management consistency review, noting that 6,400 acres of DWR had not been identified, retained, and displayed in the EA as retention. This resulted in the FS revising the EA, with the following results:

1) a new inventory of DWR was conducted that identified 9,500 acres on South Lindenberg;
2) WHMUs were completely dropped from the EA;
3) a map displaying areas where 6,400 acres of wildlife habitat will be retained on "South Lindenberg" for the remainder of the 10-year planning period was added to the final EA;
4) the selected alternative was retained as originally planned; and
5) the FS provided the ADF&G with a clearer definition of its interpretation of the use of retention on the Stikine Area.

Correspondence from the Petersburg Ranger District documents the Stikine Area position regarding timber harvesting in retention areas (memorandum from Joseph Chiarella, Petersburg district ranger, to Don Kelly, ADF&G habitat biologist, Petersburg, 7/20/84):

> The Chatham and Stikine Areas have adopted the following definitions for TLMP wildlife retention and wildlife habitat management units. These definitions will be used in finalizing the ALP 86-90 EIS and will also be used for our independent sale program.
>
> Wildlife Retention Areas - are those areas delineated for the purpose of maintaining an old-growth, virgin forest condition wherein timber harvest is deferred for the planning period or until a new planning effort (process) is completed.
>
> There are several timber management programs that involve timber harvest that will continue in retention areas. In the case where significant blowdown, bug damage or some other catastrophic event occurs, the Forest Service may elect to salvage the timber. Of course, we would have to conduct the required NEPA analysis. We envision that most small

blowdown situations occuring in unroaded areas would probably not be salvaged. In such cases, the NEPA analysis would likely reveal that the limited timber volume involved and access difficulties and costs would make such a venture uneconomical. However, the Forest Service must maintain its management perogatives and we will salvage damaged timber where it is appropriate to do so. As we evaluate such cases, we may also determine that a substitution of the "lost" retention is warranted and will make an adjustment.

The second condition where timber harvest will continue in retention areas involves firewood cutting. We intend to continue to allow the harvest of dead and downed trees by private woodcutters. Dead trees are defined as having no green needles present. As you know, we do not presently require a permit for personal use gathering of dead material for firewood.

At the same time, it is our intention to exclude from our small sales program, regular sales program and long term sale operating plans those areas which we have designated as retained for wildlife purposes as per TLMP.

The final Toncan EA identified retention for all of "South Lindenberg." DWR that could have been retained in the Toncan Sale Area was shifted to other areas of "South Lindenberg" with lower volume CFL.
The Totem Timber Sale EA identified "tentative" MAA DWR retention objectives for the portions of management areas S11, S13, and S20 that comprised the sale area. These were then compared with acres of inventoried DWR in the sale area, revealing a "surplus" of inventoried DWR relative to the "tentative" MAA retention objectives for the sale area.

A map is displayed in the Totem EA that "establishes retention areas for the remainder of the TLMP planning periods." DWR is included in proposed WHMUs with a prescription of retention. However, the actual retention areas have not been finalized and are subject to change (Jim Franzel, FS fish and wildlife staff officer, Petersburg ranger district, pers. comm., Feb. 1985).

c. Ketchikan Area retention

The Ketchikan Area has developed a retention procedure that it has used in the Suemez, the FHIP, LPK 84-89, East Carroll Inlet Management Plan, Angel Lake Planning Area, and Cherrumba Salvage EDs. This procedure involves identifying all land as some type of WHMU, correlating certain WHMUs to key seasonal or year-round habitat for selected species, establishing retention areas within each WHMU, and evaluating the effects of logging in terms of the percentage of each type of WHMU or key habitat for the given species that is clearcut during the sale and at the end of the rotation. The habitat criteria follow recommendations or modifications of recommendations of the TLMP Wildlife Task Force (FS 1979). For example, important habitat for Sitka black-tailed deer is defined as beach WHMU (land within .5 mi of shoreline and under 800-ft elevation) and Estuarine WHMU (1,000-foot forested strip surrounding estuaries). Marten and cavity-nesting habitat is defined as all forest WHMUs.

The Suemez EA identified 4.6% of the operable CFL to be retained for wildlife and 5.6% to be retained as "recreational leave" (to protect the Arena Cove-Cape Felix Area as a unique recreational feature). These percentages compare to a TLMP retention of 8% for management area K20 (memorandum from W. Dale Heigh, FS regional director of timber management, to the regional forester, n.d. [ca. Feb. 1981]). Retention was defined as CFL left at the end of the rotation. The TLMP EIS, Part 2 (FS 1979), states "no timber harvest will be allowed within about one mile of Arena Cove and Cape Felix" (p. 157). This protection was apparently not incorporated into the TLMP harvest yield calculations, however. In sale layout, roads and clearcuts were located within one-half to one-quarter mile of the Arena Cove-Cape Felix area. No maps were included in the ED, but aerial photos identifying the retention areas were reviewed in the Ketchikan Area office in February 1985.

The LPK 84-89 EIS identified 18% of the operable CFL (47,600 acres) in 12 management areas for wildlife retention. This compares to 11% identified in the TLMP. Maps in the EIS document the location of these units, although retention areas were not identified for certain VCUs (e.g., Marble Island, Cholmondeley Sound, McKenzie Inlet) where no management activity was planned for this planning period. The LPK 84-89 EA, which identified specific cutting units, was tiered to the EIS retention process, and it noted that only two cutting units totalling about 36 acres and containing extensive blowdown were located in wildlife retention areas. The EA specified that equivalent acres of high-quality, old-growth habitat would be designated as replacement habitat.

In examining the sale layout, we noted 12 cutting units that appeared to substantially overlap with retention areas established in the LPK 84-89 EIS. These units were discussed with Dale J. Thompson (LPK 84-89 team leader) in February 1985. Eleven of these units were carryover units covered under the 79-84 LPK EIS. These units were not modified to fit the designated retention areas in the EIS; instead, the location of retention areas should have been fit around the carryover units. One unit had apparently been mistakenly laid out in a designated retention area, contrary to the management intent of the LPK 84-89 EDs.

The Cherrumba Salvage Sale and the Angel Lake Planning Area EA were tiered to the retention areas designated in the LPK 84-89 EIS. However, seven units displayed in the selected alternative for the first rotation in the Angel Lake EA are within retention areas established and mapped in the LPK 84-89 EIS. This discrepancy apparently resulted because the documents were prepared concurrently. The Angel Lake EA has apparently been modified so that no cutting units occur within the LPK 84-89 EIS retention areas (memorandum from Michael A. Barton, regional forester, to ADF&G Commissioner Don Collinsworth, 1/22/86).

However, this and associated other layout concerns prompted Forest Supervisor Winn Green to clarify how retention is to be implemented on the Ketchikan Area (memorandum from Winn Green, Ketchikan Area forest supervisor, to the management team, 11/14/84). Green noted that the Ketchikan Area was the first unit on the Tongass NF to make widespread use of retention. However, in the first 18 months of implementation, numerous problems arose, including 1) harvesting blowdown in retention areas without designating replacement areas, 2) laying out harvest units in retention areas, and 3) moving units from the locations outside retention areas as indicated on maps in the NEPA documents into retention areas during layout. To resolve this he specified the following:

> Our current policy (taken from the 1984-89 [LPK] EIS, page C-5), is as follows:
>
> 1. Old-growth retention is intended as a permanent allocation. Future Forest Planning with NEPA documentation would be the vehicle for change.
>
> 2. Permitted activities in retention areas include: a) approved NEPA document activities such as Timber Transportation Facility (TTF) construction and road construction; b) harvest of blowdown or insect/disease damaged trees; and c) vegetative manipulation to accomplish fisheries, wildlife, visual, or recreation objectives. The latter must be initiated by the benefitting resource.
>
> 3. Minor boundary changes may occur, both deletions or additions, as needed for land use management. Major changes are appropriate only if 1) retention is lost to blowdown, insect, or disease; or 2) if "Better" wildlife habitat is identified. Replacement acreage should be identified by an IDT.
>
> 4. In addition, I am also adding the following requirement; actions described in items 2 and 3 will not be undertaken without prior consultation with the local Alaska Department of Fish and Game representatives. The consultation will be documented and the documentation filed in the planning records.
>
> I want each Management Team member to carefully review any activities which might encroach on retention areas to ensure that all of the above concerns are met. In addition, I am requiring that all future actions involving retention areas except minor boundary changes be reviewed and approved by me before on-the-ground implementation occurs.

The above procedure has been used recently to replace 10 acres of retention with considerable windthrow for 15 acres of beach fringe with high wildlife value previously scheduled for logging in VCU 527. The action was initiated by the district wildlife biologist after consultation and concurrence with the ADF&G habitat biologist and approved by the forest supervisor. Maps and memos documenting the "swap" are included as part of the planning record.

The FHIP Demonstration EA identified acres of retention in VCUs 591 and 593 that are tiered to the LPK 84-89 EIS.

The East Carroll Inlet Management Plan EA identified 10,036 acres of operable CFL (compared to 3,391 acres scheduled under TLMP). Maps were not displayed in the EA, however, but they are kept at the area office. The retention acreage, which is about three times that provided in the TLMP, reflects a heavy emphasis on fish and wildlife near the community of Ketchikan and includes virtually all the remaining FS-identified key DWR in the study area.

The Ketchikan MAAs completed to date have provided for substantially greater retention than the TLMP provided. The LPK 84-89 EIS indicated that a lower retention percentage elsewhere would be required to make up this shortfall. Another scenario is that the Ketchikan Area will continue to select retention acreages to fit perceived needs through the MAA process and that harvest schedules may be eventually adjusted areawide if necessary to meet demands for fish and wildlife (Charlie Gass, FS planning officer, Ketchikan Area, pers. comm., March 1985). Another possibility is that retention provided in these documents will be lost in subsequent NEPA planning within the management areas.

d. Other sales

Six additional timber sales referred to retention but did not specifically identify areas, commit CFL to retention, and analyze the effects of the retention designation in an environmental document. The ALP 81-86 EIS defined retention and refers to retention areas (e.g., "most critical wildlife habitat (in Freshwater Bay MA) protected through designation of WHMU and retention areas"; "retention areas have been identified in all alternatives, within which no timber units have been planned. Retention areas exist primarily to protect critical DWR and estuarine zones";

"retention of most sensitive wildlife zones along coast of Tenakee Inlet"). However, the EIS did not display maps of the retention areas developed by the IDT, and such maps have apparently been lost. The IDT on the subsequent APC 86-90 sale was not able to find the 81-86 retention areas (Larry Ethelbah, FS wildlife biologist, Stikine Area, pers. comm., Feb. 1985), and the FS was not able to locate retention maps for review in this report. South Windham EA makes similar references to retention without any identification or further discussion provided (e.g., "designation of habitat retention areas" have reduced anticipated adverse impacts to wildlife).

The Granite Timber Sale EA specified that "the wildlife objective should be to retain one half of the (TLMP) inventoried DWR on Etolin Island to meet consumptive demands by Wrangell residents . . . Retention areas should be within reach of sport hunters . . . within range of better anchorages." However, "for this planning period, 16,743 acres or 50% of inventoried DWR is in LUD I [TLMP wilderness area] and deferred from harvest." Thus the wildlife objective to retain 50% of the DWR on Etolin Island amounts to little more than protecting the amount of DWR that exists in LUD I, where timber harvest was not scheduled in the TLMP. "Retention," as developed in the TLMP, is to be applied only to LUDs 3 and 4 areas where timber harvesting was permitted under the TLMP.

Three timber sales on the Petersburg Ranger District (PRD) referred to WHMUs and retention targets proposed during an "in-house" MAA process that does not follow a NEPA format. The PRD Small Sales EA simply identified the "tentative MAA" areas and scheduled only two clearcuts, containing 20-50% blowdown and totalling 20 acres, in retention areas. The Bohemia EA included the "tentative North Kupreanof MAA", which has maps of WHMUs and retention targets as an appendix, stated that all alternatives were developed to meet the direction, and provided no further discussion. The Mitkof Flyer Sale was also "in keeping with" MAA direction for Mitkof Island. All three sales largely avoided logging in MAA proposed retention areas but did not incorporate the tentative MAA direction as a FS decision analyzed and validated through the NEPA process.

As noted earlier, 65% of the timber sale EDs did not identify retention. Areas where logging has been scheduled since the TLMP and where retention was not established in the final ED include the entire ALP 81-86 sale area on Chichagof and Baranof islands; the mainland management areas of C18, C19, C31, C37, C53, C54, C55, C61, S01, S31, S33, and S35; Kuiu Island; the northern portion of Mitkof Island; Wrangell Island; and the small island complex of S18. In the Ketchikan Area, retention areas have not been established in K07 where the Yahky Cove timber sale and numerous carry-over units in the LPK 84-89 EIS sale were scheduled. (Management area planning for K07 was initiated in October 1985, memorandum from Michael A. Barton, regional forester, to ADF&G Commissioner Don Collinsworth, 1/22/86). In addition, small sales consisting of A-frame beach clearcutting occur in management areas where retention has not yet been identified.

e. Considerations in the use of retention

The TLMP Wildlife Task Force established retention for vertebrate wildlife species or species groups (Table 3). With the exception of the Ketchikan Area, retention designations seldom addressed wildlife habitat needs other than key DWR. Only one sale retained habitat that was identified as important for brown bears (Gilbert Bay EIS). No sale ED retained habitat for moose, although logging was scheduled in moose range in at least six management areas. The FS, in their response to the state review of the Port Houghton EA, indicated they believed that retention may not be necessary for moose (memorandum from William Gee, Chatham Area forest supervisor, to Jay Hogan, Division of Governmental Coordination, State of Alaska, 9/21/83). This position is contrary to both research findings for southeastern Alaska (ADF&G in review a), as well as the IDT wildlife specialist's recommendations for the sale.

Where retention was identified, it was most often connected to beach fringe and adjoining forest land. Over 100 mi of beach fringe has been identified for retention. This is consistent with the emphasis in the TLMP EIS (p. 86):

> [Retention factors] enable forest managers to protect fish streams, eagle habitat, bear, wolf, waterbirds, deer, furbearers, and sensitive visual areas near recreation sites and along travel routes. Because many of these needs overlap along the beach fringe, retention of existing old-growth stands occurs extensively along the beaches.

Table 3. Use of Retention for Wildlife Species or Species Groups Identified by the TLMP Wildlife Task Force

TLMP Species/Group Requiring Retention	Timber Sale EDs Identifying Retention for Species or Species Group [a/]: Number of Sales	% [b/]
Bear	5	14
Wolf	0	0
Deer	11	30
Moose	0	0
Mountain goats	2	20
Furbearers	5	14
Land birds	4	11
Water birds	5	14
Bald eagles	5	14

a/ Includes only sales where the species was identified as a concern in the retention area or the effects of the retention designation were evaluated in terms of the acres of habitat retained for this species/species group.

b/ Percentage of total timber sale EDs where the species occurred. Mountain goats and moose did not occur in all sale areas.

The permanency of retention areas is of special concern to wildlife management. Given the environmental analysis procedure, all retention areas are subject to future changes or deletions under the NEPA process. The Stikine Area has especially stressed that the retention areas and WHMUs are valid only until the revision of the TLMP, when presumably they will either be incorporated into the Forest Plan or be changed. The Stikine Area has not displayed any long-term effects associated with retention through the life of the rotation. The Chatham Area has not, with the exception of two sales, utilized retention or displayed long-range impacts. By contrast, the Ketchikan Area, although stressing that retention designations are subject to future change through the NEPA process, has established documented retention areas and discussed long-range impacts to some extent in most sale areas.

Although the TLMP established retention as operable CFL withdrawn from harvest (harvest schedules were projected to 350 years), a number of activities related to commercial harvest of timber are being permitted in some retention areas. These activities include:

1) roads and transportation facilities;
2) harvest of blowdown, disease-damaged, and insect-damaged trees;
3) vegetative manipulations designed to enhance wildlife habitat;
4) logging that does not impair the "physical features of the environment necessary for use by wildlife during critical periods in their use cycle. (Mitkof Island retention areas)"; and
5) clearcuts salvaging blowdown.

Where clearcutting has been scheduled to salvage blowdown in designated retention on the Chatham Area (e.g., Cowee-Davis Sale) and the Stikine Area (e.g., PRD Small Sales), we are unaware of any procedure that has been established to replace the retention acres as has been done in the Ketchikan Area. The commercial harvest of blowdown or "damaged" trees could be a significant threat to the wildlife values of retention areas because standing live, healthy trees as well as snags and potential cavity-producing trees are invariably included in the sale.

Apparently the Stikine Area subtracts timber harvested for road right-of-ways from retention acres; it is not clear that this is being done in the Ketchikan Area. The LPK 84-89 EIS shows over 40 mi of main roads and five log dumps in wildlife retention areas. We found no examples where the FS has scheduled logging in retention areas to "enhance or maintain" the wildlife habitat, although this is a management option specified in some timber sale EDs in all three areas of the Tongass NF.

Finally, it should be noted that the timber harvest EDs have established retention acres in terms of either operable CFL or total CFL. According to the TLMP, only acres of operable CFL on regulated land in LUDs 3 and 4 (e.g., slopes less than 75%, islands greater than 50 acres) should be counted as TLMP-designated retention.

3. Wildlife Habitat Management Units (WHMU)

a. Degree of implementation

Only 15 (41%) of 37 timber sale EDs identified WHMUs. These include the 13 timber sale EDs where retention was identified that were discussed in the previous section. The remaining sales were all on the Stikine Area. The Skip Timber Sale ED identified the Thoms WHMU, which was "established primarily to provide a high degree of protection to historically important deer winter range." The selected alternative avoids logging in this area, but no future management prescriptions were provided. The Zarembo Lake Salvage EA identified 1,300 acres of critical DWR as a WHMU, deferred logging it, but also gave no future management prescription for that area.

The Totem EA, in addition to identifying retention WHMUs, identified three non-CFL WHMUs with high wildlife values. The Mitkof Island MAA (a non-NEPA planning effort) established a tentative WHMU around Blind Slough and Blind River, but the subsequent Mitkof Flyer EA made little reference to it and did not establish obvious management prescriptions for it through the NEPA process although the tentative WHMU occurred within the sale area.

b. Provisions for viewing and photographing wildlife

There was virtually no discussion of opportunities for viewing and photographing wildlife in WHMUs in any timber sale EA, contrary to the SAAG policy.

The Gilbert Bay EIS, while not specifically discussing viewing opportunities, established a WHMU and specified the construction of a recreational cabin in the Sweetheart Flats Area, a measure that, if implemented, might promote the viewing of wildlife. A swan observatory was designed and built in the Blind Slough WHMU. This plan was prepared separately from the IDT analysis of the area during timber planning. The Ketchikan Area developed recreational plans for management areas in the LPK 84-89 EIS and Carroll Inlet EA. Some of these proposed measures, such as development of trails and three-sided cabins in the area of a recent mountain goat transplant on Revillagigedo Island, would enhance nonconsumptive wildlife recreation.

c. Provisions for snag management

Nearly all timber sale EAs did not include implementation plans in WHMUs to provide "provisions for snag management," as required in the ARG (FS 1983). The LPK 84-89 EIS and Carroll Inlet Management Plan did, however, assess the percentage of habitat (operable CFL and total CFL) retained in WHMUs over the rotation for cavity-nesting birds. Snag management is discussed in greater detail under Best Management Practices for Wildlife.

d. Summary

In summary, except for the Ketchikan Area, the WHMU concept established in the SAAG does not appear to have been implemented to a significant degree. Prescriptions for WHMUs that have been established have focussed mostly on the percentage or acres of CFL to be retained. Other prescriptions or implementation plans, such as road locations and closures, harvest methods other than clearcuts, silvicultural treatments, and rotational logging schedules designed to maintain a portion of the habitat in early forest succession, have largely not been applied through IDT prescriptions or implementation plans. In our opinion, the failure to adopt the WHMU concept established by the SAAG and the ARG has delayed the development of a consistent program for active wildlife habitat protection and management at the project level.

4. Deferral (Postponement) of Logging in Areas with High Wildlife Values

Although retention and WHMUs have not been implemented in most management areas where timber sales have been scheduled since the TLMP, some sale EDs have deferred logging in some important wildlife areas (Table 4). The deferral of logging in portions of critical wildlife habitat has played a significant role in reducing impacts to wildlife in many of these sales. Three ADF&G Class I areas or portions of these areas have been temporarily deferred from logging (Castle River, Blind Slough, Krestof Island) in the EDs reviewed. The proposed TLMP Amendment under review at the time of completion of this report includes tentative direction to defer roading in logging in 11 VCUs originally scheduled in TLMP, but requested for deferral by the department.

The deferral of clearcutting critical DWR along the immediate saltwater shoreline is particularly noteworthy. In the timber sale EDs examined (including the first entry for Suemez Island), only about 10.5 mi of shoreline timber were identified for clearcutting. These figures do not include the Ketchikan Small Sales - Free Use Program EA, which allows 11% of the beach fringe to be clearcut (300 ft at .5 mi intervals) without specific IDT input (which is required to exceed the 11% restriction). This "blanket EA" has no apparent time restriction or volume limit and has been in effect since July 1980. It is uncertain how much shoreline forest has been and will be cut under the sanction of this NEPA document.

The deferral of beach-fringe logging is partly a result of recent timber sales that concentrated on roading and logging inland areas. Presently the Stikine Area is preparing A-frame sales that may clearcut extensive shoreline forested areas on southern Kuiu Island, and the Chatham Area is developing plans for A-frame logging in Port Houghton and other mainland areas. The present FS preferred alternative for the 86-90 APC Sale proposes a substantial amount of beach-fringe logging on Chichagof Island, especially in VCUs 279 and 283 (FS 1985a). The postponement of clearcutting of shoreline forests not in retention may be a short-lived practice. Deferral will thus provide only temporary protection of old-growth habitat unless the TLMP and the harvest schedule are modified. It is also important to recognize that many very valuable fish and wildlife habitat areas have been scheduled for roading and harvesting under timber sale EAs (Table 5).

5. Best Management Practices

a. Eagle nest buffers

Table 4. Areas of High Wildlife Values Postponed from Logging (Excluding Identified Retention Areas)

Sale	Habitat
LPK 84-89 EIS	Nonretention estuarine and beach habitat[a/]
Totem	Castle River VCU 435 (until TLMP revision)
Zarembo Lake Salvage	1,300 acres critical DWR; the only remaining travel corridor of standing timber from valley bottom to ridgetop along FS Road 6592
Skip	Thoms WHMU[b/]
Mitkof Flyer	Deer winter range in South Mitkof WHMU
	Ca. 2,000-acre portion of Blind Slough - Blind River watershed (until TLMP revision)
Fritter	Most secondary DWR
Nemo Point	Beach fringe
Campbell	Goat winter range; geese wetland areas
Cleveland	Identified DWR
ALP 81-86	Krestof I., Fish Bay, Appleton Cove, Saook Bay, Pond I. and South Arm of Kelp Bay
	Critical DWR, bear and waterfowl conc. areas, and high furbearer use areas avoided "to extent possible" and "retained throughout first rotation and beyond"[c/]
	Two areas of Suntaheen Creek deferred for further study and evaluation (one may contain unique plant species)[d/]
	Three units in lower Finger Creek[e/]
Couverden	4,200 acres of important fish and wildlife habitat ("subject to [future] harvest thru the revision of TLMP")
Port Houghton	22 mi of beach fringe; identified goat winter range; most moose winter range

a/ Although not specified in the LPK 84-89 EIS, it is the present policy of the Ketchikan Area to defer long-term sale logging in non-retention beach and estuarine habitat as long as possible (G. Clavenger, wildlife biologist, Ketchikan Area, pers. comm., March 1985).

b/ South Wrangell Sale scheduled three clearcuts in Thoms WHMU despite state opposition.

c/ Maps showing these areas were not provided and apparently lost (e.g., the 86-90 IDT could not locate them and did not use them in preparation of the 86-90 sale documents). Thus, areas that the 81-86 ALP IDT envisioned to be retained "through the first rotation" may be scheduled five years later for harvesting.

d/ The present FS preferred alternative for the 86-90 APC Sale proposes additional logging in Suntaheen Creek (FS 1985).

e/ The present FS preferred alternative for the 86-90 APC Sale proposes to clearcut these units (FS 1985).

Table 5. Selected Areas Identified as Having High Wildlife and/or Fisheries Values but not Deferred from Logging and Roading in Project Timber Sale EDs Prepared Under TLMP

Area or habitat	Sale
Suemez Island deer winter range	Suemez
Beach fringe forests throughout Ketchikan Area	Ketchikan Small Sales
Sweetwater Lake - Hatchery Creek drainages; Red Bay Area; VCU 554, 578, 587 (Prince of Wales Island ADFG Class I VCUs)	LPK 84-89
Staney Creek, Little Lake (Prince of Wales Island)	LPK 84-89
Orchard Creek drainage (Revillagigedo Island)	LPK 84-89 EIS
VCU 593 (Prince of Wales Island)	South Shaheen
Sokolof Island deer winter range	Sokolof Salvage
Portions of Blind Slough drainage	PRD small sales Mitkof Flyer Sale
Frank Creek FHMU (VCU 510)	Campbell
Wrangell Island deer winter range	South Wrangell, Nemo Point
Mitkof Island deer winter range	Cabin, Mitkof Flyer, small sales
Kupreanof Island deer winter range	Totem, Todahl, Toncan
Chuck River drainage	Chuck River[a/]
Thoms WHMU (Wrangell Island)	South Wrangell
Upper Castle River drainage (Kupreanof Island)	Totem
Cowee, Davis, and Sawmill Creek drainages	Cowee-Davis
MA C53 (Yakutat)	Yakutat Salvage, Yakutat Blowdown #2

(continued)

Table 5 (continued).

Area or habitat	Sale
Pavlof Harbor VCU	ALP 81-86, APC 86-90[b/]
Chichagof Island deer winter range	ALP 81-86, APC 86-90[b/]
Wildlife leave strips and deer travel corridors and winter range in Corner Creek drainage (Chichagof Island)	Corner Bay Salvage
Kadashan drainage (Chichagof Island) road construction	ALP 81-86
Isthmus between Port Camden and Three Mile Arm	ALP 81-86
Leave strips between clearcuts in VCUs 400 and 402 (Kuiu Island)	No ED was prepared for this harvest
Leave strips between clearcuts in deer winter range (southwestern Mitkof Island)	No ED was prepared for this harvest

a/ A Decision Notice has not been issued for this Timber Sale. However, the proposed TLMP Amendment does not defer roading or timber harvest and indicates that roading, and sale preparation will occur during the 1985-89 period.

b/ Further harvesting is proposed in the draft APC 86-90 EIS (FS 1985).

Protection of eagle nests has probably been considered in all sale layouts since the TLMP, although several EAs did not discuss it. We found only five cases in the 37 EDs that noted that eagle nests might be encroached upon by roads or cutting of standing timber. In the case of the Todahl sale, protection of eagle nests played a significant role in the design of the alternative selected. There was little discussion in the sale EDs that the FS intended to protect eagle perch trees, however. Protection of eagle perch trees occurred indirectly through retention or deferral of logging beach fringe.

b. Other buffer strips (excluding retention areas)

A number of sale EAs specified buffer strips to protect key wildlife habitats other than eagle nests. These are discussed below. The East Carroll Inlet Management Plan EA specified that no logging would occur within .5 mi of a reported peregrine falcon nesting area. The Sokolof EA established buffers between the beach and two clearcuts. The Port Houghton EA stated that a 330-ft buffer would be established around a red-tailed hawk nest if possible.

The South Wrangell EA specified leaving "windfirm visual and accoustical buffer strips to screen roads and cutting units from inland waterfowl nesting areas." These waterfowl areas involved roads and four clearcuts around certain lakes and wetlands. During project implementations, roads were laid out throughout these wetlands, with few instances of CFL buffers between the roads and the wetlands. In some locations, roads crossed wetlands within 100 to 200 ft of the lakes. None of the four clearcuts apparently retained a buffer of commercial forest between the wetlands and the unit. The roads and three of the clearcuts were acceptable to the wildlife biologist reviewing the layout, apparently because of adequate non-CFL buffers between the units and the lakes. One unit did not provide a 100-ft buffer of commercial forest along a lake recommended by the wildlife biologist and included in the layout requirements of the EA. (Data obtained from review of unit layout on aerial photos and unit cards - Wrangell Ranger District.)

The Granite EA designed wildlife buffer strips between units and streams and travel corridors for seven clearcuts and established "visual and accoustical buffer strips" to protect waterfowl nesting habitat next to one unit along Egg Lake and one unit along a beaver-pond area. The Couverden EA also used buffer strips next to travel corridors.

The Mitkof Flyer EA specified a "300-foot buffer between roads and (the north side of) Blind Slough where possible." There was such strong local and state opposition to any logging in that section of the Blind Slough drainage that the FS deferred entering this area until the TLMP revision (Mitkof Flyer Final Decision Notice - 1/28/83).

In the consistency review of the Cleveland EA, the state recommended buffer strips between two units and several small lakes. We reviewed the unit layout of the sale and found one lake was to be clearcut along half of its shoreline with no protecting buffer, another lake had roads and units within about 100 ft of the lake, with a buffer of timber in between, and the largest lake had a 200-ft forest buffer between it and the nearest clearcut.

c. Travel corridors

Eight timber sale EDs discussed considerations of travel corridors in evaluation of alternatives and sale design. Consideration of corridors was connected with protecting wildlife travel routes along streams or other wetlands (e.g., Couverden, Granite, Yakutat Salvage Sales #1 and #2) and/or the design of old-growth timber leave strips between clearcuts to provide a continual swath of forest from upper to lower elevations (e.g., Granite, ALP 81-86, Gilbert Bay, Zarembo Lake Salvage, Couverden, and Corner Bay Salvage). The latter use of leave strips often focussed on providing travel routes within or to DWR. A large percentage of the EDs that did not discuss travel corridors probably did not consider game travel routes in sale layout. Some specifics on the use of travel routes are discussed below.

The Couverden EA provided that travel routes along streams and within winter range be incorporated into the sale layout. The Granite EA designed wildlife travel routes between seven clearcuts and adjacent streams and wetlands. The Yakutat Salvage Sale moved a main road from the muskeg-timber ecotone paralleling the Situk River, partly because of the importance of this habitat as a natural game trail. The Gilbert Bay and the ALP 81-86 EIS placed leave strips between units to serve as old-growth habitat and travel corridors for deer and other species.

In two sales, the need to maintain travel corridors influenced the selection of the alternative. The Zarembo Lake Salvage Sale deferred cutting the last remaining travel corridor of standing timber between the valley bottom and the ridgetop along FS Road 6592. The maintenance of leave strips for deer movements was a major issue of the Corner Bay Salvage Sale. Nevertheless, a number of leave strips of partially blowdown timber were completely clearcut along with two leave strips of standing timber. Two clearcuts were modified to retain two narrow leave strips as travel corridors between existing units (deferring logging on 12 acres of standing timber), and a number of other leave strips in the study area were likewise deferred from logging to provide some travel routes for deer during deep snow conditions.

Leave strips between units are often susceptible to blowdown after logging. In some timber sales administered since the implementation of the TLMP, the FS has allowed leave strips to be clearcut harvested by existing logging operations operating in the sale area without IDT, state, or public review and without preparing NEPA documents to analyze the effects of such harvesting. It is unclear how widespread this practice is throughout the forest. Two such cases have been documented on the Stikine Area (Appeal of Alaska Regional Guide, J. Doerr and L. Yates, residents of Petersburg, Alaska, to R. Max Peterson, chief of the FS, 1/31/84).

A large volume (20+ MMbf) of old growth, including total harvest of at least 19 leave strips between units, was released to ALP on northern Kuiu Island from 1980 to 1982. Harvesting of these acres was not covered under any environmental document. Smaller clearcuts were joined by removal of leave strips to create large clearcuts up to 514 acres in size.

On southwestern Mitkof Island, five leave strips adjoining clearcuts logged in 1977-78 were removed in 1981, creating two cutovers 306 and 344 acres in size. This occurred in DWR supporting the highest deer densities on Mitkof Island. Aerial photos taken of Mitkof Island in 1979 revealed that these leave strips were intact (pers. obs.). No IDT or NEPA environmental analysis was ever done to our knowledge to cover harvesting of these leave strips.

The present FS preferred alternative for the APC 86-90 sale proposes to clearcut a substantial amount of the leave strips designed by the ALP 81-86 IDT (FS 1985). This potential harvest may be especially prevalent in VCUs 202, 204, 209, 218, 238, and 399. We are especially concerned about the long-term ability to maintain leave strips for travel corridors between and bordering clearcuts. Such areas appear especially vulnerable to loss from subsequent logging or blowdown.

d. Road closures

Six (16%) of 37 timber EDs have specified use of road closures at least partly for wildlife reasons. The East Carroll Inlet Management Plan EA stated that "some roads will be closed to motorized traffic during part of the year to protect wildlife habitat and provide proper road management." About 15 mi of proposed logging roads have been identified to be closed to reduce disturbance to mountain goats recently transplanted on Revillagigedo Island.

The Yakutat Salvage Sale specified that spurs within .5 mi or so of Russell Fiord and within .5 mi of the Situk River will be made impassable after logging, and the main roads will be administratively closed during and after logging for wildlife reasons. The Yakutat Blowdown #2 EA specified that some roads will be closed to the public by placing physical barriers across the road. Road closure decisions are to be reviewed every five years. Gates to close roads have been incorporated into the Yakutat sale contracts (Jack Blackwell, Juneau district ranger, pers. comm., Feb. 1985).

The Mitkof Flyer Decision Notice specified that the spur road to Unit 4 (on a hillside within the Blind Slough drainage) will be closed to automobiles after the sale, and a reasonable period of time had elapsed to gather firewood, in order to "eliminate risks of damage to wildlife values." A winter off-road motorized vehicle (snowmachine) closure has been in effect on the lower portion of Blind Slough for a number of years to protect a wintering swan area. This closure is reviewed yearly.

The South Wrangell EA stated that, upon completion of the sale, road 6271 would be administratively closed during the nesting season to minimize disturbance to nesting waterfowl. It appears likely that this road closure may never be implemented because of the demand that road will receive once the sale is completed (Richard K. Kohrt, Wrangell district ranger, pers. comm., 2/15/85).

The LPK 84-89 EA has indicated road closures for two important freshwater fishing areas (Salmon Bay Lake and Honker Divide) (see section IV. Maintenance of High-Quality Sportfishing Opportunities). These closures will also reduce disturbance to wildlife habitat.

e. Timing clauses

Only 1 of 37 sale EDs specified a timing clause for wildlife on logging activities. The Sokolof EA stated that a timing clause would be used on yarding activities near eagle nests should "either or both be in use during the life of the sale."

f. Bear-human interactions

Although an increase in bear-human conflicts was often thought to be a likely result of roading and logging, no ED offered any measures to mitigate this problem. The Couverden EA stated that "wildlife-human conflicts are under ADF&G regulatory control."

g. Snag management (other than retention)

The consideration of snags in retention areas and WHMUs is discussed in the specific sections on retention and WHMUs. This section addresses management for snags within cutting units. We could find no evidence that the FS is trying to manage for snags within cutting units. The only mention of such practices occurred in the Granite EA which specified that "a minimum of .50 snags/acre should be left in clearcuts and blowdown where possible." This was considered the minimum snag density for supporting snag-dependent species. This provision of the EA was not carried out, however (memorandum from Richard K. Kohrt, Wrangell district ranger to the forest supervisor, 1/24/83; Richard Kohrt, pers. comm., 2/15/85).

Even sales using partial cutting have not attempted to retain snags. The PRD Small Sale EA concluded that the loss of snags is minor because "there are few cavity-nesting bird species in southeastern Alaska."

h. Clearcut size

We found over 60 approved units that exceeded the 100- or 150-200- acre size limit in effect at the time the EDs were finalized. Some clearcuts were approved that exceed 300 acres in size. Most of the 100-acre-plus units were created in connection with harvesting partially blowndown forests and adjoining standing timber that often had substantial value as old-growth wildlife habitat. Six timber sale EDs were concerned largely with the harvesting of blowdown resulting from earlier clearcutting (Cherrumba Salvage, Yahky Cove, Sokolof Salvage, Zarembo Lake Salvage, Homeshore Blowdown, and Corner Bay Salvage).

Additional large clearcuts were created during sale administration without benefit of disclosure in environmental documents or other review (see section on travel corridors). Use of the regeneration requirement that trees reach only 5 ft in height to schedule harvest of adjoining forests will make clearcut size limitations meaningless from a habitat management standpoint.

i. Stipulations on future entries (including scheduling of harvest)

As discussed under the section entitled "Impacts to Wildlife Discussed in NEPA Documents", only the East Carroll Management Plan, LPK 84-89, Cowee-Davis, Suemez, and Gilbert Bay EDs disclosed the first entry and total rotation harvest. The FHIP and Angel Lake EDs were tiered to the harvest schedule in the 84-89 EIS. Of these EDs only the LPK 84-89 EIS broke the harvest schedule into specific time periods over the rotation (i.e., five-year harvest volumes by VCU to year 2004 [the end of the LPK contract] and then volume cut from years 2004 to 2050).

Numerous EDs stated that the presence of early clearcuts with high forage production was a benefit to certain wildlife species (e.g., moose, black bear, and in the Ketchikan Area, deer). However, only the LPK 84-89 EIS made any attempt to address the maintenance of early clearcuts throughout the rotation by "monitoring (vertical, horizontal and patch) diversity during project implementation." Most timber sale EDs appeared to ignore the long-term habitat needs of wildlife species that the IDT thought benefited from early regrowth stands.

Besides the very limited use of future harvest scheduling, only three (8%) of 37 timber sale EDs mentioned any wildlife considerations on future timber sale entries. The Totem EA stated that subsequent entries will place emphasis on maintaining sufficient denning sites for black bears. The ALP 81-86 EIS specified that "much of the critical wildlife habitat identified will be retained throughout the first rotation and beyond." As cited earlier, maps of these areas were apparently lost and were not available to the subsequent APC 86-90 IDT. Also the present 86-90 APC preferred alternative may not be meeting this direction (FS 1985a). The Granite EA specified that "sale layout during next entry should seriously consider the advantage to wildlife of precluding having new cutting units adjacent to units proposed for this entry."

j. Logging camp and log transfer (LTF) site locations

An inherent aspect of the logging transportation network dictates that many bays and shorelines with high habitat values will be developed and impacted to some degree. Our limited evaluation suggests the FS is making considerable effort to avoid important fish and wildlife areas during the placement of LTF. As stated in section II. METHODS, we did not review this topic in detail; however, a number of EDs rejected certain LTF locations at least partly because of wildlife and/or fisheries reasons. These EDs include such sales as LPK 84-89 (avoid subsistence and high recreation areas near Meyers Chuck), Port Houghton (avoid certain herring spawning areas), Gilbert Bay (avoid Gilbert Bay), and Couverden (avoid Swanson Harbor and use existing Homeshore LTF).

At least three EDs selected potential camp locations to reduce wildlife impacts. Potential logging camps for the Toncan and Gilbert Bay sales were moved inland to avoid impacting the beach fringe (a special logging camp may not be required for the Toncan Sale since it is near Petersburg). The Yakutat Salvage Sale ED stated that a logging camp would be located in a developed area that would not substantially increase wildlife impacts. An undeveloped campsite and a previously developed site near a swan overwintering area were rejected in this sale ED at least partially for wildlife reasons.

k. Logging slash management

Only a few sales addressed measures to reduce logging slash. The Angel Lake Sale EA cited the use of yarding of unmerchantable material (YUM) and burning piles of unmerchantable materials to reduce logging slash. YUM was not written into the sale contract, however, and KV funds are not going to be collected to accomplish this work because the sale is deficit (Greg Clavenger, FS wildlife biologist, Ketchikan Area, pers. comm., March 1985). Slash treatment may be accomplished only if other funds become available.

The Yakutat Salvage Sale EA proposed removing and piling slash to aid wildlife movement where heavy slash problems exist. This may not be necessary because the log-yarding method is not concentrating slash (Forrest Cole, timber staff officer, Juneau ranger district, pers. comm., March 1985).

The Corner Bay Salvage Sale EA specified collecting KV funds to remove slash from travel corridors in harvested leave strips. Apparently, no such collection of funds were written into the timber sale contract. Instead, sale monitoring is to be done to determine if slash treatment will be needed. [Note: The use of K-V funds for wildlife and fisheries habitat improvement projects has significantly increased the past 3 years on the Tongass NF. However, these K-V funded projects and collection of funds are covered in separate plans and are not included in the timber sale contract (memorandum from Michael A. Barton, regional forester, to ADF&G Commissioner Don Collinsworth, 1/22/86).]

The East Carroll Inlet Management Plan EA stated that "slash must be treated in areas next to critical DWR and along roads so as not to restrict deer movement." Sales under this plan have not yet been sold and harvested.

l. Retention of residual clumps

Only six sales (16% of total sales) specified the potential for modifying clearcuts to retain residual or other conifers. The Cabin Sale EA specified that patches of subdominant understory trees will be marked and left for grouse. This was done during layout on split lines, and a clause (CT2.3) was developed for reserve trees in the sale contract to allow live and dead reserve trees or groups of trees left within cutting units. This sale has not been logged and administered yet.

The Granite Sale EA specified that "where possible, hemlock whips should be preserved for grouse. At least one clump of three to 12 trees should be left per 10 acres. A wildlife biologist will work with the sale administrator in identifying and preserving these clumps." The Wrangell District response to this requirement was, "where possible generally means that any trees left after yarding are about all that we will get for grouse use. The wildlife biologist has not been funded for Granite sale administration work this year or last." (memorandum from Richard K. Kohrt, Wrangell district ranger, to the forest supervisor, 1/24/85). Apparently, no further attempt by the Stikine Area was made to see that this EA stipulation was carried out as the EA intended.

The Yakutat Blowdown Sale #2 also specified that "groups of undamaged, windfirm trees will be left standing in clearcut units adjacent to FH-10." This restriction was designed for visual management, but it could also benefit some wildlife species (because of conifer seed production and perch sites, e.g.). Because of the blowdown pattern in the units and subsequent blowdown since the EA, clumps of tree will probably not be left as the IDT had envisioned (Jack Blackwell, Juneau district ranger, pers. comm., February 1985). Two units are scheduled to be partially cut, however.

The Yakutat Salvage Sale EA specified feathering clearcut edges by leaving sapling and small-size timber standing (for visual management). This practice would help extend some forest characteristics into the logging unit. Feathering edges was difficult to accomplish in the Yakutat Sale because of the way the trees blew down (ibid.).

The LPK 84-89 and East Carroll Inlet Management Plan EDs cited monitoring mitigation prescriptions, including girdling, snag retention, and whip tree [residual trees] retention. No prescriptions are apparently being incorporated into logging plans to retain snags and residual trees, however (Greg Clavenger, FS wildlife biologist, Ketchikan Area, pers. comm., March 1985).

m. Other measures

Some miscellaneous management practices described in the EDs are discussed here.

The Granite Sale EA specified that "hollow logs will be left for bear denning sites. If possible, logs would be left with open ends pointing slightly downhill to allow moisture to drain off." Nothing was done to modify the contract to meet this stipulation. The district ranger wrote, "This could cost the logger time and money if logs are to be left and someone must move them" (memorandum from Richard K. Kohrt, Wrangell district ranger, to the forest supervisor, 1/24/85).

The Yakutat Salvage Sale specified revegetation of closed roads and disturbed areas in borrow pits with plant species of benefit to wildlife. Other revegetation measures are discussed under second-growth management.

The PRD Small Sales EA specified creating skid trails in existing clearcuts in connection with providing access to cutting units in order to scarify the soil and improve access for deer and moose.

6. Second-growth Management

Second-growth management for fish and wildlife habitat is directed at improving or enhancing the habitat values of clearcut areas. Short-term and long-term strategies are necessary, considering the general pattern of postlogging succession in southeastern Alaska (ADF&G 1985a).

Only 13 (35%) of 37 EDs made any mention of second-growth management for fish or wildlife. Projects cited include prescribed burning, precommercial thinning (PCT), commercial thinning (CT), streambank stabilization, planting forage species, and PCT slash treatment. In addition, the Port Houghton EA stated that the FS might emphasize future second-growth management if moose responded to logging.

a. Prescribed burning

Prescribed burning of recent clearcuts was listed as a potential tool to reduce slash either locally or in conjunction with reforestation on a number of Ketchikan sales, including LPK 84-89, FHIP, East Carroll Inlet, Suemez, and Angel Lake. It has also been used as an experimental silvicultural procedure on several sites in the Stikine and Chatham Areas.

The Craig Ranger District has proposed burning 100 acres of clearcuts on Suemez Island annually for three years to "improve access for deer (and other species) by reducing logging slash residues and shrub densities. Secondary effects may be increased nutritive value of forage and possible greater forb biomass." Fire is relatively uncommon in southeastern Alaska, and the short- and long-term effects of fire on wildlife, fisheries, water quality, soils, and vegetation are not well-known. The Stikine and Chatham Areas have wildlife habitat monitoring projects in experimentally burned sites. In a final report of a three-year study in the Chatham Area on the results of prescribed burning, Gibbs and Morrison (1984) concluded that burned units received more summer utilization by deer than unburned units because access to browse was improved. They noted, however, that burning could not increase winter habitat carrying capacity, generally considered the limiting factor for deer populations.

The LPK 84-89 and East Carroll Inlet EDs listed mechanical treatment of slash as a possible alternative to burning slash. We are not aware of any actual use of mechanical equipment to reduce slash accumulations in the Tongass NF.

b. Forage planting

Forage planting in second growth was listed in the South Windham, Rynda, South Wrangell, LPK 84-89, Granite, East Carroll Inlet, FHIP, and Angel Lake EDs. Most of these sales were connected with planting riparian shrub and tree species (willow, cottonwoods, and occasionally red osier dogwood) for wildlife browse and to stabilize soils along streambanks, unstable wet sites, and disturbed sites in clearcuts. The Ketchikan Area has described the planting of alder, willow, and cottonwood along streamsides as a means to control water temperatures on heat-sensitive streams and to increase primary and secondary stream production. Limited browse plantings that successfully established riparian shrubs have occurred at Yakutat, Mitkof Island, and the Thorne Bay Ranger District (TBRD). The plantings on the TBRD were in response to the August 1979 die-off of large numbers of prespawning pink salmon in Staney Creek.

In addition to browse planting, the LPK 84-89 and the East Carroll Inlet EDs stated that selected areas may be planted in grass and forbs to provide forage for wildlife.

c. Precommercial thinning (PCT)

PCT is the most-often cited second-growth management tool for wildlife in timber sale EDs. It was listed for potential use in 9 (24%) of 37 timber sale EDs. All sales where it was cited occurred in the Stikine and Ketchikan areas.

The use of PCT as a silvicultural technique to increase yields is a key assumption in the establishment of a 450 MMbf annual harvest from the TNF (FS 1979). The TLMP based timber yield calculations on the assumption that an average of 6,300 acres of second growth would be precommercially thinned yearly in order to increase future timber production. The use of PCT and the assumption that it would increase the standing inventory of timber for future harvest was used to justify raising the annual ASQ by 8.2% (from 416 MMbf to 450 MMbf) (ibid.). Thus the old-growth forest available for harvest is being depleted at an increased rate of 34 MMbf/year as a result of the PCT assumption (FS 1979). [Note: A recent evaluation indicates that the increased TLMP harvest as a result of PCT (34.0 MMbf/yr) and advanced logging technology (17.7 MMbf/yr) resulted in 1,340, 4,180, 5,970, and 3,450 additional acres of 8-20, 20-30, 30-50, and 50+ Mbf/acre volume classes, respectively, being scheduled for harvest during 1980-89 (derived from FS 1985c). This increased harvest is heavily skewed toward high-volume stands. Assuming an equal volume class distribution between harvest as a result of PCT and advanced logging technology suggests that about 980 acres of old growth, including 620 acres of 30+ Mbf stands, are scheduled for harvest as a result of PCT.] The more rapid initial harvest of old growth requires that some second-growth stands be clearcut at an earlier age to maintain a constant or increasing supply of timber harvest on the Tongass. Consequently TLMP assumed that all or a portion of the PCT stands would have a shortened rotation of about 80 years compared to the 100-year rotation of unthinned stands.

The FS Study Plan for the 706(b) report indicates that thinning accomplishments will be addressed (FS 1985b). Preliminary data supplied by the Timber Program (Bill Wilson, FS regional timber management planner, pers. comm., March 1985) indicate that the FS has contracted over 6,300 acres of PCT per year and actually thinned about 80% of the TLMP requirement. The difference between contracted acres and actual thinned acres is attributed to the lag in time between contract award and completion and the development of this relatively recent management activity on the Tongass. Thus, the FS is coming close to meeting the TLMP thinning targets. Costs of PCT for timber objectives since the TLMP are somewhat less than the average thinning cost of $275/acre estimated by the TLMP (ibid.). These figures do not take into account the administrative costs.

It is unclear to what degree, if any, PCT benefits wildlife species. Any benefits that could be derived from thinning are likely to be offset by the additional 9,800 acres of predominantly high-volume, old growth scheduled for clearcutting during this decade as a consequence of the PCT program. A review of research on understory and ungulate response to PCT is presented by the ADF&G (in review a). That the FS assumes a benefit accrues to wildlife is evident from their referral to it as a wildlife enhancement method in timber sale environmental documents.

The South Wrangell EA identified seven clearcuts totalling 399 acres that would be PCT "at a density and pattern to accomodate deer winter use . . . [insuring] that timber growth volumes are maintained within the scope of TLMP." The Totem and Todahl EAs said PCT would consider both silvicultural and wildlife objectives. The Mitkof Flyer EA identified 10 clearcuts for PCT to maintain the understory for deer. The Zarembo Lake EA specified that 75% of the clearcuts would be PCT to increase timber yield and wildlife forage. The East Carroll Inlet Management Plan EA stated PCT would enhance carrying capacity for deer during average winters. The FS "Preliminary Activity Schedule" for the second five-year period of the TLMP (1984-89) lists numerous thinning projects as wildlife habitat improvement activities.

The TLMP EIS (section II.) mentioned second-growth management projects (mainly thinning) for wildlife in five management areas during the first 10-year period. These projects include

1) regenerative thinning for deer, waterfowl, and eagle habitat in Chatham management areas C40, C41, and C44,

2) thinning for deer and wildlife in Stikine management area S11, and

3) mitigating wildlife habitat losses with "projects" in Stikine management area S10.

Implementation of these projects is discussed below:

1) In 1979, the Chatham Area outlined a DWR rehabilitation program that included three sites in C40 and one site in C41. An EA was prepared for 680 acres to be thinned and maintained on an extended rotation for DWR. Twenty-two acres were thinned in FY81 and 30 acres thinned in FY82. In FY83 and FY84, the focus shifted to clearing travel corridors in thinned clearcuts, and no additional thinning to benefit wildlife has been planned, to our knowledge. No results of deer use of treated areas are available, nor is it clear whether the extended rotation will be implemented.

2) During 1980-84, the FS contracted 1,823 acres of PCT in S11 and actually thinned about 1,433 acres (Phil Wisman, FS silviculturalist, Petersburg ranger district, pers. comm., 2/12/85). This thinning was conducted as normal thinning projects to increase timber yields without any apparent wildlife modification to the contract.

3) There have apparently been no projects instituted in S10 to offset habitat losses from clearcutting, other than scheduled KV collection for thinning a 26-year-old clearcut on the mouth of Todahl Creek in connection with the Todahl Sale.

The LPK 84-89 EIS states that ca. 200 acres of second growth will be selected and managed each year primarily to benefit wildlife. The actual accomplishments for wildlife have been 900 to 1,000 acres/year over the last two years (Greg Clevenger, FS wildlife biologist, Ketchikan Area, pers. comm., March 1985). These accomplishments have included PCT at wider spacings than is standard for silviculture and "treating" thinning slash.

Only about 2,000 (5%) of the total of 38,000 acres of clearcuts PCT from FY 1977-84 have had slash treatment on any portion of the unit (R10 information sheet on Second Growth Management Program, Wini Sidle, FS regional wildlife biologist, n.d.). This has occurred primarily in the Ketchikan Area.

Slash has been treated by "broadcast lop and scatter" on a limited basis at a cost of $60-$80/acre (Greg Clevenger, FS wildlife biologist, Ketchikan Area, pers. comm., March 1985). In FY85, the Ketchikan Area plans to treat slash in some clearcuts on 10% of the thinned area by clearing 10-foot-wide corridors every 100 ft.

The FHIP and the East Carroll Inlet EAs also listed slash treatment of PCT for wildlife.

Only certain clearcuts on the Ketchikan Area are considered candidates for slash treatment (memorandum from Michael A. Barton, regional forester, to ADF&G Commissioner Don Collinsworth, 1/22/86). Stands needing slash treatment are ranked in priority order on the Ketchikan Area using criteria similar to those used to identify stands requiring thinning. This is discussed in subsequent portions of this section.

In addition to PCT specified for wildlife in timber sale EDs, a number of other proposals have been developed throughout the region under the Second Growth Forest Management Program for R10. These projects include PCT at a variety of spacings (usually 12' X 12' to 16' X 16') on Level I. and Moss I. in the Petersburg Ranger District; on Trocadero Bay and Nada Island in the Craig Ranger District; and on White Cliff Island, Eagle Island, Naukati, and Red Bay in the Thorne Bay Ranger District.

From the above, it is obvious that the FS assumes thinning will benefit wildlife and is scheduling PCT to meet the TLMP objectives. However, even if the TLMP targets are met, the majority of clearcuts will not receive any treatment. The TLMP scheduled 172,760 acres of old growth for clearcutting during the next 10-year period (FS 1985c) and assumed 63,000 acres of clearcuts would be thinned. The ratio of cutting to thinning is 2.7:1. This, coupled with the fact that large acres of unthinned second growth existed at the time of the TLMP, implies that most clearcuts will not receive thinning treatment. However, the Ketchikan Area is currently scheduling PCT over half of all acres harvested 10-15 years ago because fewer acres are being harvested than are scheduled.

The large acreage of second growth and the limited percentage that can be thinned, given current funding, has prompted the FS in some areas to prioritize stands they feel need to be thinned for wildlife and sometimes fisheries. The Stikine Area apparently feels that former DWR and streambanks of fish streams that have been clearcut are first choices for thinning (memorandum from Larry Ethelbah, FS wildlife biologist, Stikine Area, to the forest supervisor, 10/10/84). The perceived desirability of thinning timber along streambanks in the Stikine Area appears to contrast with the objective of the Ketchikan Area, which limits the cutting of alder or methods to release conifers under alder in riparian zones without specialist approval (LPK 84-89 EIS). Each area develops site-specific prescriptions aimed to achieve local objectives (memorandum from Michael A. Barton, regional forester, to ADF&G Commissioner Don Collinsworth, 1/22/86).

The Ketchikan Area has developed the following method to prioritize wildlife thinning needs as well as clearcuts that should receive slash treatment (memorandum from Winn Green, Ketchikan Area forest supervisor, to the district rangers, 4/20/85):

Priorities for Treatment	Areas to Avoid
Area or unit has the following characteristics:	Area or unit has the following characteristics:
1. Historical deer winter range	1. Heavy residual logging slash
2. High present deer use (winter and/or summer)	2. Low historical deer use
3. Falls within deer WHMU	3. Steep slopes (greater than 75%)

4. Is in or adjacent to high human use areas

5. Has relatively high stocking density

6. Trees to be thinned are relatively large

7. Spruce is dominant species in stand

8. Residual logging slash is not a problem to animal movement

9. Salmonberry is not dominant

4. Low human use

5. Relatively little timber harvest has occurred or is planned in area

6. Falls outside deer WHMU

7. Stand is young, sparsely restocked

8. Heavy blowdown along perimeter of unit

9. Low historical deer use

10. Salmonberry predominant shrub in stand

The Stikine Area identified about 52,500 acres of unthinned second growth that requires thinning now or will soon require thinning. This figure includes about 15,400 acres of former "primary DWR" (memorandum from Larry Ethelbah, FS wildlife biologist, Stikine Area, to the forest supervisor, 10/10/84). The Stikine Area is proposing to thin 1,200 acres of these stands at a cost of $432,000 using KV funds (memorandum from Robert Lynn, Stikine Area forest supervisor, to the district rangers, 8/29/84). Thorne Bay Ranger District in the Ketchikan Area has a backlog of 112,000 acres of unthinned clearcuts less than 20 years old (Greg Clavenger, FS wildlife biologist, Ketchikan Area, pers. comm., March 1985). The Totem and the Todahl EAs both identified older clearcuts in former DWR for PCT. KV funding to do PCT was written into the Todahl EA sale contract. On the southern portion of Kupreanof Island, within and adjacent to the Totem Sale area, 384 acres of second growth has been thinned, and 288 more acres will be contracted for thinning in FY85 (Jim Franzel, FS fish and wildlife staff officer, Petersburg ranger district, February 1985).

No discussion of cost and benefits associated with any of the wildlife PCT projects (or other second-growth wildlife projects for that matter) was found during our analysis. The Ketchikan Area lists project outputs of their proposals as "unknown." Costs of thinning second-growth stands for wildlife and treating slash would surely total millions of dollars a year if most of the second-growth stands are to be treated.

Even if it were possible to PCT most clearcuts, the beneficial effects on wildlife would likely be short-lived, could result in undesirable understory responses, and would not replace old-growth habitat needs (ADFG 1985a). In addition, we found no analysis of what effect modifying PCT for wildlife (e.g., using wider spacings) has on subsequent timber yield. This is an especially relevant concern because the TLMP harvest calculations requires a certain increase in timber production as a result of PCT in order to maintain a yearly harvest of 450 MMbf.

d. Commercial thinning

The East Carroll Inlet Management Plan and the South Wrangell EAs assumed there would be future use of CT for wildlife habitat management purposes. The R10 Second Growth Forest Management Program has developed five demonstration CT projects to evaluate the effect of CT on wildlife. Studies supporting the value of CT for wildlife in R10 are apparently nonexistent, and CT is not presently considered a viable harvest technique in southeastern Alaska (FS 1983). The TLMP did not assume CT in developing harvest yield calculations (FS 1979).

7. NFMA Planning Requirements

There has been very little meaningful use of NFMA planning requirements for viable populations, diversity, and MIS in EDs to date. The LPK 84-89 EIS did identify MIS (called "species of special concern") to evaluate the cumulative effects of the alternatives. These species include deer, Bald Eagle, black bear, mink/river otter, marten, cavity nesters, early succession species, and waterfowl. Specified wildlife monitoring is concerned only with deer. Similar identification of MIS was used in the Suemez and East Carroll Inlet EDs.

We found no evidence that a valid quantitative measure of diversity has been developed and implemented by the FS in sale planning on the Tongass.

Only the Suemez Sale EA addressed viable populations. Data were lacking to establish a scientific method to determine the habitat needed to provide for viable populations. The wildlife specialist simply estimated that 40% of the habitat was needed to provide for viable populations. Implementation of MIS consideration, viable populations, and diversity at project-level planning awaits the full incorporation of NFMA planning regulations into the Forest plan. This is currently scheduled for accomplishment during the TLMP revision (memorandum from Michael A. Barton, regional forester, to ADF&G Commissioner Don Collinsworth, 1/22/86).

8. Threatened and Endangered Plants and Animal Species

To our knowledge, only some of the timber sale EDs in the Chatham Area have identified the presence of threatened or endangered species and the potential for conflict with timber sales. The Couverden EA stated that the sale would likely have no impact on humpback whales. The South Windham and Port Houghton EAs considered the effect of boat traffic disturbances on whales and the effect of log dumps on herring (a food source of whales) and concluded that no impacts were expected. The South Windham EA proposed to educate FS and contractor personnel using the area about potential concerns regarding disturbances to whales and to solicit their cooperation to reduce or avoid harassment of humpback whales.

The ALP 81-86 EIS deferred two areas of Suntaheen Creek for further study and evaluation and noted one area may contain unique plant species. We found no mention of this in the subsequent draft 86-90 APC EIS (FS 1985a), which proposes additional logging in Suntaheen Creek. The Chatham Area undertook a botanical study to search for sensitive plants in Port Houghton and South Windham prior to scheduling timber sales. No sensitive plants were found in these areas; however, the rare grass Poa laxiflora was found in the nearby estuarine area of Sandborn Canal. A retention area has been proposed around this grassflat by the botanist conducting the study (Muller n.d.)

Limited botanical work has also been conducted in the Pike Lake area of the Yakutat Forelands in recognition of this area as a unique ecological complex, and the area has been tentatively proposed as a Research Natural Area (Peteet and Bolivar 1983).

Although there are no federally listed threatened or endangered plants in Alaska and no plants have been proposed for listing by the USFWS, there is currently a list of candidate plants for which the USFWS is soliciting status information to determine if there is a need for future listing.

The FS region keeps a current record of such species and advises the areas on changes that occur. Also, there are no plants that are currently classed as sensitive in the Tongass NF. The FS region has started a process to develop a sensitive species list (memorandum from Michael A. Barton, regional forester, to ADF&G Commissioner Don Collinsworth, 1/22/86).

9. Wetlands and Floodplains

Discussion on this topic in the fisheries section is valid for wildlife. The lack of a uniform region-wide definition of these habitats limits any meaningful implementation of the Executive Orders or comparisons between sales.

10. Wildlife Habitat Enhancement

We found only one wildlife project that the FS has completed since the TLMP that could likely increase wildlife populations above existing levels. This project involved introducing mountain goats to Revillagigedo Island and was undertaken cooperatively by the Ketchikan Area FS and the ADF&G. Future potential projected benefits include a 50% increase in mountain goat hunting in the Ketchikan Area (memorandum from Winn Green, Ketchikan Area forest supervisor, to regional forester, 7/5/84).

Second-growth management has been discussed previously and is classified as mitigation. Moreover, the benefits of such projects are speculative, and treatments are largely designed for experimental purposes rather than to increase the standing crop of particular wildlife species above that produced by the natural habitat.

A few projects have been performed in the Stikine Area to cut back riparian browse and stimulate understory browse production for moose (Jim Franzel, FS fish and wildlife staff officer, Petersburg ranger district, pers. comm., February 1985). Projects have been minor and did not apparently have expected outputs attached. Chatham Area staff has attempted to provide artificial nest structures for geese and cavity-nesting birds, but, to date, these attempts have been unsuccessful (Gibbs 1984; Hal Gibbs, FS wildlife biologist, Hoonah ranger district, pers. comm., 3/1/85).

B. Fish

1. Impacts to Freshwater Fish Production as a Result of Logging Scheduled Under TLMP

An evaluation of 37 timber sale EDs showed that likely impacts to fish production identified by the FS ranged from enhancement to unacceptable impacts (Table 6). These are discussed below.

a. Low level of impacts

Twenty-five (68%) EDs estimated that timber harvesting would have either no impacts or acceptably low impacts on freshwater fish production. This included the Totem Timber Sale, which was expected to reduce fish production on Castle, Tunehean, and Zim Creeks by about 2% over a 10-year period, resulting in an estimated total loss of $17,850 to the commercial fisheries. The Suemez EA thought impacts would be acceptable despite the fact that it permitted the "maximum cutting to streams allowed in the Area Guide." Low impacts to fish production are generally attributed to the absence of fish-producing streams in the proximity of the logging activity and/or the use of best management practices (BMPs) during timber sale design and layout. Much emphasis was placed on BMPs to minimize the potential impacts to fish production.

An increase in sedimentation was generally recognized as an unavoidable result of roading and clearcut harvesting associated with timber sales. Nevertheless, these sale documents usually concluded that increases in sedimentation would be minor, short-lived, and of little negative significance to fish production, especially given the use of BMPs during layout.

b. Unacceptable impacts

Only the Cowee-Davis Timber Sale was described as likely to have unacceptable impacts on fish production. The decision to permit adverse impacts to streams in the Cowee-Davis sale area resulted when the forest supervisor selected two additional areas for harvesting in order to make up a short-fall in timber volume detected during layout (Cowee-Davis Decision Notice 7/14/83). These harvest areas, referred to as alternatives 7A and 9A, had been rejected by the IDT because of the high risks to Davis, Cowee, and Canyon Creeks. The possible results of logging Alt 9A include "potentially unacceptable impacts on water quality and fish habitat" and "very high potential for landslides [that would] result in potentially high

Table 6. Expected Degree of Impacts to Freshwater Fish Production Associated with Logging Revealed in 37 Timber Sales Prepared Under TLMP[a/]

Expected Level of Impact	No. of Timber Sales (% Total Sales)
None or low	25 (68)
Unacceptable	1 (3)
Enhanced production	1 (3)
Uncertain	7 (19)
Not discussed	3 (8)

a/ See text for further discussion.

adverse effects to Cowee Creek and rearing tributaries [and soils and water quality]." The expected impacts from logging Alt. 7A included high potential of introducing sediment to coho rearing streams [with] potentially unacceptable impacts on water quality and fish habitat likely [including a possible] 50% reduction of coho and steelhead rearing capacity to 17 to 19 acres on Davis Creek for 2 to 5 years." Also, Alt. 6B, which was selected, has "potential [for] landslides [which] could impact 8.3 acres of chum, pink, coho, and steelhead habitat in lower Davis Creek for several years." The selection of additional units to meet timber targets at the likely expense of fish production and water quality appears to directly contradict the provisions of the NFMA and the TLMP.

c. Enhanced production

The Yakutat Salvage Sale was described as expected to enhance fish production. This expectation was based on expected low impacts to salmon spawning areas and increased coho rearing habitat resulting from the construction of three rearing ponds as part of the sale.

d. Uncertain

Seven sales (19%) did not clearly specify the expected impacts on fish production. These sales include FHIP, Angel Lakes, Campbell, Bohemia, South Wrangell, Granite, and LPK 84-89, all of which described logging and/or roading along or adjacent to fish habitat. The discussion of expected impacts associated with the LPK 84-89 sale is vague and unclear. The LPK 84-89 EIS stressed that quantitative impacts on coho and other fisheries could not be estimated. The LPK 84-89 EA developed proposed maximum guidelines for timber harvesting before fisheries impacts were likely. (These are discussed in a later section of this text in connection with FHMUs.) Several areas were scheduled for clearcutting where these guidelines are to be exceeded, which suggests impacts are likely. Also, 12 scheduled units were described as high potential risks, and 33 units were described as moderate potential risks to fisheries. The LPK 84-89 EA described potential impacts from logging as "insignificant," "short-term," and "minimal" with "no major effect on water quality" despite the scheduling of 2,600 acres of clearcutting in "streamside habitat zones". This conclusion in the ED is predicated upon implementation of "special considerations" during harvest unit layout. The 84-89 EA did not address carryover units in this impact analysis.

e. Impacts not discussed

Three timber sales did not discuss the impacts of logging on fish production. These sales include the Rynda Island Sale (which has very limited fish habitat), the Ketchikan Small Sales and Free-use EA (which specified that harvesting within 200 ft of a stream course will be considered on a case-by-case basis by the district fisheries biologist), and the ALP 81-86 EIS. The ALP 81-86 EIS did indicate that impacts from sedimentation were expected to be negligible on fish streams on the Chatham portion of the sale area but gave no further expected impact for the Chatham Area. No discussion of potential impacts of logging on the five VCUs on Kuiu Island scheduled for harvest under the ALP 81-86 sale was included, despite the presence of substantial commercial fish production in these VCUs and the state's request that the FS discuss the effects of the preferred alternative on the fisheries of East Kuiu (State of Alaska comments on DEIS, 12/31/79, printed in FS 1980, p. 269-278).

f. Future management direction

The draft APC 86-90 EIS states, "The cost of culverts [on small, higher gradient rearing streams] large enough to ensure that all juvenile salmon pass, usually exceeds the value of the habitat foregone. The decision to allow this effect to occur is based on a site-specific examination of the stream. A benefit to cost analysis is used to help make the decision . . . Resident fish species, primarily Dolly Varden char, could be affected to a greater degree than coho salmon because there is less economic value associated with these fish. All action alternatives have the same probability of habitat loss occurring due to decisions concerning placement of culverts" (FS 1985, p. 4-21 to 4-22).

We are concerned that the APC 86-90 sale indicates that the FS is changing TLMP policy to reduce fish production in favor of timber economics. The NFMA and associated regulations that were discussed previously that prohibit the FS from "seriously and adversely affecting fish production or water quality" do not permit this protection to be foregone by a desire to lower logging costs. Neither the TLMP or the NFMA make any distinction between anadromous and resident fish. Both require equal protection.

2. Retention

Only 2 (5%) of 37 timber sales examined provided retention to protect fish habitat. The Gilbert Bay EIS established a 1,500-acre retention area (including 650 acres of CFL) on the "Sweetheart Flats" that contained several salmon spawning and rearing streams and the head of the Gilbert Bay estuary. The retention designation was designed to protect both fish and wildlife values.

The LPK 84-89 EIS established streamside WHMUs (zones within 500 ft of streams) and identified that 58% (23,780 acres) of the total old-growth CFL in these units would not be logged during the rotation (to year 2050). Although these WHMUs were primarily to protect wildlife habitat, the amount of fish habitat retained was also analyzed. A total of 121 mi and 8,500 acres of streamside CFL fish habitat was designated for retention (these figures apparently include inoperable as well as operable CFL).

The Suemez EA indicated that .1% of the CFL was set aside as "fish leave." No map of this area or other discussion was provided in the EA, and Ketchikan Area personnel could not provide a location of the fisheries retention area. A review of the aerial photos on which the retention areas were mapped failed to reveal any areas classified as "fish leave."

The remaining 95% of the timber sale EDs apparently did not classify operable CFL for fisheries retention.

3. Fish Habitat Management Units (FHMUs)

The ALP 81-86 EIS and the FHIP, LPK 84-89, East Carroll Management Plan, and Suemez EDs identified units called FHMUs, fish habitat sensitivity zones (FHSZs), sub-FHMUs, or stream habitat zones (SHZs). These units represented the fish habitats and associated forests where the IDT felt logging might affect fisheries and largely served as the land base upon which the effects of logging on fisheries were estimated. Some management prescriptions were also developed for some of the units to protect the fisheries values. None of these units were mapped in any of the EDs.

The ALP 81-86 EIS identified FHMU as "an area of fish habitat identified during the IDT process as having fish values of such importance that the habitat within the management area designated by the IDT is managed with fish as the primary resource." A FHSZ was "that portion of the FHMU most sensitive to disturbance and generally requiring special management prescriptions." Both FHMU and FHSZ were "areas most likely to be impacted by timber harvest." Prescription for management of FHMUs and FHSZs were not discussed in the EIS but left to IDT recommendations on specific cutting units. "All units in FHMU will be reviewed and those in FHSZ will be given a thorough evaluation on-the-ground before harvest." The ALP 81-86 Sale clearcut 3,139 acres in FHMUs and 70 acres in FHSZs. The total acreage left unlogged in FHMUs and FHSZs was not revealed, and FHMUs and FHSZs were not developed for the five VCUs on Kuiu Island, despite the presence of substantial fish habitat.

The Suemez EA developed nonexclusive subhabitat units for pink and chum salmon spawning (6%), coho salmon and steelhead trout spawning and rearing (26%), Dolly Varden and cutthroat trout spawning and rearing (15%), nonfish (53%), and temperature-sensitive stream habitat (6%). Figures in parentheses reveal the percentage of CFL scheduled for logging in each sub-FHMU during the first entry. A detailed prescriptive plan for each sub-FHMU and identified fish stream was developed in the fisheries specialist report. These recommendations were to be incorporated into the unit layouts.

The concept of SHZ was developed during the LPK 84-89 EIS and is defined as side slopes and stream gradients of 15% or less (LPK 84-89 Fisheries Specialist Report). Similar SHZs have since been used in the FHIP and Carroll Inlet EDs. Impacts evaluated within SHZs include total streambank harvest, harvest of temperature-sensitive streams, total harvest, miles of road construction, and individual clearcut unit risk ratings from none to extreme. The following management guidelines were established to presumably determine acceptably low impacts to fisheries in the LPK 84-89 EA:

1) Maximum first-entry harvest of 30% of total streambank. Streambank forests "stabilize the streambank, provide LOD [large organic debris] and organic nutrients, support insects, and other fish foods." Five VCUs were scheduled for harvesting where the 30% criterion would be exceeded.

2) Maximum cumulative harvest of 25% of streambanks of temperature-sensitive streams. No harvest was proposed where this criterion would be exceeded.

3) Maximum harvest of 30% within total SHZ for any VCU. The EA scheduled harvesting in SHZs in eight VCUs where this criterion was exceeded. In four of these VCUs, previous harvesting had already exceeded the additional one to four percent of the total SHZ in the VCU for harvest. In the other VCUs, the timber scheduled under the sale ranged from 11 to 30 percent of the total SHZ in the VCU and caused the 30% criterion to be exceeded.

4) Maximum road density of 1.5 road miles/mi^2 in total SHZ for any VCU. Six VCUs were roaded where this criterion was exceeded.

In the LPK 84-89 sale EA, units and roads were not changed when the proposed maximum guidelines were exceeded. Instead, when analysis revealed that the guidelines were being exceeded, a statement of justification was included indicating that exceeding the guidelines would not impact water quality and fish production. In particular, one statement of justification was that clearcuts 15 years of age or older were no longer to be considered openings along streambanks but would function instead like a forest for the purposes of the guidelines (memorandum from Winn Green, Ketchikan Area forest supervisor, to Robert Grogan, associate director, Division of Governmental Coordination, State of Alaska, 10/31/84). It is not certain that 15-year-old clearcuts can make significant contributions of large woody debris (LWD) into the stream system or significantly shade larger streams from the summer sun when warm temperatures are most critical.

The East Carroll Inlet Management Plan EA used SHZs with the same cumulative effects analysis as the LPK 84-89 EA. In this case, the selected alternative did not exceed any of the above guidelines. It should be noted, however, that the guidelines applied to the average of all streams in the management area (K35). Harvest or roading along streambanks and within SHZ could exceed the maximum guidelines on an individual watershed or stream tributary and consequently impact fish production. These site-specific impacts could not be detected when using an average harvest or roading intensity over a number of VCUs.

Regarding the East Carrol Inlet Management Plan EA, the state specifically requested that cumulative streamside cutting along fish streams identified as temperature sensitive should not exceed a total of 25% of the streamside vegetation of each "individual stream" (emphasis added) (memorandum from Robert Grogan, associate director, Division of Governmental Coordination, State of Alaska, to Winn Green, Ketchikan Area forest supervisor, 6/5/85). Individual streams are apparently considered by the FS when using the following guidelines for temperature-sensitive streams:

1) a maximum of 3,000 ft of streamside harvest in any one clearcut, and

2) a maximum of 1,000 ft of streamside harvest on south and west sides of any stream in any unit (memorandums from Winn Green, Ketchikan Area forest supervisor, to Robert Grogan, associate director, Division of Governmental Coordination, State of Alaska, 10/31/84 and Winn Green to Robert Grogan, 7/10/84).

The FHIP EA simply addressed SHZ in terms of acres cut (not percentages) for comparisons of alternatives.

Only 3 other (11%) sales identified specific FHMUs. These three sales include the Gilbert Bay retention zone discussed in the previous section, the Nesbitt Sale EA, which identified FHMUs along the south side of two temperature sensitive fish streams (including two lakes and a total of about 8.5 mi of stream), and the Campbell Sale EA, which identified two FHMUs (a 97-acre portion of Frank Creek and a 159-acre portion of Tom's Creek that contained Tom's Lake and a braided stream area). No logging was scheduled in the Nesbitt FHMUs and "any [future] timber harvest within [these] FHMUs will be carefully controlled to prevent summer water temperature increases." The Campbell Sale EA provided no direction for managing the FHMUs and will clearcut 14 acres of the Frank Creek FHMU.

In summary, instead of all timber sales EDs developing FHMUs, only 8 (22%) sales actually did this, and only three to five developed a prescriptive plan for these units depending on the interpretation of this requirement.

4. Deferral (Postponement) of Logging in Areas with High Fisheries Values

The practice of deferring logging in sensitive areas until later in the rotation is discussed in detail in the wildlife section. This practice was also used to protect certain fisheries areas (Table 7). Some important areas where logging was not deferred are shown in Table 5.

5. Use of Best Management Practices

As indicated in the previous section on impacts to fish production, the use of BMPs has been envisioned as playing a major role in minimizing impacts on fish production and water quality to an acceptable level. This section discusses management practices referred to in timber-sale-related EDs that are to be implemented to protect fish habitat.

a. Retention of Buffer strips

Retaining a zone of forest timber in its natural condition along fish streams is a widespread management practice that was probably implemented to some degree in most timber sales in streamside habitat zones or during unit lay-out on the ground. Buffer strips were often used to maintain standing timber between clearcuts, roads, and rock pits. Buffer strip retention is one possible prescription for FHMUs, however only about 9 of 37

Table 7. Areas of High Fisheries Values Postponed from Logging (Excluding Identified Retention Areas)

Sale	Area
Campbell	Tom Creek
Totem	Castle River VCU 435 (until TLMP revision)
	Major tributary of Tunehean Creek (including road building along a sensitive portion)
Bohemia	Cathedral Falls Creek
Mitkof Flyer	Ca. 2,000-acre portion of Blind Slough - Blind River watershed (until TLMP revision)
ALP 81-86	South Arm, Kelp Bay

timber sale EDs specifically prescribed retention of buffer strips. Widths of buffer strips ranged from a thin strip of riparian alder and unmerchantable trees to buffers exceeding 400 ft in width. Their application ranged from use on most fish streams to use only along the most sensitive streams. Buffer strips were maintained around portions of Sitkoh Lake by requiring logging to salvage only blowdown and to leave the standing timber (Corner Bay EA).

Despite the use of buffer strips, clearcutting to the edge of the streambank is also a common forestry practice. Over 40 mi of streambanks along fish streams were scheduled to be clearcut in 10 timber sale EDs that discussed streambank harvest or provided maps depicting streambank harvest. This includes the LPK 84-89 EA, which plans to harvest 17.3 mi of streambank along catalogued anadromous fish streams. Recent research is indicating that logging along streambanks may result in a decrease in rearing habitat, with subsequent lower production of rearing smolts, such as coho salmon (ADFG 1985a). Moreover, evidence suggests that clearcut harvest of streambank forests deprives the stream of future sources of LWD, thus impacting rearing habitat for a long time. These findings indicate potentially serious consequences to fisheries production as a result of streambank harvest (ibid.).

Presently, buffer strips have no permanent protection from future clearcutting. The need to readdress buffer strip management and the practice of clearcutting streambanks is evident.

b. Debris management

Management of instream debris is directly related to buffer strip management because buffer strips serve as potential sources of LWD. Recent research has documented that woody debris in streams maintains the stability of the stream, provides cover and nutrients, and creates fish-rearing habitat (ibid.). It can act negatively if it blocks salmon migration or reduces spawning habitat, although LWD may be extremely important in stabilizing spawning reaches. Policies toward management of debris in streams have changed since 1979 as a result of on-going research. The importance of LWD for fish production was not widely recognized when many of the timber sale EDs were prepared. The standard practice of requiring logging debris that falls into streams to be removed within 24 or 48 hours is being reevaluated, and guidelines are being developed to manage debris that results from logging as well as natural debris or debris that results from blowdown (FS 1984b). The greatest challenge to debris management is the development of guidelines that provide a consistent approach but that also provide flexibility to tailor management to the specific physical and hydrological characteristics of each stream. Based on research to date, retaining a buffer strip may be the most feasible and reliable method to ensure that natural LWD will be available on a long-term basis.

Clean-out of natural debris from streams is generally not being permitted without fish biologist input. Examples of this include the Yakutat Salvage Sale, which required that trees that were blown down in salmon streams be left unless they block fish passage; the Corner Bay EA, which required that blowdown be left in Sitkoh Lake; the Homeshore Blowdown EA, which stated that blowdown in Humpy Creek would be selectively marked for removal; and the LPK 84-89 EA, which specified that stream clean-out would be done only if fish habitat can be maintained or improved.

The LPK 84-89 EA was the only one of the 37 EDs that specified a need to consider LWD management when clearcutting next to streams. Measures proposed included reserving certain trees as future sources of LWD and falling standing timber into streams to improve rearing capacity. It is unclear how widespread these practices will be during the course of the sale.

Two sales have emphasized the need to clean wind-thrown timber from V-notches. In the Corner Bay EA, the cleaning of debris in V-notches is to be accompanied by soil revegetation measures. No collection of KV monies to accomplish this work was written into the sale contract, however. In the Homeshore EA, additional stream-cleaning costs for V-notches in one unit were to be provided for in the sale.

c. Timing clauses

The use of timing clauses to restrict logging-related activities in or adjacent to streams in order to avoid critical periods in the life cycle of fish (e.g., salmon migration or spawning, egg incubation) is a potentially valuable tool for reducing impacts to fish production. Timing clauses generally serve to reduce the risks that expected or unexpected impacts to water quality would pose to fish production.

Based on an examination of timber sale EDs it appears that the use of timing clauses for fisheries protection is limited. Only 7 (19%) of 37 timber sales specified the use of timing clauses, and at least two of these sales have not implemented them. No mention of timing clauses was found in the LPK 84-89 EDs or the ALP 81-86 EIS. [Note: Timing clauses for fish habitat protection are used as standard practice on unit release cards in the Ketchikan Area, according to the FS (memorandum from Michael A. Barton, regional forester, to ADF&G Commissioner Don Collinsworth, 1/22/860.]

A summary of the use of timing clauses discussed in EAS is presented below:

1) South Wrangell

The South Wrangell EA specifies "construction of road 6270 which parallels Fools Creek on steep terrain and the bridge crossing on this stream and Thomas Creek would require a timing restriction" and that "instream construction activities should be managed to minimize siltation during the period July 15 thru May 15." Methods to reduce erosion control along a section of road 6270 directly above Fools Creek included "possible end hauling of excavation and/or prompt erosion control work." The sensitivity of this area to erosion and potential fisheries damage and the need for special management prescriptions was recognized and documented by the IDT, subsequent district and supervisory office (SO) soil, hydrology, fish, and wildlife specialists, and the district ranger. Nevertheless, timing clauses were deliberately omitted during SO review because the staff felt they could become too burdensome for the potential road contractor (Richard K. Kohrt, Wrangell district ranger, pers. comm., 2/15/85). Instead the Stikine SO decided to designate the area as a "sensitive area" in the preroading contract. This designation was inadvertently neglected when the preroading contract was prepared, partly because the contract was prepared in the extremely short time period of four or five days (memorandum with enclosure from John Hughes, Stikine Area forest supervisor, to the staff and district rangers, 10/14/82). The outcome was that none of the protective measures cited in the EA were ever implemented, including end hauling of excavated material. The result was high sediment loads dumped into Fools Creek along with large rocks and woody debris from overshot rock pits at the time when salmon were spawning in the stream.

Among the impacts described during field inspections are the following:

> The upper [water quality monitoring station] was almost destroyed by falling rock from the road ROW blasting activities 500 feet uphill from the opposite creek bank the station is located on. We found rocks up to a foot long in the creek and on both its banks [as well as tree limbs].
>
> [On Aug. 26 during a moderate rain shower] I watched the contractor's crew dig a ditch across the road to keep a stream from washing out a portion of it. This water then ran across the road over and through the sidecast material at the road's edge before entering Fool's Creek 200 feet downslope . . . I walked to the downstream water quality monitoring station and found Fool's Creek running water almost as heavily silted as the water running across the road. I could only see the pink salmon in the creek when they approached within a couple of inches of the water surface. I visited the upstream water quality site (above most of the road runoff) and found the creek running clear . . . The fish are in the creek in large numbers (5000+) and are spawning or have spawned . . . Virtually all the spawning gravels in Fools Creek are being impacted by the road (memorandum from Kent Russel, FS fish biologist, Wrangell ranger district, to the district ranger, 8/9/82 and 9/2/82).

The FS conducted a field review of the situation on Sept. 1, 1982, and documented the problems associated with this section of the South Wrangell road system. The ADF&G was also notified of the problem. The end result was that the road surface was capped with competent rock and exposed banks were successfully seeded to where by 1985 the road posed no unusual sediment problems to Fools Creek (Richard K. Kohrt, Wrangell district ranger, pers. comm., 2/15/85). Although catastrophic siltation impacts such as Fools Creek are likely relatively uncommon, the need to pay stricter attention to environmental concerns when preparing preroading contracts is evident. The Stikine Area's policy regarding the implementation of timing clauses recommended by the IDT is not clear. The South Wrangell Review Team addressed this issue and concluded, "We have had a taste of 'sensitive' versus C clause timing restrictions. We recommend the incorporation of well thought out timing clauses in all future contracts involving protection of fish habitat. Because of the high cost associated with timing clauses, we recommend they be used only after all other alternatives have been considered (memorandum with enclosure from John Hughes, Stikine Area forest supervisor, to the staff and district rangers, 10/14/82)."

2) other Stikine Area timing clauses

A contract clause with a timing restriction has been incorporated in the Todahl Sale contract in response to the EA stipulation that "activities within 100 feet of Todahl Creek would be timed to minimize adverse effects on fish and water quality" (Jim Franzel, FS fish and wildlife staff officer, Petersburg ranger district, pers. comm., Feb. 1985). This sale has not yet been administered.

The Bohemia Sale EA similarly required that the "annual operating schedule for timber and roads will be reviewed by fisheries biologists to coordinate timing operations to minimize adverse effects to fish and water quality." No timing restrictions were placed on the "preroading" construction (ibid.). However, a rechannelization of an upper tributary of Big Creek was restricted to periods of time when the stream did not exceed a certain flow level. This restriction, which was developed by FS hydrologists and fisheries biologists and reviewed and approved by ADF&G biologists, has been successfully incorporated into the "preroading" contract (ibid.).

The PRD Small Sale EA "prohibited logging from April 1 to June 1 on beaches where herring spawn." The intent of the EA has apparently been fulfilled in that no small sales along beaches have yet been scheduled where the ADF&G has identified herring spawning areas (ibid.).

3) Chatham Area

The Juneau Ranger District has incorporated timing clauses into both the Yakutat Salvage Sale and the Yakutat Blowdown #2 Sale. The placement of drainage structures during road construction was restricted to the period May 15 to July 15, in keeping with the stated intent of the EA. It has furthermore been the Juneau Ranger District's practice to enforce this restriction to the point of shutting down operations during time periods not specified in the EA (Jack Blackwell, Juneau district ranger, pers. comm., February 1985).

Timing clauses were inserted into a contract for construction of the Kadashan road to restrict vehicle crossing prior to bridge construction on two fish streams. However, FS biologists are generally cautious in recommending inclusion of timing clauses in contracts because of possible effects on road building costs. Any such recommendations can, nevertheless, be accepted or not, by sale administrators. On the Chatham Area, sale administrators also retain authority to permit contract deviations; however, district ranger review and approval is required. The FS notes that general timing restrictions are sometimes not implemented due to poor documentation in EDs, poor judgement by contract administrators, or lack of adequate fish run timing (memorandum, Michael A. Barton, regional forester, to ADF&G Commissioner Don Collinsworth, 1/22/86).

The Port Houghton EA identified a potential timing restriction to store logs in upland areas during herring spawning and incubation if leachates from log rafts affected herring habitat. The ADF&G questioned whether the FS would have an adequate monitoring program to detect whether leachates were in fact affecting herring habitat.

4) bridge reconstruction

Several bridge reconstruction EA's specified timing clauses. These include the following EA specifications:

> Any work within the wetted perimeter of Yatuk Creek will have to take place at a time when fishery habitat impacts are acceptable as determined by Forest Service Fish Biologists (EA pertaining

to permanent replacement of four bridges on the Thorne Bay District - June 1982).

No equipment will operate in the wetted perimeter of the four project sites during temporary bridge removal or permanent bridge construction. Any work which is later determined necessary and is within the wetted perimeter will have to take place at a time when fishery habitat impacts are acceptable as determined and approved by the Thorne Bay District Ranger . . . bridge removal should preferably occur from May 15 to August 1 to minimize impacts to the fisheries resource. If accomplishing the work is not feasible during this time period, work can occur at any time with prior approval of the District Ranger (EA pertaining to replacement of four bridges in the Whale Pass Area of Thorne Bay - 4/4/84).

The Wrangell Ranger District has also successfully used timing clauses on bridge reconstruction (Richard K. Kohrt, Wrangell district ranger, pers. comm., 2/15/85). However, timing clauses were not specified in the Thorne Bay EA for replacement of bridges on Hatchery Creek, Logjam Creek, and Dog Salmon Creek. Also, no timing restrictions were placed on bridge reconstruction on stream #106-42-03 in the Zarembo Lake Salvage EA, despite the state recommendation that timing restrictions be used to avoid peak use by migrating and spawning salmon.

5) Summary

Somewhat less than 15% of the timber sales have apparently used timing clauses to protect fish habitat. It is evident the FS is presently exercising considerable discretion to allow fish biologists, sale administrators, district rangers, or other staff personnel to modify or eliminate timing clauses specified or recommended in final EDs.

d. Culvert and bridge standards

Little discussion of culvert and bridge standards appeared in timber sale EDs. Apparently the practice of assuring fish passage when installing culverts and bridges had become so widespread that it was not a focus of environmental analysis during the 1979-1985 period. The Yakutat Salvage

EA stated that "adequate cross drains must be provided to maintain natural runoff patterns to small ephemeral streams along road corridors." The Mitkof Flyer EA specified that "roadside drainages will not be ditched directly into fish streams . . . Settling ponds or ditching into muskegs will be employed where applicable."

e. Stream temperature guidelines

Streamside timber plays an important role in reducing excessively high stream temperatures during summer periods with hot weather (ADFG 1985a). Removal of this timber by logging promotes higher stream temperatures, which, together with low water flows, can result in anoxic conditions that kill fish. In 1979, for example, during a period of prolonged hot weather, an estimated 30,000 to 40,000 unspawned pink salmon died in the intertidal area of extensively logged Staney Creek (memorandum from Karl Hofmeister, ADF&G fishery biologist, Ketchikan, to J. Doug Jones, ADF&G fishery biologist, Juneau, 9/6/84). The extensive removal of timber along streambanks is believed to have been a factor in the extent of the mortality.

Eight (22%) of 37 EDs discussed temperature-sensitive streams with respect to increased summer temperatures (Table 8). Protection of these streams ranged from retention or postponement of logging streambank timber to clearcutting up to 25% of the streambank timber (apparently the maximum cutting recommended under current regional guidelines). Planting of riparian browse along temperature sensitive streams is discussed in the section entitled "Second Growth Management."

f. Other measures

It appears that it has been standard practice for the FS to provide fish streams with either primary or secondary protection. This protection is covered under a regional policy C6.51. General measures to protect primary streams include directional falling and yarding of timber away from the stream or full suspension of logs yarded over streams. The Suemez EA required full suspension over braided stream channels.

Other specific measures used in individual sale include the following:

1) winter logging along streams - The PRD Small Sales EA has scheduled some winter logging along fish streams requiring frozen ground

Table 8. Protection of Temperature Sensitive Streams (tss) Discussed in Timber Sale EDs

Sale	Discussion / protection measures
LPK 84-89	Guidelines allow cutting up to 25% of the streambank forest on tss in a 15-year period (actually scheduled 1.7 mi to harvest)
Suemez	No degradation of two tss anticipated due to application of tss requirements on two streams
South Shaheen (FHIP)	Identified three tss
Angel Lake	Limit logging on tss; plant riparian browse
Granite	Listed clearcut units near tss (cut .15 miles of such streambanks)
Nesbitt	Scheduled no harvest on south side of tss in FHMUs
Bohemia	Followed R10 guidelines for timber harvesting tss streams
PRD small sales	Protect tss Blind Slough (state concern); FS felt they met this concern with the selected alternative

and snow conditions. The specifications of at least one of these winter sales were changed to drop the requirement for snow after consultation with the ADF&G (Jim Franzel, FS fish and wildlife staff officer, Petersburg ranger district, pers. comm., February 1985). The PRD has also used winter tractor yarding to salvage windthrown timber along salmon streams in Blind Slough and Farragut Bay with little apparent soil disturbance. Two clearcuts along Cowee Creek have been designed to require tractor yarding with frozen ground and 12 inches of snow in keeping with the Cowee-Davis EA.

2) channel relocation - This has been designed for an upper tributary of Big Creek in the Bohemia Sale to move the stream away from the proposed road right-of-way and minimize sedimentation problems.

3) dispersing runoff - The Yakutat Salvage EA stated that skid trails would be located perpendicular to local surface drainageways in order to disperse runoff.

4) roading in wetlands - The Cowee-Davis EA specified that, for selected alternative 8A along Cowee Creek, a "high profile road would be constructed with 2-3 feet of 1-to 1½-foot diameter coarse rocks capable of transmitting relatively large flows." Also that "culvert or bridge placements would occur at maximum 200 foot spacings."

5) soil revegetation and erosion mitigation measures - In evaluating timber sale EAs, it is evident that numerous SAAG and ARG measures are being considered throughout the Tongass. These measures include grass seeding (and sometimes fertilizing) of exposed soils along roadsides, in V-notches, and in clearcuts; layout considerations, such as road locations avoiding steep areas, uphill yarding, directional falling, split lines on V-notches, and multiple settings; stockpiling overburden from rock pits for future use; prohibiting blasting on steep slopes when the soil is saturated; end-hauling (as opposed to sidecasting) material in cut banks; and use of partial or full suspension in yarding. Use of Grabinski or short-skyline yarding systems to obtain log suspension on areas with steep, shallow soils is a feasible practice specified in a number of timber sales (e.g., Toncan, Cowee-Davis).

6) <u>barging</u> - Direct barging, as opposed to rafting, can reduce impacts to estuarine areas. Barging was considered and not selected in the Port Houghton and South Wrangell sales. It has been used or selected as the log transfer method for the Cowee-Davis, South Windham, Homeshore Blowdown, and Couverden sales. The Port Houghton EA considered it as a method to reduce impacts to herring spawning areas. The South Windham EA selected barging in order to protect king crab habitat and an important anchorage.

6. Second-growth management

The chief second-growth management proposals revealed in timber sale EDs for fisheries have included planting of streamside vegetation (discussed in the Wildlife section) and streambank stabilization.

The LPK 84-89 and East Carroll Inlet EDs were the only two sale EDs where we found a stated intent to use a variety of measures to stabilize streams that were to be clearcut without buffer strips along the banks. Management procedures that may be implemented include grass seeding, planting shrubs, installing gabions or dropping logs into the streams to improve rearing habitat. Projects to investigate the potential for adding LWD to streams are also being considered on Prince of Wales Island (Ken Thompsen, FS fish and wildlife staff officer, Ketchikan Area, pers. comm., March 1985).

7. NFMA - Indicator Species

The only completed timber sale ED we reviewed that discussed fish species as MIS was the LPK 84-89 EIS, which identified coho salmon as a "primary MIS." The reasons for selecting the coho salmon are stated, and each alternative is evaluated in terms of potential impacts on this species. A monitoring plan was developed that will employ one or two Level 3 and 4 fisheries surveys both before and after the sale to measure the effects of the sale activity on coho habitat. The subsequent project level 84-89 LPK EA did not appear to address coho as a MIS, however, in its evaluation of the sale impacts.

8. Wetlands and Floodplains

It appears from a review of timber sale EDs that only the LPK 84-89 EIS has attempted to define wetlands and floodplains in keeping with the E.O.s and address the requirements of Sec 2(a).

There is no standard forestwide classification method for identifying "floodplains" or "wetlands." Consequently there is no standard approach in timber sale planning to identifying lands that fall under Executive Orders 11988 and 11990. Virtually every timber sale ED provided no documentation that "construction activities" were permitted only when "no practical alternative" existed and "all practicable methods to minimize harm to wetlands" were incorporated into the proposed action. Although attention was given to fish and other habitat values associated with wetlands, well over half the EDs did not discuss wetland protection in relation to E.O. requirements.

It is essential that a land classification method be developed and "wetlands" and "floodplains" be given standard, forestwide definitions if a meaningful and orderly implementation of E.O.s for "Protection of Wetlands" and "Floodplain Management" is to occur on the Tongass NF. It should be emphasized that protection of wetlands and floodplains benefits many wildlife species as well as fish species.

9. Cumulative Effects and Harvest Scheduling in Watersheds

Only three timber sale EDs appeared to address the effect of past cutting on water quality or fish habitat. The Nesbitt Timber Sale EA developed an Integrated Drainage Sensitivity Analysis to determine the number of acres that can be harvested while still protecting water quality (and fisheries). This preliminary analysis method provided a framework for addressing the total amount of CFL that should be cut in a given drainage at any point in time and how logging could be scheduled over the rotation in order to maintain water quality and fish production. The method has proved too complex to use for timber sale planning and has apparently not been used for planning other timber sales (Jim Kimbal, FS fish and wildlife staff officer, Stikine Area, pers. comm., 2/12/85).

The LPK 84-89 EA and Carroll Inlet Management Plan EA both addressed past and proposed cutting along streambanks and in SHZs in evaluating the effects of timber harvest on fish production. Guidelines for determining impacts on fish production apparently considered clearcuts less than 15 years of age, as well as proposed cutting. Life-of-rotation harvest schedules were developed for 12 management areas in the LPK 84-89 EIS. It is not known if these logging schedules were designed to be compatible with the needs to maintain water quality and fish production. A standard model for estimating the effects of total-rotation harvesting would be helpful in ensuring that clearcut scheduling is compatible with water quality and fishery needs.

10. Fish Habitat Enhancement

During the first five years of TLMP implementation, a number of fish enhancement projects were developed and implemented by the FS.

In the Ketchikan Area, the major projects from 1980 through 1984 were a gabion fishway constructed on Hatchery Creek, reconstruction of the Bakewell fishway, a steep pass constructed on Sunny Creek, four years of fertilization on McDonald and Hugh Smith Lakes, and clearing, rehabilitating, and maintaining spawning gravel on Fish Creek near Hyder (Ken Thompsen, FS fish and wildlife staff officer, Ketchikan Area, pers. comm., March 1985). Projects that are scheduled for future implementation or project design include several new fish passes, lake and stream stockings, construction of spawning channels for chums, rearing and spawning stream habitat improvement projects, and additional lake fertilization.

The Stikine Area during FY 80-84 completed a 40' steep pass on Dean Creek and a vertical slot fishladder on Irish Creek (Jim Franzel, FS fish and wildlife staff officer, Petersburg ranger district, February 1985). During that time, they also studied and developed final fish pass designs for a number of other streams. The current Stikine Area fishery enhancement plans schedule construction of fish passes on Upper Keku, Slippery, St. Johns, and Slo-Duc creeks between FY85 and FY88. Other projects completed included grass seeding of a coho salmon pond on the East Fork of the Bradfield River and debris removal of windthrown trees in a salmon stream.

The Juneau Ranger District fish improvement projects have consisted of 11 coho-rearing enhancement projects (mostly ditch construction to ponds for fry access and rearing) plus 2 spawning enhancement and 3 stream debris and barrier removal projects in the Yakutat Area. Projects around Juneau include construction of Moraine Lake trickle dams and an Indian Lake cooperative coho fry-rearing project. Future projects include Dredge Lake coho stocking and a proposed fishway on Negro Creek (Dave Browning, FS fish biologist, Juneau ranger district, pers. comm., March 1985). Fish enhancement work has also been scheduled through the Yakutat Salvage Sale and Blowdown #2 Sale. Four coho-rearing ponds with islands for waterfowl use are to be constructed from borrow pits. The edges and islands are to be planted with grass, forbs, willows, and/or emergent vegetation where necessary. (Two of these have been constructed to date, one of which failed because of drainage problems [Jack Blackwell, Juneau district ranger, pers. comm., February 1985]).

The Hoonah and Sitka ranger districts have completed the following fisheries enhancements projects: construction of two fish ladders each in Corner Creek, and Kizhuchia Creek; fertilization of Fall Lake and Redoubt Lake to benefit sockeye spawning; removal of logjams from outlets of two lakes and four streams; removal of five deteriorating bridges; removal of windthrown trees from three streams; experimental felling of whole conifers into lakes to provide rearing habitat; and experimental limbing of blowdown debris to promote natural removal of logjams (Unpubl. FS repts. Annual wildlife and fisheries report, Chatham Area, FY 80, 81, 82, 83, and 84). The experimental limbing efforts have been judged largely unsuccessful and will require modification to be effective mitigative measures.

Most, if not all, of the fish enhancement projects have been reviewed and coordinated with ADF&G and/or with regional aquaculture associations. Some of the enhancement projects are cooperative projects with the ADF&G, especially those that involve stocking fish (e.g., the Irish Creek fishway required coho salmon stocking because the stream was naturally without salmon because of a barrier at its mouth).

C. General Measures for Fish and Wildlife

This section discusses the use of uneven-aged timber harvest methods, extended rotations, and protection of CFL on oversteepened slopes to protect fish and wildlife habitat values.

1. Use of Harvest Systems Other than Clearcutting

a. As required

The ARG (FS 1984a) states that "even-aged harvest cutting methods are prescribed for all [forest types], except where uneven-aged management is needed to meet other resource objectives. Clearcutting . . . will be used . . . only where such a practice is determined to be optimum to meet the objectives and requirements of the Forest Plan and can be carried out in a manner consistent with [protection of other resources] and regeneration of the timber resource. [Harvest methods] will not be chosen primarily because they will yield the greatest dollar return or the greatest amount of timber, although these factors will be considered (p. 3-15)." This policy is largely a restatement of the NFMA (U.S. Statutes 90:2954).

b. As implemented

Only 6 (16%) of 37 timber sales prepared since the TLMP that we evaluated specified harvest methods other than clearcutting, and only 2 of these sales harvested a substantial portion of the sale volume using partial cutting (Table 9).

About 80% of the acreage logged under the PRD Small Sales EA employs a partial-cut harvest method. These sales select for windthrown, dead, defective, and dying trees, although other trees, especially spruce, are added to improve the economics of the sales. Such logging is located where timber stands border logging roads throughout most of the PRD, outside the ALP 81-86 sale area, and along beach-fringe forests bordering saltwater. Partial cuts along beach fringe are to retain 80% of the trees, a measure that the FS believes will provide adequate nesting habitat for eagles and have less impacts on deer and moose winter habitat than clearcutting. Although this type of logging has been demonstrated to be a viable harvest method, it has been largely restricted to within 1,000 ft from roads or water access. The EA did not indicate that stands selected for partial cutting will be permanently managed as uneven-aged stands. Instead, these stands may be clearcut at a later date.

The Yakutat Salvage Sale was modified during layout to harvest about 40% of the acres by partial cutting. This was an attempt to try to maintain some forested canopy, while salvaging windthrown timber in areas where partial blowdown occurred. Retaining standing timber in areas of blowdown harvest was viewed as a measure to mitigate impacts to wildlife and other resources. The implementation of partial cutting has been technically feasible; however, standing timber in and along clearcuts has continued to blow down, making the long-term maintenance of the partial cut stands uncertain (Jack Blackwell, Juneau district ranger, and Forrest Cole, FS timber staff officer, Juneau ranger district, pers. comm., February 1985). By contrast, the Yakutat Blowdown #2 Sale prepared only a minor acreage for partial cutting, although resource considerations were apparently similar.

The Granite Timber Sale EA proposed to manage about 30 acres of forest in braided stream channels by partial cutting 25% of the stand at each of four 25-year intervals. This was proposed as a measure to test the use of partial cutting on maintaining bank stability. A running skyline with lateral yarding capability was to be employed, and one unit was logged using this

Table 9. Timber Sales and Management Area Analysis Since TLMP that Have Prescribed Partial-cut Harvest Methods

Environmental Document	% of Sale	Reason for Partial Cut
ALP 81-86	4/467 units	Soil or visual protection
LPK 84-89 EIS (MAA for K08)	0[a/]	Protect Honker Divide canoe route and recreation area
PRD Small Sales	79% of acres harvested	Not given
Granite	2% of acres harvested	Protect stream stability[b/]
Yakutat Salvage	42% of acres harvested	Maintain standing timber while salvaging blowdown
Yakutat Blowdown #2	2% of acres harvested	Maintain standing timber while salvaging blowdown

a/ Selective harvest was proposed for future sales in an area specified in the EIS.

b/ This was done mainly as a research exercise to determine its feasibility (Richard K. Kohrt, Wrangell district ranger, pers. comm., 2/15/85).

method. However, because of insufficient deflection, lateral yarding capability was not achieved. As a result, the unit was essentially strip cut, rather than uniformly partial cut (Dave Rak, FS soil scientist, Wrangell ranger district, pers. comm., 2/15/85).

The second unit on the Granite Sale was later scheduled for clearcutting when it was discovered during layout that the stand was not on an active floodplain as the IDT had assumed (Richard K. Kohrt, Wrangell district ranger, pers. comm., 2/15/85).

Four units in the ALP 81-86 sale were planned for partial harvest to protect either soil or visual resources. All these units are to be monitored to determine results, and considerable effort has been spent to prepare these units for harvest and to design appropriate monitoring methods. Because none of these units have yet been logged, no results are available. One constraint on scheduling innovative logging techniques is the degree of selection exerted by APC as holder of a 50-year contract. In the case of the 81-86 sale units, the FS cannot specify when APC is to log the partial cut units so that they may proceed to monitor the results and gain information of the actual effects.

The LPK 84-89 EIS, while offering no timber volume to be harvested by partial cutting during the next five-year period, identified a one-quarter-mile-wide selective harvest buffer on both sides of a one-half-mile-wide retention area comprising the Honker Divide Canoe Route and Recreation Area. This area was established through MAA in order to protect one of the most unique and publically sensitive natural attractions on Prince of Wales Island. The use of selective cutting is noteworthy in that it was established as a long-range harvest method through the MAA process, and it was used in conjunction with a retention area to increase the amount of forested habitat bordering a unique natural feature.

The other 31 timber sale EDs evaluated did not reveal any consideration of harvest methods other than clearcutting in the development of alternatives. This lack of analysis was prevalent even when objectives for resources other than timber (e.g., visual quality) were not met. We feel that greater attention should be given to the use of partial cutting and uneven-aged harvest methods in keeping with NFMA. Where retention is not used, partial cutting may have applicability for managing such areas as streamside forests, beach-fringe forests, and roadside forests. The latter method might retain such features as trapping opportunities and buffers to road traffic that would be lost by clearcutting.

2. Implementation of Extended Rotations for Visuals Under TLMP

   a. As required

      The TLMP allocation of CFL to extended rotations of 200 and 120 years in LUDs 3 and 4, respectively, to protect visual quality (FS 1979) could serve an important role in reducing impacts to fish and wildlife. Placing land in extended rotation for visuals reduces the rate of cutting in critical watersheds, reduces impacts to water quality, and affords more protection to the esthetic environment, thus enhancing sportfishing and hunting experiences. Wildlife habitat is protected by reduced cutting rates, and a slower depletion of old-growth forests occurs in watersheds with substantial amounts of forest in extended rotation.

      A total of about 168,000 and 123,000 acres of <u>normally operable CFL</u> in LUDs 3 and 4, respectively, was scheduled for extended rotations (Table 10). Under a 200-year rotation, 50% of these acres in LUD 3 (about 83,000 acres) were to be left unlogged for 100 years and then cut over the next century. About 17% of these acres in LUD 4 (20,000 acres) were to be left unlogged for 100 years (given a 120-year rotation) and then cut during the next 20 years.

      Extended rotations of 120 years were identified in the TLMP for about 12% of the normally operable CFL in LUD 4 and, if implemented, would result in about 2% of the normally operable old-growth habitat being deferred from clearcutting for 100 years. Extended rotations of 200 years were identified in the TLMP for about 28% of the normally operable CFL in LUD 3 and, if implemented, would result in about 14% of the normally operable old-growth habitat being deferred from clearcutting for 100 years. This deferred harvest is most significant in the LUDs 3 of the Stikine and the Chatham Areas where 38 and 36%, respectively, of the normally operable CFL were to be clearcut on a 200-year schedule under the TLMP.

      It should be noted that numbers cited in this section, including Table 10, were derived from an analysis of the TLMP S2K database and are only

Table 10. Approximate Acres of Normal Operable CFL Allocated to Extended Rotation in TLMP Harvest Calculations for Visual Protection[a/]

Area	LUD 3[b/]	LUD 4	Total
Acres normal operable CFL in extended rotation			
Ketchikan	21,000	29,000	50,000
Stikine	56,000	46,000	102,000
Chatham	92,000	48,000	140,000
TOTAL	169,000 (50,000)	123,000 (107,000)	292,000 (257,000)
% total normal operable CFL			
Ketchikan	10	6	--
Stikine	38	12	--
Chatham	36	18	--
TOTAL	28 (24)	12 (9)	--
% total normal operable CFL unlogged year 2080 in areas with extended rotations[c/]			
Ketchikan	5	1	--
Stikine	19	2	--
Chatham	18	3	--
TOTAL	14 (12)	2 (1.5)	--

a/ Data derived from analysis of TLMP S2K database (Unpubl. data, ADF&G, Division of Habitat, Douglas). High visually sensitive areas within 500 ft of saltwater and TLMP-identified estuarine, streamside, and inland grassland bear habitat were protected in conjunction with wildlife retention and were not allocated to extended rotation in TLMP harvest calculations. These areas are not included in the data presented here.

Also note that the numbers shown are approximations and that recent analysis by the FS (FS 1985c) suggests that the numbers shown slightly overestimate the actual acreages and percentages. The estimates derived from the recent FS report are given in parenthesis.

b/ Does not include "special LUD 3" excluded from TLMP harvest calculations.

c/ Assumes one-half of the normally operable CFL in extended rotation in LUD 3 areas would be cut during the next 100 years (a 200-year rotation) and that five-sixths of the LUD 4 extended rotation areas would be clearcut during the next 100 years (a 120-year rotation).

approximations. Subsequent analysis will result in some changes. Recent analysis by the FS (FS 1985c) indicate that there are 149,754 and 107,452 acres of normally operable CFL scheduled for logging under TLMP in LUDs 3 and 4, respectively, compared to our analysis of 169,000 and 123,000 acres, respectively. No breakdown has been provided by the FS to our knowledge of the amount of extended rotation by LUD classification for each Area.

b. As implemented

Project implementation of extended rotations was evaluated using two criteria: (1) whether visually sensitive areas were identified for extended rotations and (2) whether the TLMP-inventoried visual quality objectives (VQOs) for retention and partial-retention were adopted. Retention and partial retention VQOs closely correspond to high visual sensitivity areas identified in the TLMP (see TLMP EIS part 2, FS 1979) and allocated in TLMP harvest calculations to extended rotations.

Only four (11%) of 37 EDs adopted project-specific VQOs and specified the use of extended rotations (Table 11). The best example of extended rotation in project planning is the LPK 84-89 EDs. Areas for visual extended rotations were developed for each alternative and displayed on maps in the EIS. The landscape architect then developed the recommended percentage of harvest for the first entry in areas of extended rotation for 13 VCUs. These are displayed in the project EA and range from 12 to 20%. The LPK 84-89 harvest exceeded these recommendations in two VCUs, and in one VCU the "established VQO" was met despite the over-harvesting. However, the relationship of the amount of inoperable CFL in a VCU to the percentage of CFL harvested and the length of time that would constitute a first entry was unclear. It would be desirable to have this procedure clearly explained and standardized for the region.

The Todahl EA stated that "timber visible from saltwater would require ca. 200-year rotation to meet long-term VQO." The first sale was carefully planned to meet the VQO; however, to our knowledge, no attempt has been made to determine the effect of a long-term rotation on the rate at which timber could be harvested to meet this objective. Similarly the Cabin Sale EA stated "there will be a 200-year and 120-year rotation in LUD III and IV, respectively, in visually sensitive areas." Nevertheless, the sale overharvested these areas and will not meet the

Table 11. Areas Identified for Extended Visual Rotation in Timber Sale Environmental Documents

Area	Sales	Met VQO
Management Areas K01-04, K08-11, K14, K32	LPK 84-89, South Shaheen (FHIP)	Yes for VCUs 528, 531, 533, 534, 552, 559, 573, 574, 575, 591, 593, 596, 620, 740 No for VCU 736 [a/]
VCU 443	Todahl	Yes
North Mitkof I.	Cabin	No [b/]

a/ This resulted because the scheduled harvest will cut 30% of the high-visual areas rather than the recommended 20% harvest during the first entry.

b/ This resulted because the scheduled harvest in the Cabin Sale ED will "overharvest" the high visual areas in LUD 3 facing the Wrangell Narrows.

VQO in a highly, visibly sensitive area as defined by the TLMP criteria that include marine highway, boat route, road and trails, and areas associated with communities. No attempt to relate the proposed extended rotations in the Cabin Sale Area to project-level scheduling of harvest on Mitkof Island has occurred, to our knowledge.

The most striking fact is that 90% of the timber sales under the TLMP have completely failed to address identification of project-level VQOs and implementation of extended visual rotations. In the first five years of the harvest rotation under the TLMP, about 50% of scheduled timber sales "overharvested" the high visual areas (i.e., did not adopt and implement TLMP inventoried VQOs) (Table 12). This impact will become apparent as these units are logged over the next few years. Additional loss of timber in these areas to subsequent blowdown will probably result in further old-growth depletion and visual impacts. If sales planned over the next five years similarly fail to address implementation of the TLMP provision for extended rotations, severe visual impacts will likely occur, and areas that would have provided important wildlife old-growth habitat for a longer period will be lost to clearcutting.

As in the case of retention (discussed earlier), there should be flexibility during implementation to shift extended rotations from one area to another without affecting the TLMP harvest schedule. For example, some "viewsheds" allocated to a 200-year rotation in the TLMP could be managed on a 100-year rotation, while other "viewsheds" could be managed for a "preservation" VQO (no-cut) without reducing the acreage of CFL the TLMP assumed for harvest during the next 200 years. We found no evidence that the FS has considered any of these options during project and management area planning. Instead, to date, extended rotations or modifications of such measures are largely unused by the FS despite the TLMP. The FS has acknowledged the need to improve procedures for implementing extended rotations in the proposed TLMP Amendment (FS 1985c). If new procedures are adopted, implementation could occur for sale planning during the 1986-89 period.

3. Protection of Unregulated CFL on Oversteepened Slopes

   a. As required

   The NFMA regulations state that the forest planning process shall identify and designate lands as not suited for timber production in the

Table 12. Summary of Timber Sales Impacts on Areas with "TLMP Inventoried VQO" of Retention and Partial Retention [a/]

Impact of Sale	No. sales	(%)	
Adopted and met inventoried VQO for retention/partial retention	10	(29)	b/
Didn't adopt or meet inventoried VQO for retention/partial retention	15	(44)	c/
Uncertain impacts	9	(26)	d/
Total sales	34	(100)	e/

a/ These impacts do not consider additional blowdown losses that generally result from clearcutting.

b/ Includes Mitkof Flyer, South Wrangell, Port Houghton, Totem, Todahl, PRD Small Sales, Zarembo Lake Salvage, Yakutat Salvage, FHIP, and South Windham.

c/ Includes Highbush, East Carroll Inlet, Toncan, Campbell, Rynda, Cabin, Nemo Point, Fritter, Skip, Gilbert Bay, Cowee-Davis, Couverdeen, Yakutat, ALP 81-86, and LPK 84-89.

d/ Includes Granite, Sokolof, Corner Bay, Homeshore Blowdown, Angel Lake, Ketchikan Small Sales - Free Use, Yahky Cove, Cherrumba Salvage, and Suemez.

e/ Does not include Cleveland, Nesbitt, and Bohemia sales that had no or essentially no retention/partial retention VQO areas identified.

preferred alternative where, among other things, "technology is not available to ensure timber production without irreversible resource damage to soils productivity or watershed conditions" (36 CFR 219.14). TLMP identified all slopes over 75% and all slopes of 66 to 75% with a severe soil rating as unregulated timber and excluded them from logging (Rideout et al. 1984). Furthermore, the NFMA regulations (36 CFR 219.27[c],[1]) allow timber harvest on these lands only in three cases: 1) salvage sales, 2) sales necessary to protect other multi-use values, and 3) activities that meet other objectives on such lands if the forest plan establishes that actions are appropriate.

The TLMP, by withdrawing the designated lands from timber production calculations, declared that timber harvest for the sake of meeting timber targets was not an appropriate objective for such lands. The SAAG policies (adopted by the TLMP) state that "development activities will not be approved on terrain where IDT evaluation indicates a high likelihood of massive failure and where mitigation measures are not practical" (FS 1977) and the TLMP states that "the Area Guide policies for soil protection will be strictly enforced" (FS 1979, p. 115).

Protection of the stability of steep slopes is of great importance to fish and wildlife. Landslides can have serious negative impacts on fish production and water quality. The acreage of unregulated CFL set aside from logging provides an important old-growth reserve that the TLMP assumed would help meet the needs of old-growth-dependent species (FS 1979). Commercial forests on slopes greater than 75% in LUDs 3 and 4 total over 280,000 acres, including about 62,000 acres of high-volume (greater than 30,000 bf/acre) old growth (Unpubl. analysis of TLMP S2K database, ADF&G, Division of Habitat, Douglas).

Since the TLMP began, the FS contracted a study of the feasibility of harvesting on slopes over 75%. This study (Burke 1983) concluded:

> It is quite clear that observational and experimental data tends to support the extremely high risk to the environment as the result of timber harvest activity on slopes in excess of 75%. The removal of commercial timber on slopes in excess of 75% from the current allowable sale quantity (ASQ) is apparently based on published research identifying the high risk of logging under these particular conditions. This action appears to be justified (p. 14-15).

Moreover, no mitigation measures to assure that clearcutting oversteepened slopes will not cause massive landslides are currently known.

b. As implemented

At least 13 (35%) of 37 sales scheduled clearcutting on extreme hazard soils (Table 13). The amount scheduled ranged from less than 1% to 27% of the total sale. Most of the sales that scheduled logging on unregulated CFL did not specify what the likely impacts would be. In three cases, the EDs stated that negative impacts were likely. These sales include Cowee-Davis, Suemez Island, and the LPK 84-89 sales. In the Cowee-Davis Sale, the ED stated that logging high-hazard areas would "likely [have] potentially unacceptable impacts on water quality and fish habitat [on Davis Creek]", with a "50% reduction in coho and steelhead rearing capacity to 17 to 19 acres for 2 to 5 years" and "impact to 8.3 additional acres of chum, pink, coho, and steelhead habitat by 50 percent reduction for several years," while on Cowee Creek there would be "very high potential for landslides [with] potentially unacceptable impacts on water quality and fish habitat likely." The Suemez EA scheduled 40% of the high-hazard soils for clearcutting over the rotation. As a result, "some slumps and slides are expected." The LPK 84-89 EIS indicated that clearcutting of moderate and extreme-hazard soils will occur and that, despite mitigation measures, short- and long-term adverse impacts will result. The Totem EA called for monitoring for landslides, without specifying likely impacts from logging 270 acres with slopes in excess of 75%.

The present FS preferred alternative for the APC 86-90 sale would schedule clearcutting on 3,210 acres of forests with extreme soil hazards (totaling 15% of the acres harvested)(FS 1985a). This harvest includes clearcutting 297, 110, 611, 86, 189, 207, and 461 acres of forest with extreme soil hazards (TLMP unregulated CFL) in VCUs 202, 203, 204, 210, 217, 281, and 283, respectively. This harvest is expected to result in an increased loss of 182 acres of forest production in these VCUs above natural levels based on a FS model. Actual impacts could be much higher. By contrast, the ALP 81-86 sale EIS in the same area stated that "confirmed areas of high hazard (soils) will not be logged" (FS 1980, p. 53).

Not one timber sale ED we reviewed identified unregulated CFL, mapped it, and excluded it from logging. This procedure appears to be essential

Table 13. Timber Sales Scheduled to Clearcut Forests on High-hazard Soils.[a/]

Sale EA (EIS)	Acres of High-Hazard Soils Clearcut	% of Harvest Acres High-Hazard Soils
LPK 84-89	Not specified	Not specified
East Carroll Inlet Mgmt. Plan	Not specified	Not specified
Suemez (total rotation)	ca. 950	ca. 7
Granite	205	13
Cleveland	166	27
South Wrangell	130	8.5
Port Houghton	5	trace
Totem	269	11
Nesbitt	160	15
Fritter	8	1
Skip	5	2
Cabin	49	6
Cowee-Davis	Not specified	Not specified
Six other timber sales[b/]	Uncertain if any	Uncertain if any

a/ This list does not include salvage sales on unregulated CFL. "High-hazard" soils classification used in the EDs is the same as the TLMP "extreme hazard" classification.

b/ Sales included are Angel Lake Planning Area, South Shaheen (FHIP), Toncan, Campbell, Todahl, and South Windham. These sales do not include the ALP 81-86 EIS, which identified 1,200 acres of 75+% slope in proposed clearcuts. The 81-86 ALP EIS states that clearcuts on steep slopes were to be examined during layout and "confirmed areas of high hazard will not be logged" (FS 1980).

if NFMA and TLMP requirements are to be implemented at the project level. Another major portion of timber not scheduled for harvest in the TLMP is that considered to be inoperable under current logging technology. Several sales (e.g., Gilbert Bay, Cowee-Davis, LPK 84-89) identified the inoperable CFL (CFL that is physically inaccessible to harvest). Accounting for the amount of inoperable CFL is important because it will provide old-growth habitat only if it remains inoperable and unlogged throughout the rotation.

The LPK 84-89 and East Carroll Inlet Management Plan EDs included inoperable CFL in evaluations of the amount of CFL that would remain at the end of the rotation when estimating long-term impacts on old-growth-dependent wildlife species. The East Carroll Inlet MAA did not display a map of the inoperable CFL. In the LPK 84-89 EIS, inoperable CFL was displayed on maps, and the EIS evaluation assumed that 50 and 54% of the important wildlife old-growth habitat and total old-growth habitat, respectively, would be left in year 2050, with 56 and 77%, respectively, comprised of inoperable CFL. When reviewing the LPK 84-89 sale units, we noticed 12 clearcuts in areas mapped as inoperable CFL. The Ketchikan Area is currently planning to allow harvest in these "inoperable" areas if layout shows that logging is feasible (Dale J. Thompson, LPK 84-89 Team Leader, Ketchikan Area, pers. comm., February 1985). However, we are unaware of any process to track the amount of "inoperable" CFL that will actually be logged. Thus the amount of "inoperable" old growth remaining at the end of the rotation may actually be much less than what the LPK 84-89 EIS and the TLMP have assumed, especially for the high-volume stands with the most favorable economic return, inasmuch as these are most likely to be scheduled for harvest.

In summary, timber sale documents are generally not identifying unregulated CFL, mapping it, and excluding the acreage from logging, as was assumed by the TLMP. In practice, operable unregulated CFL has been scheduled for harvest to meet timber targets despite likely environmental impacts, including long-term loss of forest production. This practice is likely to further deplete habitat that the TLMP assumed would provide for old-growth wildlife habitat needs and increase impacts to water quality and fish production.

V. REVIEW OF MEASURES IMPLEMENTED TO MAINTAIN OR ENHANCE USES OF FISH AND WILDLIFE ON THE TONGASS NATIONAL FOREST

A separate report entitled "A Regional Overview of Fish and Wildlife Use in Southeast Alaska" (ADF&G, 1985 b) has been prepared to provide a regional overview of the various categories and magnitudes of fish and wildlife use in southeastern Alaska for the department's contribution to the 706(b) report. This section reviews the measures included in NEPA documentation to maintain subsistence uses and sportfishing, as well as the potential effect of preroading and roading on these uses.

A. Maintenance of Subsistence Uses of Fish and Wildlife

1. As required

Sec. 810(a) of ANILCA specifically requires all federal agencies to evaluate the effects of uses of public land in Alaska on subsistence uses and needs and alternatives that would reduce or eliminate lands needed for subsistence purposes.

2. As implemented

The establishment of criteria to evaluate the impacts of timber harvest on subsistence has been a gradual process. The FS region has been refining and developing direction for conducting ANILCA Sec. 810 evaluations since 1982 and participated in the development of guidelines which were adopted by the Alaska Land Use Council in 1984.

Only 6 (LPK 84-89, Yakutat Salvage, Yakutat Blowdown #2, Suemez, Corner Bay Blowdown, East Carroll Inlet) of 37 EDs identified subsistence uses as a potential concern. How the concern was addressed in each of these six documents is detailed below along with some discussion of two draft timber sale EDs that were still being prepared at the time of this study. The remaining EDs either did not discuss subsistence or indicated that subsistence resource uses and needs were largely absent in the affected area. Subsistence was not a concern of any timber sale on the Stikine Area or the ALP 81-86 Sale. However, the ALP 86-90 Draft EIS has addressed subsistence in detail, as discussed below.

a. Suemez Island

The Suemez EA identified Suemez as the island that supplies Hydaburg with "nearly all their deer" and indicated that Meares Passage was especially important for subsistence deer hunting. The impact of the sale on this subsistence hunting was not stated. First entry sale layouts included clearcutting along the entire Suemez side of Meares Passage, with no apparent special considerations towards subsistence. Thirteen percent of the identified critical deer winter range was scheduled to be clearcut the first entry, and 43% was scheduled to be clearcut during the rotation. The long-term management goal for the island is to maintain viable populations of deer (as opposed to huntable populations), and a 75% reduction in deer hunting at the end of the rotation was predicted by the FS biologist if the logging plan is implemented.

b. Corner Bay

The Corner Bay Blowdown EA identified deer hunting, especially along logging roads, as a subsistence concern. The identification of this concern as a traditional use concern was challenged by the ADF&G, which felt that use of logging roads for deer hunting in the sale area was largely by FS staff and loggers with access to vehicles, while the bulk of traditional subsistence hunting occurred along the shoreline, utilizing water access. The EA stated that this sale would have no negative effect on subsistence. Again, the state disagreed, arguing that campsite locations, especially the Sitkoh Lake location, would displace subsistence users, and removal of habitat in travel corridors (20 acres of standing timber, including two leave strips and 256 acres of partial blowdown containing several other leave strips, were scheduled for clearcutting) would contribute to a decline in deer and marten.

c. Ketchikan sales

The East Carroll Inlet Management Plan EA identified subsistence uses to be trapping, deer and bear hunting, and subsistence fishing, and stated that logging would have no impact on the availability of subsistence resources. Alternative areas for subsistence were available, according to the EA. The plan identified critical DWR and allocated nearly all of it for retention. This retention allocation for wildlife totalled about three times the amount provided for the area under the TLMP.

The LPK 84-89 EIS acknowledged that game supplements the diet and is the main source of animal protein for many rural people but stated that the definition of subsistence hunting in the Ketchikan Area is "unclear." The EIS described the impacts on subsistence as the same as the effects on wildlife. The effects of the LPK 84-89 Sale on subsistence were described as insignificant because only 3.6% of the critical DWR and 5.1% of the total CFL would be harvested (Revised LPK 84-89 EA). The cumulative harvests at the end of 1989 were projected to total 27.3

and 21.1% of the critical DWR and the total CFL, respectively.

d. Yakutat Area sales

The Yakutat Salvage Sale and Yakutat Blowdown #2 Sale EAs described the effect of increased access on subsistence. The Yakutat Salvage EA stated that increased access would have an adverse overall impact on subsistence, unless Yak-tat Kwaan harvested blowdown on adjoining Native-selected lands. If this occurred, the FS stated that the sale would then have no effect on subsistence. It is unclear why the impact of two concurrent sales would negate one another rather than result in cumulative impacts.

The Yakutat Blowdown #2 EA, on the other hand, stated that increased access would benefit wood gathering and berry picking and have no significant effect on other subsistence users and resources. Neither Yakutat sale EDs expected resources to drop below "critical biological levels."

e. Juneau Area sales

Two sales EDs, although not specifically concerned with subsistence, indicated that timber harvesting would increase subsistence use of the area. The Gilbert Bay Sale was expected to increase both recreational and subsistence use of wildlife, and the Cowee-Davis Sale was expected to benefit subsistence uses by increasing the wood fuel and berries available to Juneau and access for hunting and fishing.

f. ALP 86-90

A brief discussion of the Draft ALP 86-90 EIS (FS 1985a) is included here because this document addresses subsistence uses in greater detail than the earlier ALP 81-86 EIS which was completed prior to the FS establishing direction for addressing subsistence uses on NF lands. Considerable effort was made by the FS while preparing ALP 86-90 to contact ADF&G regarding subsistence concerns. Subsistence uses are defined as most wild food- and firewood-gathering activities except bear hunting. A brief discussion of the subsistence uses of each community is provided and the acres of identified subsistence areas logged and miles of roads constructed around Hoonah, Kake, and Pelican (based on areas identified during Coastal Zone Management planning) are displayed for each alternative. The draft document concludes that none of the action alternatives will effect the availability of subsistence resources, although there may be changes in some use areas. The subsistence considerations do not appear to influence alternatives developed or selected. No discussion of the cumulative effects of logging on subsistence over the entire rotation is provided.

In its response to the DEIS, the state indicated it believed that insufficient data had been presented to conclude that the sale would have "no effect" on subsistence uses (memorandum from Diane Mayer, project coordinator, Division of Governmental Coordination, State of Alaska, to Michael Barton, regional forester, 7/22/85).

g. Chuck River sale

State comments to the Chuck River Revised EA (Chatham Area) raised concerns over how subsistence-related impacts were addressed. At the time this report was being prepared, no final decision notice had been issued, so the sale was not evaluated in detail. The state (memorandum from Robert Grogan, associate director, Division of Governmental Coordination, State of Alaska, to Ken Roberts, Chatham Area forest supervisor, 11/1/84) contended that the impacts of the sale on subsistence has not been adequately addressed. Details identifying subsistence users, harvest locations and methods, magnitude of subsistence uses, periods when subsistence activities occur, species of fish used for subsistence, significance of this area to subsistence communities, and potential conflicts between subsistence uses and increased sport harvests were lacking. The state contends that without this information it is not possible to determine that the sale will have no impact on subsistence.

h. General subsistence use guidelines

Although the Suemez and Corner Bay EDs identified only deer as a subsistence resource, other sales, such as Yakutat, included many wildfood-gathering activities, as well as trapping and firewood cutting. The Ketchikan Area recently reviewed its subsistence guidelines (memorandum from Winn Green, Ketchikan Area forest supervisor, to the regional forester, 7/5/84). The memorandum stated that all EAs presently address subsistence and no current or proposed activity has been identified that would impact the availability or use of subsistence resources. The principle subsistence uses in the Ketchikan Area were described as harvest of salmon, trout, furbearers, deer, and black bear. The LPK 84-89 fisheries specialist's report noted that subsistence use of fish was restricted to sockeye, pink, and chum salmon. Coho salmon were excluded by regulation in the Ketchikan Area. The magnitude of subsistence fishing was determined, based on the number of subsistence fishing permits issued, but no comparable estimates of subsistence trapping and hunting were possible because they occur under sport regulations. The memorandum stated that fish and wildlife enhancement funds spent by the FS were increasing the numbers of fish and wildlife available for subsistence users. (This report found no evidence, other than the goat transplant, that wildlife is increasing as a result of enhancement work. Rather, wildlife habitat and carrying capacity appear to be continuing to decline as a result of clearcutting.) Other actions related to subsistence that were not connected with timber sales included permitting motorized access (subject to reasonable regulation) for rural residents engaged in subsistence activities in Misty Fiord Wilderness and a mountain goat transplant on Revillagigedo Island, which was projected to have the potential of increasing the current goat hunter yield in GMU 1A by 50% and thus enhance both subsistence and recreational hunting opportunities.

We found only two sales proposing mitigation measures that were described as reducing impacts to subsistence. The Yakutat Salvage Sale EA proposed road closures during and after the sale to reduce impacts on subsistence activities. The LPK 84-89 EIS Decision Notice located a FS administrative site, logging camp, and primary LTF in a bay that had already been developed in order to help preserve the lifestyle of residents of Meyers Chuck. Vixen Harbor was not selected for development in order to protect the subsistence use of this area by residents of Meyers Chuck.

FS timber-related EDs we reviewed did not evaluate the cumulative effects of logging and roading on subsistence. They seldom addressed the impact of logging camps on traditional subsistence areas.

B. Maintenance of High-Quality Sportfishing Opportunities

The value of sportfishing in the Tongass NF has long been recognized by residents and others (Schwan 1984). It was a documented concern during the formation of the TLMP and a selection criterion in the allocation of lands to wilderness or nonwilderness areas (FS 1979). The percentage of fish streams currently in wilderness or roadless (LUD 2) areas ranges from 33 for major overwintering anadromous trout/char lakes and chum salmon streams with 500-6,000 fish escapements to 100 for major chinook salmon producers (Table 14). The bulk of the remaining fish streams are in LUDs 3 and 4 areas. This section focuses on protection given sportfishing areas in LUDs 3 and 4 during the preparation of timber sale documents.

1. As required

The TLMP EIS (FS 1979) specified that some protection could be provided, at least in LUD 3, to protect the esthetics of sportfishing and that high-value sportfishing streams would likely receive the most intensive management prescriptions.

> LUD III would also provide more flexibility in project design to retain aesthetic values (of fish streams) (ibid., p. 92).
>
> Sport fisheries will be impacted more than commercial fisheries since the esthetic quality of sport fishing experience may . . . be affected . . . Management of LUD III areas provides more latitude for protecting the associated environment of these streams (ibid., p. 190).
>
> Among those stream systems likely to receive more intensive prescriptive management are 84 (watersheds) identified by ADF&G as highly important sport fishing areas (those that were allocated LUDs III and IV) (ibid, p. 92).

In addition, the TLMP provided latitude to fully protect fish production of every fish stream (FS 1979), and the FS participated in formulation of regional salmon plans that call for increased productivity of salmon from TNF lands to provide higher commercial and subsistence salmon harvests.

2. As implemented

Table 15 presents a summary of timber developments since the formation of TLMP in the "high-quality" and "important" sportfishing watersheds allocated to LUDs 3 and 4. No new logging has been prepared in 27 (79%) of 34 watersheds. However, many of these watersheds will probably be scheduled for logging during the next 5 to 10 years based on current FS "action plans".

Logging avoided the important sportfishing areas to some degree in all of the remaining sales. The LPK 84-89 MAA used a combination of wildlife retention buffer strips, extended visual rotations, and logging deferals to help reduce impacts to four important sportfishing areas. Road closures are proposed for two of the sportfishing areas (Honker Divide and Salmon Bay Lake) to attempt to maintain a semiprimitive recreational experience. The Stikine Area deferred

Table 14. Land Status of Major Fish-Producing Watersheds [a/]

Category	Monuments-Parks	Tongass Land Management Plan (TLMP) Land Use Designation (LUD)**				State Land	Native Selection	Total
		I	2	3	4			
"Quality Watershed"								
Cat. No. 1	7 (36.8)	1 (5.2)	6 (31.5)	3 (15.7)	2 (10.5)	0	0	19
Cat. No. 2	19 (29.6)	0	14 (21.8)	11 (17.1)	13 (20.3)	2 (3.1)	5 (7.8)	64
Rainbow Lakes	5 (83.3)	0	0	0	0	0	1 (16.6)	6
Steelhead streams [b/]	7 (28.0)	1 (4.0)	6 (24.0)	3 (17.0)	8 (32.0)	0	0	25
Cutthroat streams [b/]	11 (26.1)	1 (2.3)	10 (23.8)	11 (26.1)	7 (16.6)	0	2 (4.7)	42
Overwinter lakes [b/]	4 (12.1)	1 (3.0)	6 (18.1)	10 (30.3)	9 (27.2)	2 (6.0)	1 (3.0)	33
Chinook salmon								
Major producers	1 (33.3)	0	2 (66.6)	0	0	0	0	3
Medium producers	4 (50.0)	0	2 (25.0)	0	1 (12.5)	1 (12.5)	0	8
Minor producers	10 (45.5)	0	4 (18.1)	4 (18.1)	4 (18.1)	0	0	22
Coho producers								
(500 escap.)	45 (22.9)	1 (0.5)	25 (12.7)	49 (25.0)	76 (38.7)	ND [c/]	ND	196
(100-500 escap.)	69 (31.7)	0	17 (7.8)	49 (22.0)	82 (37.7)	ND	ND	217
Pink salmon								
(50,000 escap.)	38 (28.7)	1 (0.7)	8 (6.0)	19 (14.3)	66 (50.0)	ND	ND	132
(10,000-50,000)	80 (26.8)	0	25 (8.3)	73 (24.4)	120 (40.2)	ND	ND	298
Chum salmon								
(6,000 escap.)	70 (34.1)	1 (0.4)	19 (9.2)	28 (13.6)	85 (41.2)	2 (0.9)	ND	205
(500-6,000)	81 (25.0)	0	27 (8.3)	77 (23.4)	134 (41.3)	5 (1.5)	ND	324

a/ Taken from Schwan (1984).
b/ Includes only "major" producers.
c/ Not determined.

Table 15. A Status Report on Timber Developments and Protection Measures Implemented to Protect the Esthetics of Sport Fishing in TLMP High-value Watersheds Allocated to LUDs 3 and 4

Watershed	LUD	Timber Harvesting[a/] - Protection
Mud Bay Creek	3	Upper portion previously logged. No logging scheduled on lower portion of the creek.[b/]
Pavlof Harbor	3	This area has been heavily logged in the past and additional logging was scheduled under ALP 81-86 EIS without addressing sportfishing. No logging was scheduled between the lake and its outlet into Pavlof Harbor.[b/]
Castle River	3/4	Upper drainage (LUD 4) scheduled for intensive timber harvesting; lower creek (LUD 3) containing important sportfishing areas (VCU 435) deferred until TLMP revision.
Duncan Canal - Salt Chuck	W/4	No logging schedule
Kadake Creek	4	Logging scheduled prior to TLMP; no specific protection for sportfishing; lower 2 mi unlogged.[b/]
Sweet Water - Thorne System	3/4	LPK 84-89 EIS established a permanent wildlife retention buffer of about 500 ft width around the Indian Creek-Barnes Lake-Sweetwater Lake complex and a ¼ mi-wide-no cut zone on each side of the Honker Divide Canoe Route from Hatchery Lake to the south end of MA K08; the no-cut zone is bordered on each side by a ¼-mi wide partial cut zone with numerous visually sensitive hillsides totalling over 10,000 acres placed in extended rotation; no logging or preroading is scheduled in Honker Divide prior to 1989.

(continued)

Table 15 (continued).

Watershed	LUD	Timber Harvesting[a/] - Protection
Sarkar Lakes	2/4	No new logging scheduled under LPK 84-89 EIS; MAA[c/] has not been completed yet.
Helm Bay	3	No logging scheduled; deferred to MAA for Cleveland Peninsula.
Orchard Lake	3/4	No logging scheduled; LPK 84-89 EIS identified retention and extended visual rotation for VCU 734 only; retention included a buffer along the south side of the lake and the lower 2 mi of Orchard Creek, and a 1.5 to 2 mi buffer on the east side of the lake around an existing recreation area; visual retention areas include the hillsides south of Orchard Lake and the lower 2 mi of Orchard Creek and hillsides 3 mi east of Orchard Lake; future logging plans call for extensive roading along Orchard Creek to about 1 mi of the lake and extensive harvesting in the upper portion of the drainage.
Ward Cove System	3	Much of this highly developed area is in state or private ownership; the FS maintains a campground and picnic area on Ward Cove Lake.
Akwe River	3	No logging currently scheduled, included as preroading area in Preliminary Activity Schedule, 1984-89.
Italio River	2/3	No logging currently scheduled, included as roading area in Preliminary Activity Schedule, 1984-89.

(continued)

Table 15 (continued).

Watershed	LUD	Timber Harvesting[a] - Protection
Arnklin River	2/4	No logging currently scheduled, included as preroading area in Preliminary Activity Schedule, 1984-89.
Square Lake (Ustay R.)	3	No logging currently scheduled, included as preroading area in Preliminary Activity Schedule, 1984-89.
Admiralty Creek and Young's Lake	3	No logging currently scheduled yet.
Kook Lake and Creek	3	Heavily logged previously; Corner Bay Salvage EA scheduled additional harvest of leave ships above Kook Lake; logging is to be designed to protect sockeye spawning areas.
Sitkoh Creek	4	No new logging scheduled on creek; Corner Bay Salvage EA scheduled additional harvest around lake; standing timber is to be left around lakeshore during salvage sale.
Salmon Lake	3	No logging currently scheduled.
Port Krestof	3	No logging currently scheduled.
Tower's Lake	3	No logging currently scheduled.[d]
Kah Sheets Lake	4	No logging currently scheduled.[d]

(continued)

Table 15 (continued).

Watershed	LUD	Timber Harvesting[a/] - Protection
Ideal Cove Lakes	3	No logging currently scheduled. Classified as a recreation area (FS 1979); the FS has maintained boats on the lakes, trails between the lakes, a three-sided shelter, and picnic platforms.
Blind Slough	3	The south half of the drainage has been extensively logged and developed; small sales have continued off the roads; the north half of the drainage has been deferred from logging until the revision of TLMP (Mitkof Flyer EA).[e/]
Virginia Lake and Creek	3	No logging currently scheduled.[d/]
Kunk Lake and Creek	4	No logging currently scheduled.
Snake (Olive) Creek	4	Previous logging. No new logging scheduled since TLMP.
Thom's Lake and Creek	3	Logging scheduled under South Wrangell EA; roads were built on both sides of creek; three clearcut units had buffers of 300 ft to 1,300 ft along Thoms Creek system; road access has increased use of sport fishery (Richard K. Kohrt, Wrangell district ranger, pers. comm., 2/15/85); lake and outlet of creek are now in state or private ownership.
Red Bay Lake	3	LPK 84-89 EIS established ca. 500-ft buffer of permanent retention around the lake, with adjoining hillsides on both sides of the lake being managed for extended visual retention; no cutting is scheduled to occur in the Red Lake drainage in 1984-89.

(continued)

Table 15 (continued).

Watershed	LUD	Timber Harvesting[a] - Protection
Salmon Bay Lake	3	LPK 84-89 EIS established a buffer of permanent retention around the lake with extended visual retention on the adjoining hillsides similar to Red Bay Lake; in addition the lower portion of the stream (largely muskeg) is to be left unroaded, with the streamside forest in permanent wildlife retention; the objective is to emphasize a semiprimitive recreation experience; only two units salvaging blowdown are to be logged in 1984-89, and roads into the VCU are to be closed to vehicle traffic when timber harvest is complete
Staney Creek	4	Heavy previous cutting; LPK carryover for 1984-89 was not reevaluated; MAA has not been done.
Black Bear Lake	3	Mostly Native land; no FS logging currently scheduled.
Miller Lake	4	No logging currently scheduled.
Niblack System	4	No logging currently scheduled.
Essowah Lake	4	No logging currently scheduled.

a/ Includes only timber harvesting scheduled since TLMP.

b/ Additional logging and/or roading is proposed in the Draft 86-90 EIS (FS 1985). See text for discussion.

c/ MAA = Management Area Analysis.

d/ The Stikine Area 10-year logging plan calls for possible timber sales in these drainages in the next 5 to 10 years.

e/ The FS preferred alternative for the Mitkof Flyer Sale is to log and road the entire north portion of the Blind Slough drainage and emphasize the area for logging sales while maintaining a buffer of about 300 ft around the Blind Slough and Blind River area (Mitkof Flyer EA). Over 550 local people signed a petition requesting that the FS leave the north half of the drainage unroaded. In response to the public input and the state position that the area be left unlogged, the FS deferred logging until the TLMP revision (Mitkof Flyer Decision Notice).

roading and logging two important sportfishing areas (Castle River VCU 435 and the north half of Blind River-Blind Slough). Both decisions were partly in response to the department's Class I land designation and, in the case of Blind Slough, a high level of local opposition to the FS initial decision to road and log the remainder of the drainage. The public response serves to indicate that the protection of key recreational features is a very important concern in at least some communities of southeastern Alaska.

In addition to the protection measures mentioned above, the FS has maintained recreational cabins, mooring buoys, trails, and often row boats in many of these and other sportfishing areas. These facilities have directly enhanced fishing opportunities and are of major importance to freshwater sportfishing (Schwan 1984).

It is important to note that the above protective measures, in all cases, exceed the amount of timber the TLMP allocated to retention for those areas. This means that either other areas will receive less retention or the harvest levels will have to be reduced if important sportfishing areas are to be managed for some kind of aesthetic setting. Whether the proposed measures will be sufficient to maintain a setting in keeping with the desires and needs of the sportfishing users has not been evaluated nor has monitoring been proposed to our knowledge.

Several EAs addressed other sportfishing areas or potential areas while developing timber sales. The Gilbert Bay EIS (LUD 3) set aside the "Sweetheart Flats" in retention and scheduled a public recreation cabin to be constructed there by 1983. This measure would probably maintain and promote sportfishing; however, the cabin has not been constructed because of lack of funds (Jack Blackwell, Juneau district ranger, pers. comm., February 1985). The Highbush EA (LUD 4) considered recreational sportfishing opportunities on Highbush Lake, but the timber sale did not meet the tentative MAA direction to maintain a pristine fishing environment. The proposed MAA direction to restrict access to the lake to a trail was deleted, the visual quality objective for the lake was not met, logging roads were designed to come within 450 ft of the lake, and two clearcuts were prepared that would log to within 300 ft or less of the lake.

Both the Yakutat Salvage and Yakutat Blowdown #2 EAs addressed the effects of salvage logging within the 4-mi-wide Situk Wild and Scenic River Study Corridor. The final decision result was that two proposed roads paralleling the Situk would be deleted to protect fish and wildlife, no new roads would be constructed in the corridor area, and only 10 acres containing blowdown along the existing road would be logged within the study corridor. This decision carried the assumption that no degradation of the wild and scenic values of the river would occur.

Eleven sales we reviewed discussed the potential for increased access to sportfishing. Five sale documents concluded that no significant increase was likely because either the sale would not result in construction of road access to new fishing areas or the sale was in remote areas with low sport fish values. Three sales (Gilbert Bay, Highbush, and Toncan) indicated that an increase in sportfishing was likely but that it would not be detrimental to fish populations. The Cowee-Davis EA concluded that increased access and angling could be detrimental to the cutthroat trout population in Bessie Lake, and the South Wrangell EA concluded that increased sportfishing on Thoms Lake could be detrimental to the sockeye population. The Granite EA specified that the impact of angling on the resident trout population of Egg Lake should be monitored, but this monitoring requirement was subsequently deleted.

The Draft APC 86-90 Sale (Stikine and Chatham Area) proposes logging in three TLMP high-value watersheds and does not establish any apparent measures to provide for the esthetics of sportfishing. This contrasts sharply with the retention areas, visual extended rotations, and road closures developed for the LPK 84-89 Sale in the Ketchikan Area that were discussed previously. In particular, the FS preferred alternative for the APC 86-90 Sale would construct roads and clearcut along the lower portion of Mud Bay Creek and Mud Bay and along the hillside above Pavlof Lake. Logging in the Kadake drainage would be limited to two clearcuts in the headwaters, and the lower stream sections would have no new logging scheduled. Assigned VQOs would not be met in the Mud Bay and the Pavlof VCUs.

C. Effects of Preroading and Roading

Roading areas previously roadless and establishing new communities through the siting of logging camps can significantly change patterns of fish and wildlife use. Logging camps may be in operation for several years at a time and may be reactivated during each entry period if multiple entries to a watershed are planned. Some logging camps (e.g., Edna Bay) have become permanent settlements through state land selection and disposal to private ownership.

Roading and logging camps are generally considered an ancillary effect of timber harvest by the FS. That is, lay-out of the timber harvest units themselves and silvicultural and rotational planning often severely constrain transportation network, camp, and log transfer location to optimize logging costs. "Preroading" areas, however, has recently been accelerated (briefing paper from Michael Barton, regional forester, to the Alaska State Cabinet, 5/14/85) and mainline roads that serve administrative purposes have been built in lieu of spur roading into uneconomic stands to facilitate timber harvest (e.g., Kadashan drainage, Portage Bay-Kake road). Preroading occurs prior to timber harvest and was included in the TLMP as a means to subsidize the costs of access to marginal stands in order to maintain the 450 MMbf annual sale offering level from the Tongass NF (FS 1979). The proposed "Preliminary Activity Schedule" for the 1985-89 period (memorandum from Michael Barton, regional forester, to the Friend of the Tongass National Forest, 3/25/85) schedules 270 mi of preroading, with 75 mi in areas where no timber harvest activity is scheduled until after 1989, the end of the TLMP planning period. The impacts of preroading can be significant because of the increased access to formerly remote fish and wildlife populations and increased human activity and harvest.

In reallocating funds to accelerate preroading, the FS decided to reduce their capability to analyze the cumulative effects of alternative logging and transportation systems. The FS initially identified the need for an analysis to be included in 706(b) reporting and forest planning of alternative logging and transportation systems to provide (1) information for assessing the economic and physical feasibility of timber harvest, (2) a more specific integration of harvesting and roading plans, and (3) information to develop cost-effective uses of transportation-logging systems to harvest marginal stands. Procedures for Logging and Transportation System Analyses (LSTAs) were developed to provide alternative ways to access and harvest all CFL in various volume classes in specific areas (FS 1985b). These analyses would have also provided an efficient means to analyze and potentially mitigate the long-term transportation- and harvest-scheduling impacts of alternatives that maximized protection of high-value fish and wildlife habitat or harvest areas. However, the implementation of representative analyses and inclusion of the results in the 1985 706(b) Report were halted in order to reprogram funds into the preroading program (memorandum from John Sandor, regional forester, to the forest supervisors, 5/4/84).

Controlled access or road closures can mitigate the impacts of increasing human activities and harvests along road systems. However, physically blocking access is often impractical, expensive, or difficult to maintain in extensive remote areas. Harvest regulation in such areas would require a massive enforcement capability that the state is unlikely to ever possess. The change in accessibility of fish and game populations is, thus, difficult to reverse, and it should be a primary consideration in the provision of roaded areas, particularly well in advance of anticipated logging impacts.

One potential positive measure identified during the development of TLMP was the incorporation of local concerns to protect subsistence lifestyles when designing transportation plans (FS 1979). We could not determine to what degree local concerns were being incorporated into transportation plans at the project level, however.

VI. REVIEW OF MONITORING IMPLEMENTATIONS

A comprehensive monitoring program and a system to modify management practices accordingly are essential to implement effective management practices. Tiered NEPA reviews can provide sequential opportunities to develop management practices that are appropriate, specific, and based on current state-of-the-art resource management knowledge at each level of regional, management area, and project-level planning. Monitoring is also essential to identify poor management decisions and practices, improper implementation of planned activities, unforeseen events that may affect expected project outputs, and the need to change activities to prevent further adverse impacts and/or restoration of degraded habitat.

A. Requirements for Monitoring

This section briefly summarizes some requirements for monitoring actions on FS lands.

1. NEPA

Council on Environmental Quality regulations for implementing the NEPA specify that:

> Agencies may provide for monitoring to assure that their decisions are carried out and should do so in important cases. Mitigation (40 CFR 1505.2) and other conditions established in the environmental impact statement or during its review and committed as part of the decision shall be implemented by the lead agency or other appropriate consenting agency. The lead agency shall:
>
> (a) Include appropriate conditions in grants, permits or other approvals.
> (b) Condition funding of actions on mitigation.
> (c) Upon request, inform cooperating or commenting agencies on progress in carrying out mitigation measures which they have

proposed and which were adopted by the agency making the decision.

(d) Upon request, make available to the public the results of relevant monitoring (40 CFR 1505.3).

2. NFMA

The NFMA and associated regulations have further strengthened the role of monitoring as a normal procedure in the implementation of Forest plans. Salwasser (1984) has summarized these requirements as follows:

> Population trends of the management indicator species will be monitored and relationships to habitat changes determined (36 CFR 219.19).
>
> Personnel will cooperate with State fish and wildlife agencies to the extent practicable (36 CFR 219.19).
>
> Monitoring will relate to the minimum specific management requirements (36 CFR 219.27) for:
>
> (a) Resource protection: diversity of plant and animal communities, habitats for viable populations, habitats for management indicator species, and protection of critical habitat for threatened or endangered species;
>
> (b) Vegetative manipulation: practices have the desired effects on fish and wildlife habitat, and practices are practical and feasible;
>
> (c) Silvicultural practices: cultural treatments meet wildlife and fish standards and objectives, and timber harvest cuts meet wildlife and fish standards and objectives;
>
> (d) Even-aged management: openings located and shaped to meet wildlife and fish standards and objectives to the extent practicable;
>
> (e) "Riparian areas: management practices meet fish habitat standards and objectives; and
>
> (f) Diversity: management prescriptions meet diversity standards and objectives.

3. Other

Other FS documents specify project monitoring and evaluations including the TLMP, Part 2 (FS 1979: 3-6) and the ARG (FS 1983: 3-45 to 3-51). The TLMP specifies that timber management activities, fisheries enhancement activities, and wildlife habitat improvement activities will be monitored and monitoring will determine:

1) How well amenity related goals and objectives are being met, and how well the issues and concerns are being resolved,

2) whether effects are happening as predicted, and

3) how well policy standards and guidelines are being carried out.

B. Monitoring Implementation

Table 16 summarizes monitoring specified in timber sale EDs under the TLMP and whether or not the monitoring has been done. UNKNOWN refers to those items for which the status of the monitoring could not be determined. TOO EARLY refers to those items specified in EDs that aren't applicable because the sale either has not been sold or activities haven't progressed to the stage when the monitoring needs to be done. NOT YET refers to those items where monitoring is applicable but hasn't been done yet, although it could still be accomplished. NOT DONE refers to those items that it is apparent the FS will not monitor. This determination was derived from personal communications with FS personnel or reviews of FS memorandums. PARTIALLY refers to items where some monitoring has occurred but it is unclear if the intent of the specified monitoring has been fulfilled. Twenty (54%) of 37 timber sale EDs made no mention of monitoring relevant to fish and wildlife. We did not evaluate FS compliance with monitoring requirements associated with timber sales EDs finished prior to the TLMP. Much of the monitoring information for these sales should have been collected and analyzed during this time period (FY80-84) when these sales were active.

The Stikine Area has reviewed its monitoring procedure and developed three categories of monitoring (Stikine Area supplement to FS Handbook, 11/82, section 24.2, pp. 1-2). Category I is a "management requirement" and is funded as part of the project cost. This consists of monitoring that directly controls the decision or a management prescription that is part of the decision. Category II consists of activities that fit the definition of monitoring but are a part of established on-going programs such as management reviews and regeneration surveys. These will not be listed as monitoring in the EA/EIS. Category III is activities designed to resolve major and/or reoccurring issues or management concerns. These will be listed as "monitoring opportunities" and are not considered "management requirements." They will apparently be prioritized by staff but may not be funded or completed.

In the Stikine Area, monitoring tied to meeting a timber harvest target will probably be done, whereas monitoring concerning other resources that are not directly linked to

Table 16. Summary of Monitoring Specified in Timber Sale EDs

Source: TLMP EIS Part II (FS 1979)

1) MA S35 (Thomas Bay) Wildlife studies in progress will aid in development of long-range plan for future management. NOT YET. Studies are completed and a wildlife plan has been proposed that identifies retention areas and needs, mitigation measures, and full rotation harvest and logging schedule. These recommendations have not been incorporated into a long-range plan for future management of the area.

2) MA K11 (Heceta). Special study to determine why deer population has remained so good on Heceta and provide directions for managing deer in other areas. NOT YET.

3) MA K29 and K30 (Cleveland). Do mountain goat study in cooperation with ADF&G. YES. FS provided partial funding and support for goat studies by ADF&G and FSL. Research results are emerging from these studies that should aid in development and evaluation of timber sales planned for the Cleveland Peninsula.

Source: ALP 81-86 EIS (FS 1981)

4) Test of skyline to meet best management practices on unstable soil. NOT YET. Although the unit has been laid out, no mechanism exists to require ALP to conduct the test, given the currently uneconomic conditions, so that results will be available to plan future sales.

5) Monitoring of instream activities that influence fish habitat. PARTIALLY. The bridge installation on Port Camden Creek was monitored in relation to intragravel sediment levels using McNeil sampling.

6) Long-term effects of logging on alluvial fans and floodplains. NOT YET. One inconclusive study was completed on the effects of logging on the Indian River floodplain. No studies concerning long-term effects of logging on alluvial fans have been initiated.

7) Interagency fisheries research program to monitor three streams to protect and improve freshwater and estuarine habitat. NOT YET. An interagency research program was prepared by ADF&G, FS, and NMFS, and study areas were set up. However, unit layout was not designed to provide a basis to test hypothesis. The area has not yet been logged.

8) Postdevelopment changes in physical aspects of fish habitat. TOO EARLY. Most units have not yet been logged.

(continued)

Table 16 (continued).

9) Hunter success records and animal mortality counts before, during, and after timber harvesting. NOT DONE. The harvest data prior to logging have not been collected, and there is no apparent effort by the FS to gather these data, and compile them in a meaningful manner to address the monitoring need.

10) Effectiveness of leave strips and susceptibility to blowdown. TOO EARLY. The Chatham Area is planning to monitor the leave strips.

11) Comparison of animal use of clearcut units of various sizes, shapes, aspects, and geological locations. TOO EARLY. (See comment 8).

12) Four clearcut units on Finger Creek designed to study relationship between blowdown and unit design. NOT YET. The units have not been logged.

13) Monitoring plans for all proposed landscape alterations. UNKNOWN. We found no indication of such monitoring plans in the Stikine or Chatham Areas.

14) Modify and intensify monitoring of Kadashan as a barometer watershed to evaluate the effects of pre-roading. TOO EARLY. A monitoring program is on-going, but no results are available on the effects. The road has not been completed due to a legal injunction.

Source: LPK 84-89 EIS and revised EA

14) Review of carryover units from previous sales by district ranger to see if they meet standards and guidelines applicable to 84-89. QUESTIONABLE. Apparently the district rangers did review these units, but the Ketchikan Area could not provide written documentation of this review and what changes, if any, were made. The carryover units were apparently not evaluated in the 84-89 EDs with regard to clearcuts over 100 acres, "new" harvesting in Stream Habitat Units, "new" harvesting in visual extended rotation areas, or harvesting in designated wildlife retention areas. Impacts of carryover units are assumed to be previous logging impacts with regard to SHUs and visual areas. Eleven carryover units were located in wildlife retention areas shown in the EIS. (See retention discussion in Wildlife section.)

15) Assess relative population and habitat suitability of deer by establishing and reading deer winter range pellet-group and browse transects. YES. This is scheduled to start in 1985 in cooperation with ADF&G.

16) Evaluate 10-20% of all fisheries prescription for their effectiveness. TOO EARLY. Sale is just starting.

(continued)

Table 16 (continued).

17) Assess effectiveness of prescribed mitigation for:
    a) slash disposal and PCT. YES. Monitoring plans have been developed and are underway.
    b) girdling, snag and whip retention - NO. Apparently these are not being prescribed in the sale layouts, and monitoring plans have not been developed.

Source: East Carrol Inlet Management Plan EA

18) Monitoring program to determine effects of water quality on streamside cutting of temperature-sensitive streams (required stipulation of state consistency review). YES. Referred to forestwide plan currently underway, which monitors selected temperature-sensitive streams. This monitoring is expected to continue for several more years.

19) Establish deer winter range pellet-group and browse transect to be read annually. YES. Scheduled to start April 1985.

20) Establish deer winter range snow transect. UNKNOWN.

21) Field review of slash disposal, snag and whip tree retention, PCT, and girdling prescribed mitigation measures. TOO EARLY. Layouts just starting. Apparently there are no snag and whip retention measures being implemented in unit layouts.

22) Evaluate effectiveness of 10-20% of all fisheries prescriptions. TOO EARLY.

23) Evaluate sensitivity of fisheries surveys annually. UNKNOWN.

24) Evaluate habitat enhancement and rehabilitation project successes with escapement and juvenile estimates one to five years after projects. TOO EARLY.

Source: Suemez EA

25) A forestwide monitoring effort will check the assumption that deer populations (numbers?) are proportional to winter habitat. NOT DONE.

26) Pellet, browse utilization, and range conditions transects to evaluate population trends and habitat. YES. (In progress.)

27) Snow depth transects to determine usable winter range. YES. (In progress.)

(continued)

Table 16 (continued).

<u>Source</u>: South Wrangell EA

28) Monitor for landslides - <u>TOO EARLY</u>.

29) Install thermograph on Thomas Creek and monitor at least one year before timber harvest and periodically after sale closure. <u>UNKNOWN</u>. Tentatively approved for monitoring; however sale has not sold.

30) Spawning gravel sediment monitoring on Fools Creek. <u>YES</u>. Monitored with respect to road construction. Write-up of results in progress.

31) An IDT review of compliance with plan and applicable direction per cooperative agreement with ADEC will be done before close-out of the project. <u>TOO EARLY</u>.

<u>Source</u>: Granite EA

32) Moniter partial cut on floodplain to determine effect on streambank stability and regeneration. <u>IN PROGRESS</u>.

33) Monitor at least five units with high slide potential to determine if mitigation measures are effective. <u>IN PROGRESS</u>.

34) Monitor resident trout population in Egg Lake to determine if population declines with increased angling pressure. <u>NOT DONE</u>.

35) Install portable thermographs upstream and downstream from Units 12 and 14, and monitor stream temperatures June 15 to August 20, prior to and through timber harvesting. <u>YES</u>.

36) Monitor if wildlife continue to use the travel corridor left adjacent to six units. <u>NOT DONE</u>.

37) Check that buffer strip along Unit 15 is adequate to maintain continued nesting of waterfowl. <u>NOT DONE</u>.

38) Monitor if there are significant differences in deer use between Unit 17 and proposed leave area. <u>NOT DONE</u>.

39) Check that buffer along Log Jam Creek adequately provides a visual and acoustical barrier and preserves the use of the existing wildlife corridor. <u>NOT DONE</u>.

40) Check that wildlife continue to use existing ponds as a result of the leave areas. <u>NOT DONE</u>.

41) Establish four deer browse and pellet-group transects. <u>NOT DONE</u>.

42) Evaluate deer hunting success and effort before and after timber harvesting. <u>NOT DONE</u>.

(continued)

Table 16 (continued).

Source: Sokolof EA

43) Determine correlation between snow depth and deer use of cutover and old-growth areas. NOT DONE.

44) Establish permanent browse/pellet-group transects to determine temporal and spatial use of vegetation by deer. NOT DONE.

45) Colormark about 20 deer to determine population structure and mobility. NOT DONE.

46) Determine effect of precommercial thinning on deer populations. TOO EARLY.

Source: Cabin EA

47) Monitor postlogging wildlife use of residual hemlock trees left in clumps in clearcuts. TOO EARLY.

48) Effect of postsale traffic on deer movements on roads constructed through deer winter range on state lands along Frederick Sound. TOO EARLY. Presale monitoring developed to evaluate postsale effects has not been done, indicating that this project may not be completed.

Source: PRD Small Sales EA

49) Monitor partial cut at Thomas Bay for snow interception capabilities, vegetative growth, moose use, and blowdown risk. IN PROGRESS. Project was in progress at time the document was prepared and will apparently continue.

Source: Totem EA

50) Implement temperature sensitivity study on tributaries of Castle River and Tunehean Creek where significant timber harvest occurs. TOO EARLY. FS is on record as saying this will only be done if extra funds are available.

51) Take gravel samples on upper Tunehean Creek before and after logging and road construction to determine if detectable changes occur in fine sediments. TOO EARLY.

52) Study soil disturbance and landslides for five years following logging. TOO EARLY.

(continued)

Table 16 (continued).

Source: Port Houghton EA

53) Monitor red-tailed hawk and Bald Eagle nests annually to determine effects of management activities. TOO EARLY.

54) Check run-off from log storage to see if suspended sediments are reaching fish habitat. TOO EARLY.

Source: Corner Bay EA

55) Monitor harvest units during and after logging to determine need to implement IDT mitigation measures for resource rehabilitation. TOO EARLY.

56) Monitor four units during and after logging to determine need to clear 50-ft-wide deer travel lane. Coordinate monitoring with ADF&G. TOO EARLY.

Source: Yakutat Salvage Sale EA

57) On-site inspections to evaluate harvesting impacts on wildlife. Reviews would assess compliance with mitigation measures and adequacy of wildlife retention areas. Some evaluation will be conducted in cooperation with ADF&G. IN PROGRESS. Apparently personal evaluations by wildlife specialists have occurred, although the JRD could not provide write-ups documenting this. There are no wildlife retention areas in the sale. Division of Game (ADF&G) has not yet been involved in any on-site inspections of the sale (Bruce Dinneford, ADF&G game biologist, pers. comm., April 1985).

Source: Couverden EA and Yakutat Blowdown #2

58) Monitoring will be limited to visits to the area by wildlife biologists. TOO EARLY.

Source: Gilbert Bay EIS

59) Review by hydrologist of timber harvest aspects pertinent to water quality prior to Sept. 1 of each field season. Corrective actions, if needed, will be taken, if possible, by Oct. 1 of each year. TOO EARLY. Sale didn't sell.

60) Monitor blowdown damage. TOO EARLY.

61) On-site inspections by wildlife biologists. TOO EARLY.

62) On-site inspections to evaluate bridge and culvert installations. TOO EARLY.

(continued)

Table 16 (continued).

Source: Cowee-Davis EA

63) Monitor eagle nest adjacent to Sawmill Creek Road. TOO EARLY.

Source: South Windham EA

64) Check drainage of log storage area during periods of heavy rains. TOO EARLY.

65) Humpback whale use in project area will be monitored in cooperation with NFMS. Observations of whale numbers, seasons of use, and activities will be reported to NMFS as available. QUESTIONABLE. The sale hasn't sold yet. However, it appears the FS has no procedure established for monitoring whales and reporting whale sightings to NFMS.

66) Monitor small population of goats to assure adequate winter range is available for them. TOO EARLY.

67) Monitor sale area annually for disturbances effecting site productivity or sedimentation. TOO EARLY.

68) Fish biologist will check road construction and maintenance at stream crossings. TOO EARLY.

69) Fish biologists will check timber layout in areas near streams. UNKNOWN.

carrying out a timber sale may not be done. An example of the latter is a timber sale that has already been approved for cutting, and the IDT recommends monitoring the impacts of the cutting on an important temperature-sensitive stream. Because the cutting has already been approved, this is a "Category III" monitoring, and no real effort may be made to see that it gets done (memorandum from Robert Lynn, Stikine Area forest supervisor, to Dorothy Douglas, regional coordinator, Division of Governmental Coordination, State of Alaska, 8/27/84).

Other monitoring projects not connected with the timber sales EDs or the TLMP MAA described above have been undertaken by the FS. These include monitoring of LTFs, monitoring of habitat mitigation and enhancement work, and administrative studies. A brief list of many of these studies is given below.

Ketchikan Area. The Ketchikan Area is involved with sediment monitoring in the Blossom/Wilson River systems, with two different studies dealing with LWD, and with a study directed at coho salmon habitat selection. The FS is partially funding an ADF&G research program assessing the wolf-deer-habitat relationship in southeastern Alaska. They are also starting an administrative study with the University of Idaho determining the effects of PCT and slash treatments on deer movements and use of clearcuts and deer activity patterns and forage selection in recent clearcuts and shrub/sapling stands. Previous administrative studies have evaluated the effect of clearcutting on mink and otter use of shoreline forests and habitat use by breeding birds in clearcuts and old-growth forests. Other studies are experimenting with developing models of habitat selection and use and timber harvest impact analysis. Much of the Ketchikan Area's present studies apparently center around participation in monitoring various thinning projects as part of the Second Growth Management Program.

Stikine Area. The Stikine Area has conducted and/or funded a variety of studies during FY80-84, including studies on black bear seasonal movements, habitat selection, and denning requirements; trumpeter swan wintering ecology at Blind Slough; inland wetland vegetation and use by beaver and muskrat; osprey nesting; eulachon spawning habitat characteristics and eagle concentration patterns on the Stikine River; short-eared owl and waterfowl food habit studies; blue grouse breeding habitat studies; understory response and summer bird use of burned and unburned clearcuts; moose telemetry studies on the Stikine River; success of browse plantings for wildlife; response of deer and vegetation to PCT on Level I; resident fish pass studies; Blind Slough energy budget monitoring; Port Camden monitoring for fish channels; coho salmon production in a gravel borrow pit on the East Bradfield River; deer exclosure constructions in DWR on Level and Mitkof islands; sediment studies on three bridge replacement projects; cooperative work with the National Marine Fisheries Service on "Kake Burn" Creek and buffer strip studies; and LTF monitoring for bark accumulation on at least five sites.

Chatham Area. The Chatham Area has attempted several different habitat improvement projects described as second growth management techniques, including construction of nest boxes for cavity-nesters, construction of nest platforms for goose nesting, browse plantings for moose, slash burning, the provision of cover for fish in lakes by felling conifers, and thinning of travel corridors through clearcuts with dense slash accumulations. Habitat improvement projects are generally monitored to determine their success or failure. Chatham Area staff also cooperated on a river otter and a grizzly bear study.

A preharvest survey of the Kennel Creek area was conducted to monitor the effects of partial-cutting harvest methods on deer use; however, deer use was extremely low "due to past timber harvesting and removal of critical deer winter range" (Hanley n.d.). The partial cut was never conducted because of its uneconomical nature.

In 1981, the Hoonah Ranger District of Chatham developed a fisheries monitoring program. A report was submitted in 1982, but the fisheries specialist was transferred and no subsequent reports were prepared.

In 1982, Chatham Area also developed a Bald Eagle nest-monitoring program in response to a permit stipulation following a waiver to construct a road that encroached within 330 ft of three Bald Eagle nests. The monitoring plan requires observing and reporting annually to the U.S. Fish and Wildlife Service (USFWS) on the effects of some 30 similar encroachments in the Chatham Area. The Sitka RD maintains data on each nest on file but has not reported to the USFWS to date.

Some of the above studies were conducted cooperatively with the ADF&G, universities, or other researchers. Some studies are on-going. Results range from rather comprehensive analyses to very limited or inconclusive findings.

The need that emerges from a review of monitoring studies and programs is the development of a procedure to feed the information gathered back into the management process. It is unclear whether monitoring findings are being incorporated into harvest scheduling and long-range forest planning. For sales planned but carried over into subsequent planning periods, no mechanism exists to ensure reevaluation and modifications based on then-current knowledge. In some cases, it appears that wildlife findings are not being used if they affect the normal practice of clearcutting without regard to retention and long-range impact analysis and planning. For example, the Thomas Bay wildlife studies have not been incorporated into long-range timber planning as required by the TLMP (FS 1979), and the FS is on record as stating that moose may not need winter range (memorandum from William Gee, Chatham Area forest supervisor, to Jay Hogan, associate director, Division of Governmental Coordination, State of Alaska, 9/21/83), despite the studies' findings to the contrary. In fact, no long-range planning or retention has been implemented by the FS for moose through a project-level timber sale ED to our knowledge (Table 3).

The funding and program support for monitoring appears to be inadequate. In general, "hard" targets (i.e., targets to which staff are held accountable) are apparently not assigned to monitoring tasks. Thus, as funding and specialist staff are reduced, as has been the consistent trend in two Forest Areas since 1979, and which may be a result of future federal budget reductions, the ability to conduct monitoring may be foregone. A review of the annual reports of the ranger districts and the Fish and Wildlife Program demonstrates a clear trend towards increased involvement in presale planning, reduced field reviews either prior to preparation of NEPA documentation or during unit layout, and the absence of a comprehensive postsale monitoring program. Remote sensing-type inventories and modelling of ecosystem interactions are being supported despite the identification of substantial data gaps, which render such tools largely inaccurate for either large-scale or project-scale applications. At the same time, the NEPA documentation displays a trend toward prescribing large-scale application of mitigative measures with no demonstrated effectiveness and deferring prescriptive habitat management to site-specific field reviews.

The site-specific field reviews by resource specialists are described as the mechanism by which appropriate mitigative measures will be applied and refined. However, shrinking specialist program budgets and staff make it difficult, if not impossible, to accomplish this level of review in the face of increasing demands to participate in planning the harvest at a rate of 450 MMbf/year, much less develop and accomplish an effective postsale monitoring program.

VII. CONCLUSIONS

This section summarizes our findings regarding measures the FS has implemented or are on public record as intending to implement to protect fish and wildlife habitat on the Tongass NF under the TLMP and the ANILCA.

1. The following measures have been implemented to date by the FS on a widespread basis throughout the Tongass:
   - Location and protection of eagle nests
   - Fisheries inventory and design of road standards to ensure fish passage
   - Consideration of soil erosion mitigation measures described in SAAG
   - Deferral of logging shoreline timber

- Development of fish habitat enhancement projects and participation in Regional Salmon Team review processes for fisheries enhancement projects and subsequent implementation
- Use of primary and secondary stream protection
- Considerations of fish and wildlife protection in log dump and logging camp locations

There is concern that some of these habitat measures may be reduced to increase the economics of timber harvest and to maintain the TLMP harvest schedule, and/or as a result of reductions in federal funding of needed specialists to implement the program. A final assessment of the use and effectiveness of these measures cannot be made until the projects have been administered and subsequent activities for the areas planned.

2. The following measures have been implemented to some degree in most areas but are not consistently applied, and some of these measures may be reduced or eliminated by subsequent action:

   - Full protection of the biological production of all fish streams (Cases were found where detrimental effects to fish production are likely or the effects of logging on fish habitat are unclear.)
   - Consideration of measures to maintain stream temperatures in temperature-sensitive streams in planning streambank harvest and design and implementation of streambank buffers along fish streams (Much clearcutting to the streambank still occurs on fish streams, however.)
   - Design and maintenance of wildlife travel corridors and leave strips between clearcuts (These measures appear especially vulnerable to loss as a result of subsequent timber harvest.)
   - Restriction on logging activities for fish protection
   - Accountable retention of high-value wildlife areas (The Ketchikan Area has made a considerable effort to identify retention, whereas the Stikine Area has done a limited job of this. The use of retention is virtually absent in Chatham Timber Sale EDs. The accounting process for retention is unclear in the Stikine Area.)
   - Deferral of logging in high-value wildlife and fish habitat
   - Deferral of logging in high-value sportfishing areas and use of retention, extended rotations, and road closures to protect these areas (Only the Ketchikan Area has made any substantial use of retention, extended rotations, and road closures to protect sportfishing areas.)
   - Identification and protection of subsistence uses (FS EDs consistently state that project timber

sales are not affecting subsistence; however, the ADF&G has frequently disagreed. The FS EDs have not addressed the cumulative effects of logging on subsistence.)

3. The following measures have not been implemented to any significant degree in the Tongass NF, except where indicated:

   - Consideration and use of harvest systems other than clearcutting during project-level timber sale planning
   - Retention of stream habitat for fisheries (The Ketchikan Area has identified retention of streamside habitat to protect fish and wildlife values to a limited extent.)
   - Use of extended rotations as assumed in the adopted TLMP harvest schedule (FS 1979). (The Ketchikan Area has done this for the LPK 84-89 Sale.)
   - Road closures (Road closures have been specified in only a few instances and are apparently not usually considered in timber sale planning and environmental analysis.)
   - Protection of soils on oversteepened slopes through withdrawal of CFL from the timber harvest base as assumed in the adopted TLMP harvest schedule (FS 1979).
   - Implementation of NFMA planning requirements, such as determining viable populations levels, managing for diversity, selection of management indicator species, and monitoring the impacts of timber harvesting on population trends of management indicator species
   - Snag management and manipulation of timber harvest methods to retain snags and clumps of residual trees
   - Prescriptions to manage logging and thinning slash (The Ketchikan Area is currently experimenting with methods of treating PCT slash. The results of such treatments are not available.)
   - Stipulations of future entries for timber harvest and harvest scheduling over the life of the rotation within a project area (The Ketchikan Area has made progress in this area.)
   - Development of FHMUs and WHMUs with IDT-developed prescriptive plans as required by the SAAG
   - Consideration and protection of wetlands and floodplains per presidential Executive Orders (A regionwide classification of wetlands and floodplains appears to be a necessary step in carrying out the intent of the presidential Executive Orders.)
   - Valid cost-effective wildlife habitat enhancement projects
   - Timing restrictions on logging activities in order to mitigate impacts to wildlife habitat

- Analysis of the cumulative effects of timber harvesting on fish and wildlife over the entire rotation (The Ketchikan Area has made a considerable effort to address the amount of old growth left at the end of the rotation within project areas.)
- Management Area Analysis as a second tier to the TLMP through the NEPA review process (This is being done only on the Ketchikan Area.)
- Whole drainage retention of certain LUD 3 and LUD 4 areas with high value habitat and high human use; concentration of harvest into areas of low-value habitat and use
- Long-term scheduling of timber harvests to sustain clearcut areas in early regrowth stages. (This action, in conjunction with old-growth retention, might reduce detrimental impacts to a variety of fish and wildlife species.)

4. The following conclusions were drawn regarding the status of second-growth management for fish and wildlife:

   - Considerable effort and funds have been spent on second-growth habitat management for fish and wildlife, despite the fact that such measures are largely experimental and have unknown results. Precommercial thinning and prescribed browse planting are the most common second-growth measures being proposed and implemented. Procedures for manipulation of large woody debris sources to streams and management of woody debris in streams within clearcuts are likely to be developed in the future in response to research findings

   - FS timber sale EDs often did not portray the results of second-growth habitat management as uncertain and did not document the required costs needed to implement the proposed work. FS documents often suggested that thinning of clearcuts was a proven enhancement or mitigation measure, in lieu of retention of old-growth acreage, to maintain habitat values

   - Methods to mitigate habitat losses to wildlife species that utilize old growth have not been demonstrated, and the nonrenewability of old growth under a 100-year harvest rotation is usually not addressed as a management issue during project-level planning. Many protective measures built into the TLMP have not been widely applied on the Tongass (e.g., designation of retention of normally operable CFL, extended rotations, protection of unregulated CFL), and the TLMP harvest schedule in itself will result in substantial habitat degradation to many wildlife species (FS 1979)

5. Current research findings (ADF&G in review a) indicate that the successful implementation of fisheries prescriptions, such as retention, buffer strips, timing clauses, adequate fish-pass structures, withdrawal of timber harvesting on oversteepened slopes, and careful harvest scheduling over the life of the rotation, in keeping with these research findings, can probably effectively reduce many impacts to fish production during logging activities. Adequate training and funding of FS fisheries specialists is essential for adequate implementation. Measures in the TLMP, such as retention and extended rotations, together with other prescriptions could be emphasized around key areas to help reduce impacts to the esthetics of sportfishing. These measures would reduce the ability to protect other habitats, however, given the amount of retention provided in the TLMP.

6. The fulfillment of monitoring commitments in NEPA documents on the Tongass NF has been uneven, and a number of commitments to monitoring have not been met. No procedure presently appears to exist to ensure that the results of monitoring or applied research on management practices will be used to modify planning of future or ongoing sales.

   We found no evidence that standardized, comprehensive project-level monitoring and reporting is occurring. Successful and effective monitoring will require a commitment to its importance, development of a system that includes timber sale planning and implementation programs responsive to monitoring results, and adequate funding. Without adequate funding of long-term field-level reviews throughout the implementation of the sale, proposed monitoring will largely be paper exercises without benefit of validation.

The above findings are based on review and detailed analysis of environmental documents for 37 timber sales prepared since the TLMP, plus review of available information on regional and area programs for fish and wildlife. The timber sales we analyzed represent most of the "new" timber volume prepared on the Tongass National Forest under the TLMP up to the spring of 1985. Timber sale environmental documents developed prior to the TLMP and most of those being prepared at the time of this report were excluded from this study. Most of the sales analyzed had not been sold yet or were in the early stages of implementation. Consequently, review of on-the-ground fish and wildlife protection during timber sales prepared under the TLMP was limited in this report. We feel on-the-ground review is a necessary area for study in order to make a complete determination of the degree to which fish and wildlife protection measures are implemented on the Tongass.

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a/ FS timber sale environmental documents, including decision notices, referenced throughout this report, can be obtained by contacting the FS area where the timber sale was scheduled. See Table 1 for the location of the FS timber sales by area.

Appendix A. Sample Evaluation Form

TIMBER EVALUATION FORM

A. General Data

Sale name ______________________________
Area(s) ______________________________
District(s) ______________________________
LUD(s) ______________________________
VCU number(s) ______________________________
Entry (1st, 2nd, etc) ______________________
Volume ______________________________
Year Scheduled ______________________________
Date of ROD or Decision Notice ____________

B. Subsistence

1. What impact does the sale have on subsistence as determined by the subsistence determination? ______________________________
____
____

2. Was subsistence an identified concern? ________________ Did it influence the development of the alternatives? ________ the selection of the preferred alternative?________ If yes to any of the above, please describe. ______________________
____
____

3. What subsistence uses were identified for area? (include state correspondence regarding subsistence uses). ________________
____
____
____

4. If subsistence was an identified concern, what mitigation measures were used to reduce the impacts on subsistence? _____
____
____
____

C. General Habitat Management Concerns

1. What percent (and acres) of the sale volume is 8-20 mbf/acre? ______________________________ What percent (and acres) of the sale volume is from the "technologically marginal" CFL? ______________________________

2. What harvest cutting methods other than even-age management are prescribed for fish or wildlife protection? ______________
____
____

3. What stipulations are put on future timber harvest entries? Is multiple entry or life of the rotation planning described in the ED? ______________________________

4. How many clearcuts exceed the 100-acre size limit? Show size of clearcuts. ______________________________
Did subsequent blowdown or layout changes enlarge clearcuts beyond 100+ acres? Describe. ______________________________

5. Are the TLMP inventories evaluated and considered accurate for timber and wildlife habitat? Discuss. ______________________________

6. Are 705(a) funds used to mitigate impacts on fish and wildlife habitat? _______ Discuss any use of 705(a) funds to benefit fish and wildlife that is identified in the ED. ______________________________

7. Does the ED discuss the cumulative impacts of timber harvesting on fish and wildlife habitat? ________ Are impacts of cutting prior to the sale identified, discussed, and evaluated in the ED? ______________________________

8. How is carry over volume dealt with in ED for the large sales?
____

9. Is protection of wetland and floodplain habitat values addressed? ______________________________

10. What measures are described to maintain water quality of streams? ______________________________

D. Wildlife

1. Is operable CFL placed in retention specifically for wildlife? ______ Is it mapped in the ED (Environmental Document)? ______ If no, how is it documented? ______

   How many acres (total, CFL, operable CFL) are retained? ______

   What is the average size of the retention areas? ______

   What species of wildlife is the retention specifically set aside for (e.g. deer, general old-growth users, cavity nesters)? ______

   What portion (percentage, acres) of the retention is in different volume classes? ______

   What are the habitat characteristics and values of the areas retained (e.g. carrying capacity)? ______

   What criteria(s) were used to select the retention area(s)? ______

   How is the retention dispersed in relation to the study area and other critical wildlife habitat within the sale area? (attach maps if appropriate) ______

   What management activities are allowed in retention areas and what are specifically excluded? ______

   Are the retention areas accessed by roads? ______

   How is retention defined? ______

   What is specified in the EA regarding the permanency of retention areas? ______

What habitat management measures besides preservation are described in the EA for retention areas? ____________________

____

____

____

Other relevant information ____________________

____

____

2. Were WHMU/EHMU for wildlife needs developed in the ED? ______ Are these areas identical to retention areas in Question 1? ______ (If yes, go on the Question 3). What % of WHMU/EHMU are specially retained for wildlife? ____________________

____

Are the WHMU/EHMU mapped in the environmental document? If no, how are they documented? ____________________

____

What are the habitat characteristic(s), wildlife value(s), and selection criteria(s) for WHMU/EHMU? ____________________

____

____

____

How are the WHMU/EHMU located and dispersed in relation to the study area and other critical wildlife habitat within the study area? ____________________

____

____

What prescriptions are applied to WHMU? EHMU? ____________________

____

____

____

Are WHMU/EHMU accessed by roads? ________

Other relevent information (include definitions) ____________

____

____

____

3. What are the impacts of the sale on the wildlife resource?

____

____

____

What is the relative rank of the selected alternative with regard to wildlife impacts compared to other action alternatives? ____________________

____

4. Is timber harvested on islands less than 50 acres? ______ If yes, describe. If no, are islands less than 50 acres counted as retention acres? ______________________________

5. Discuss the use of the following items to manage and protect wildlife:

buffer strips ______________________________

scheduling future harvest and life of sale planning __________

indicator species ______________________________

road closures ______________________________

timing clauses ______________________________

travel corridors ______________________________

viable population levels ______________________________

desired levels ______________________________

diversity (include definition) ______________________________

carrying capacity ______________________________

R&E species ______________________________

management of bear-human interactions ______________________________

other measures identified (exclude second-growth management)

6. Is the effect of increased disturbance on wildlife addressed? ______ Is the effect of increased access on consumptive and non-consumptive wildlife uses discussed? ______ If yes, discuss. ____

7. How are riparian areas defined, managed, and protected for wildlife in this sale? ____

8. Are plans implemented to insure that early successional regrowth stages are available throughout the timber rotation for species utilizing such habitats? ______ If yes, what species are specifically being managed for? ____

9. Are 100 meter buffers maintained around all eagle nest trees? ______ If no, what is the extent of impact to eagle nest trees? ____

   Is habitat retained to assure the desired quality and quantity of eagle habitat, nest trees, and perch trees? ____ How many miles of shoreline are scheduled for clearcutting? __________ Placed in retention? __________

10. Are opportunities to view and photograph wildlife identified? ______ If yes, discuss. ____

11. Discussion: what is specifically done to manage for snags? ____

12. What measures are proposed to mitigate against losses of wildlife habitat? ____

13. Other relevent information (thinning; treatment of blowdown). ____

E. Fish

1. What are the described impacts of the sale on the fisheries resource? ____
____
____
________________________ What was the relative rank of the selected alternative with regard to its impact on fisheries compared to other action alternatives? ____________________
____
____

2. Is retention defined and used for fisheries? ______ If yes, discuss ____
____

3. Did the IDT develop FHMUs/EHMUs for fisheries protection in the ED? ______ If yes, describe ____________________
____
____
Are the FHMUs/EHMUs mapped in the ED? ______ (If no, how are they identified and documented? ____________________
____
____

4. Discuss the use of the following items to manage and protect fisheries:

buffer strips ____
____

scheduling future harvest and life of sale planning __________
____

debris mgmt ____
____

timing clauses ____
____

indicator species ____
____

culvert and bridge standards ____________________
____

hot and cold temperature sensitive guidelines ______________
____

other measures identified ____________________
____
____

5. How are riparian and floodplain areas defined, managed and protected for fisheries in this sale? ______________________

6. Does the sale address the esthetics of sport fishing? _______
If yes, discuss measures implemented and for what streams?

7. Is the effect of increased access on sport fishing evaluated? _______ If yes, explain ______________________

8. Other relevant comments ______________________

F. Second Growth Management

1. Describe in detail every type of second growth management being implemented to meet wildlife habitat needs. Do not include standard silviculture treatments for timber production unless such treatments are specifically related to wildlife habitat needs. If appropriate, list the results to date.

G. Soils

1. Are slopes 75%+ and slopes 66 to 75% with "severe" soil hazards excluded from logging? ________ shown on maps in the environmental document? ________ If no, how are the acres inventoried and documented? ______________________________

____

How many acres of the above severe soils are harvested? ______ ________ How many of these acres are in drainages with fish streams? ______________

2. What soil protection measures are used on slopes 35 to 75%?

____

____

____

on braided stream bottoms? ______________________________

____

on other riparian areas? ______________________________

____

3. What other measures are used to minimize erosion? ___________

____

____

____

H. Visual

1. Are TLMP inventoried VQO's for retention and partial retention met? ______________________________

2. Are areas with extended rotations for visuals identified in the environmental document? _______ If yes, discuss acres identified, prescriptions, etc. in the EA (EIS). ___________

____

____

3. Do areas with extended rotations for visuals overlap with areas to be managed as wildlife habitat? ______________ Is there a conflict? ______________________________

I. <u>Monitoring</u>

1. Describe every item relevant to fish and wildlife that is identified for monitoring. Be as specific as possible. Has the item been monitored? _______ (UA = Unable to tell, TE - Too early to start monitoring plans)

J. Resolution of Fish and Wildlife Issues

1. Did selection of a preferred alternative maximize protection of fish and wildlife habitat? _____ If not, what other factors were overriding? ______________________________

____

If economics were overriding, describe the trade-off. _______

____

____

____

2. List every important fish and wildlife issue, concern, and opportunity raised by DFG or the state through the scoping process and subsequent review. As a minimum, use ICO's listed in the document, State response to scoping and State review of DEIS or draft EA to identify issues. Items of a minor technical matter (such as clarification of wording) or comments that are clearly erroneous in terms of generally accepted biological data (clearcutting may provide opportunities to improve winter range for deer) can be ignored. List how each concern was resolved (e.g. not acknowledged, acknowledged but rejected, etc.) Include harvesting of low volume timber as an issue if it was raised. Were TLMP prescriptions summarized in TLMP EIS, Part II met? (Discuss each one).

Human Use of Pacific Herring, Shellfish, and Selected Wildlife Species in Southeast Alaska With an Overview of Access for Noncommercial Harvests of Fish and Wildlife

By Joseph G. Doerr and Marilyn J. Sigman

Technical Report 86-5

Alaska Department of Fish and Game
Division of Habitat
Juneau
June 1986

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The numerous drafts of the manuscript were typed by Thea L. Nelson, with some support from the Technical Support Unit of the Division of Habitat, Anchorage. The maps were prepared by Graphic Artist Gay E. Pulley.

INTRODUCTION

This report was prepared to summarize data on the human use of Pacific herring, Dungeness, Tanner, and king crabs, shrimp, abalone, scallops, geoduck clams, sea urchins, Sitka black-tailed deer, moose, black and brown bears, and furbearers, and to provide an overview of access for noncommercial harvests of fish and wildlife in the Southeast Region. The report was prepared as part of the Alaska Habitat Management Guide project and is divided into three sections: 1) human use of select wildlife species, 2) human use of Pacific herring and select shellfish species, and 3) an overview of access.

The first two sections are intended to complement the Alaska Habitat Management Guide reference maps for the Southeast Region, volumes 1 and 2. Readers should refer to these reference volumes for more site-specific information. The human use accounts in this report, together with the reference-map volumes, provide a detailed description of available known harvest information of the selected species and are intended to be of value for both regional and local planning.

The third section is intended to provide a description of current access patterns in the region, to summarize existing sources of quantitative information on the modes of access used to harvest particular species, and to summarize information on the access patterns of residents of individual communities. It is designed to complement the human use accounts and reference maps described above and the more detailed information that will result from analysis of the hunter economic surveys described below.

This report is intended to be used in conjunction with other Alaska Habitat Management Guide reports, in particular, the report entitled Economic Overview of Fish and Wildlife, volumes 1 and 2. Volume 1 of that report contains a Southeast Alaska section describing the economic value of the Southeast Alaska Pacific herring, shellfish, halibut, sablefish, and salmon fisheries. It also contains sections describing the economic overview of sportfishing, both statewide and regionally. Volume 2 contains Southeast Alaska sections with economic overviews of furbearer harvest, subsistence gathering, and nonconsumptive uses of fish and wildlife. In addition, volume 2 contains a statewide economic overview of hunting with regional analyses of permit hunts. These volumes should be consulted for information on the economic importance of human uses of fish and wildlife in the region.

Three Southeast Alaska hunting economic surveys were initiated as part of the Alaska Habitat Management Guide project, in cooperation with the Division of Game. Three groups of people who hunted in Southeast Alaska were sent questionnaires concerning the characteristics of areas they chose for hunting and the amount of money they spent hunting: 1) mountain goat hunters in 1984; 2) moose hunters in 1984; and 3) Sitka black-tailed deer hunters in 1985. The results of these surveys were in the process of being analyzed as this report was finalized. It is anticipated that the economic surveys will yield further information relevant to the human use of deer, moose, and the mountain goats, to access patterns associated with hunting these species, and to the importance of hunting in the regional economy.

PART I. HUMAN USE OF SELECTED WILDLIFE SPECIES IN THE SOUTHEAST REGION

I. MANAGERIAL AUTHORITY

In 1925, the Alaska Game Commission was established by an act of Congress "to protect game animals, land furbearing animals, and birds in Alaska, and for other purposes." This was the beginning of formal wildlife management in Alaska. Concurrent with statehood in 1959, under authority of Article VIII of the State Constitution, the legislature established the Department of Fish and Game. The Division of Game and Board of Fish and Game were given jurisdiction over resident wildlife. In 1975, separate boards of game and fish were created by legislative act. Hunting of resident terrestrial wildlife is controlled under the Alaska Administrative Code and Title 16 Alaska Statutes. The hunting regulations are described each year in the ADF&G publication entitled Alaska Game Regulations and in permit hunt supplements.

II. BOUNDARIES

A. Game Management Units and Subunits

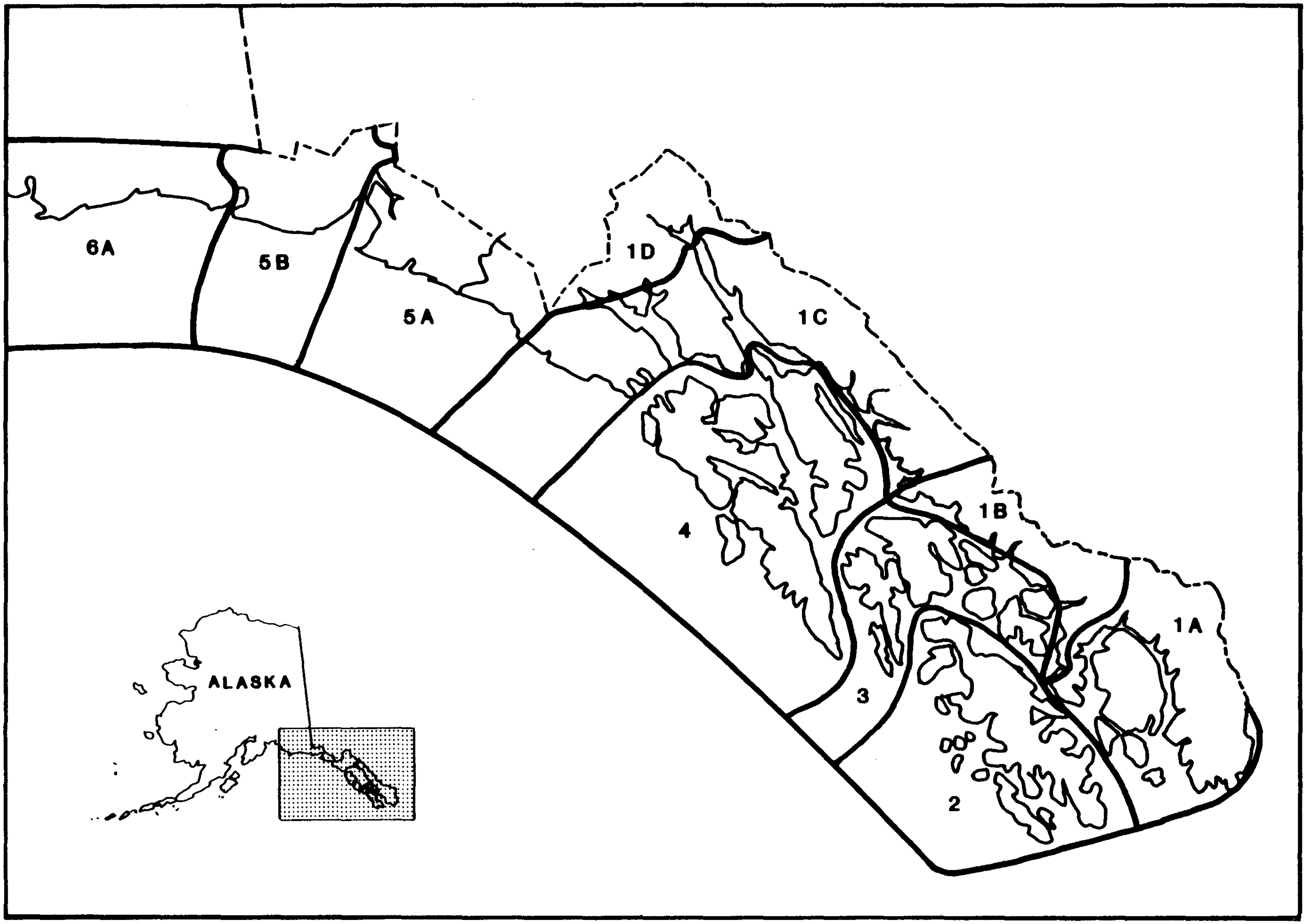
The State of Alaska is divided into 26 game management units (GMUs) for the purpose of establishing hunting regulations and recording harvest data. GMUs 1 through 5 and a portion of GMU 6 comprise the Southeast Region of the Division of Habitat (see map 1). GMUs 1, 5, and 6 are further divided into game management subunits (GMSs). GMUs and GMSs have been defined in 5 AAC 78.005 as follows:

- GMU 1 consists of all mainland drainages from Dixon Entrance to Cape Fairweather and those islands east of the center line of Clarence Strait from Dixon Entrance to Caamano Point and all islands in Stephens Passage and Lynn Canal north of Taku Inlet.

- GMS 1A consists of all drainages south of the latitude of Lemesurier Point, excluding all drainages of Ernest Sound.

- GMS 1B consists of all drainages between the latitude of Lemesurier Point and the latitude of Cape Fanshaw, including all drainages of Ernest Sound and Farragut Bay and including the islands east of the center lines of Frederick Sound, Dry Strait (between Sergief and Kadin islands), Eastern Passage, Blake Channel (excluding Blake Island), Ernest Sound and Seward Passage.

- GMS 1C consists of all drainages between the latitude of Cape Fanshaw and the latitude of Eldred Rock, including Sullivan Island and the drainages of Berners Bay and excluding the drainages of Farragut Bay.



Map 1. Game management units and subunits in the Southeast Region.

- GMS 1D consists of all drainages north of the latitude of Eldred Rock, excluding Sullivan Island and the drainages of Berners Bay.

- GMU 2 consists of Prince of Wales Island and all islands west of the center lines of Clarence Strait and Kashevarof Passage, south and east of the center lines of Sumner Strait, and east of the longitude of the westernmost point on Warren Island.

- GMU 3 consists of all islands east of GMS 1B, north of GMU 2, south of the center line of Frederick Sound, and east of the center line of Chatham Strait, including Coronation, Kuiu, Kupreanof, Mitkof, Zarembo, Kashevarof, Woronkofski, Etolin, Wrangell, and Deer islands.

- GMU 4 consists of all islands south and west of GMS 1C and north of GMU 3, including Admiralty, Baranof, Chichagof, Yakobi, Inian, Lemesurier, and Pleasant islands.

- GMU 5 consists of all Gulf of Alaska drainages and islands between Cape Fairweather and the center line of Icy Bay, including the west side of the Guyot Hills.

- GMS 5A consists of all drainages east of Yakutat Bay, Disenchantment Bay, and the eastern edge of Hubbard Glacier, and includes the islands of Yakutat and Disenchantment Bay.

- GMS 5B consists of the remainder of GMU 5.

- GMU 6 consists of all Gulf of Alaska and Prince William Sound drainages from the center line of Icy Bay and the west side of the Guyot Hills to Cape Fairfield, including Kayak, Hinchinbrook, Montague, and adjacent islands, and Middleton Island, but excluding the Copper River drainage upstream from Miles Glacier and excluding the Nellie Juan and Kings river drainages.

- GMS 6A consists of Gulf of Alaska drainages east of Palm Point near Katalla, including Kanak, Wingham, and Kayak islands.

B. Major Harvest Areas

For the purpose of recording harvest and other data, GMUs and GMSs are further divided into major harvest areas, which comprise entire islands, island groups, or portions of the mainland or large islands that often contain a number of watersheds. The major harvest area is designated by the letter X followed by a two-digit code in GMUs 1 through 5. The letter U followed by a two digit-code is used to designate major harvest areas in GMU 6.

C. Minor Harvest Units and Minor Specific Units

Major harvest areas are subdivided into minor harvest units which may contain one or several drainages. Minor harvest units are divided into minor specific units, also called UCUs, which represent the smallest geographic unit of the coding system.

Minor harvest units and minor specific units are each designated by a two-digit code. Thus, the code 01B-X16-0102 corresponds to GMU 1, subunit B, Major Harvest Area X16, Minor Harvest Unit 01, and Minor Specific Unit 02, which represents the Cat Creek watershed on the mainland near Cape Fanshaw.

III. HUMAN USE OF SITKA BLACK-TAILED DEER

A. Introduction

Sitka black-tailed deer are indigenous to the mainland south of Berners Bay and most islands of GMUs 1, 2, 3, and 4 (Johnson and Wood 1979). Deer were transplanted to the Yakutat Area GMS 5A in 1934, where they now occur at relatively low levels (ibid.). Deer were transplanted to Sullivan Island in Lynn Canal between 1951 and 1954 (Burris and McKnight 1973). Several deer transplants were also made in the Taiya Valley near Skagway in 1951, 1952, and 1956, but harvestable populations have not been established. The general distribution of deer in GMU 6 does not include the portion of GMU 6 within the Southeast Region.

Deer hunting is an important activity in Southeast Alaska. This chapter summarizes deer harvest levels and hunting effort in the Southeast Region since about 1960.

B. Management Considerations

1. Influence of winter weather on deer populations. The amount of mortality caused by starvation as a result of winter weather conditions is generally recognized as the major factor regulating deer populations in Southeast Alaska (Merriam 1970, Olson 1979). Low deer numbers occurred in the 1910's, 1925, 1934, 1950, 1956, 1969, and in the 1970's (Ralston 1943, Merriam 1970, Olson 1979). Periods of low deer abundance usually were preceded by a series of severe winters, and periods of high deer abundance were preceded by mild winters (Merriam 1970). Periods of low deer abundance occurred in areas that did not support wolves or receive substantial hunting pressure (ibid.).

   Generally, deer populations quickly increased following declines (Merriam 1970). However, there have been at least two instances of prolonged low deer numbers during this century, both following two or more extremely severe winters. Following the winters of 1909 and 1910, deer were almost entirely depleted over much of the Ketchikan area, including the southern portion of Prince of Wales Island (Ralston 1943). Even 8 to 10 years after these winters, no deer sign was observed during the entire season by the road crews working on the Portage Road between Sulzer and Chomly on Prince of Wales Island, an area that was normally heavily used by deer (ibid.)

The pronounced low in deer numbers in portions of GMS 1A and 1B and GMUs 2 and 3 following the severe winters of 1968-1969, 1970-1971, and 1971-1972 has been well documented (Olson 1979, ADF&G 1983). Even in the early 1980's, it was difficult to find any sign of deer during field reconnaissance in areas with traditionally high deer use on Kuiu and Kupreanof Island (ADF&G 1983, Doerr 1985).

Drastic declines in deer numbers have resulted in corresponding declines in deer hunter success and deer harvests in the affected areas (Merriam 1970, Johnson and Wood 1979).

2. <u>Influence of clear-cutting on deer populations</u>. Clear-cutting in the Southeast Region can have a major impact on deer hunting because it removes old-growth forests that provide critical winter habitat for deer and thus lowers the carrying capacity of the area for deer (Sigman 1985). Clear-cutting eliminates the forest canopy that intercepts snowfall and allows deer access to winter forage which exists in the understory of old-growth forests. Furthermore, clear-cuts regenerate into dense, even-age pole stands that persists for 150 years or more. These pole stands are largely devoid of deer forage in the understory and do not provide suitable habitat for deer. Under an expected timber harvest rotation of 100 to 125 years, this loss of old-growth habitat and critical deer winter range will be permanent (Wallmo and Schoen 1980, Sigman 1985). A model developed by Schoen et al. (1985) predicts declines in relative deer numbers as a result of logging scheduled on the Tongass National Forest. This model predicts that deer populations will decline by 50 to 75% over the life of the timber harvest rotation in three-quarters of the region's watersheds that are scheduled for clear-cutting under the Tongass Land Management Plan (United States Department of Agriculture 1979). Further declines in deer populations will result from clear-cutting on state, native, and other private lands in the region.

3. <u>Influence of road construction on harvest patterns.</u> The effects of road construction on deer hunting has not been well researched in Southeast Alaska, partly due to the recent history of extensive road construction in most parts of the region. The construction of roads can change harvest patterns. Road construction has increased deer hunting, at least temporarily, in some areas (e.g., Prince of Wales Island

[ADF&G 1982, 1983]). However, the long-term effects of road access on deer harvest patterns is unclear.

A recent study reported that the construction of the Hollis-Klawock road initially resulted in increased deer hunting along the road corridor by Klawock residents (Bosworth 1986, Ellanna and Sherrod 1986). Deer hunting success along the road corridor and use of the road by Klawock hunters subsequently fell to very low levels due to increased competition for deer by outside hunters using the ferry and road system and by the fact that clear-cut areas with advanced conifer regeneration are not desirable for deer hunting (ibid.).

4. <u>Disposal of public lands to private ownership</u>. The transfer of public land to private ownership such as is occurring under the present Alaska State Land Disposal Program results in loss of deer habitat as a result of housing construction and other land development, as well as direct loss of public hunting areas as the lands become private property (ADF&G 1982, 1983). These impacts are most severe where land disposals occur in beach fringe forest or other critical deer winter habitat and/or where land disposals occur in traditional high-quality deer hunting areas (such as certain beach fringe forest near protected anchorages or other access points).

   The land disposals are resulting in the development of small settlements in rural areas. People residing in these areas utilize the fish and wildlife resources in the nearby vicinity as a food source. As a result, demand for use of fish and wildlife is increasing in areas near state land disposals.

5. <u>Influence of predation</u>. Current evidence indicates that predation by wolves has the potential to keep deer populations at extremely low levels if the ratio of deer/wolves is reduced below a certain critical level (Van Ballenberghe and Hanley 1984). The prolonged low density of deer in portions of Southeast Alaska since the severe winters of 1968-1972 has been associated with the presence of wolves and black bears (Olson 1979; ADF&G 1982, 1983). In areas where wolves and black bears are present, especially in portions of GMU 3, deer still remain at low levels, despite the absence of hunting seasons and, in some areas, the absence of significant alteration of habitat by logging or other human activities.

6. <u>Deer density and harvest patterns</u>. Game biologists in Southeast Alaska have long recognized that hunter success and deer harvest levels were positively related to the density of deer (Merriam 1970, n.d.a; Johnson and Wood 1979). The exact relationship has not been determined, however, partly because of the inability to precisely estimate deer numbers and hunter success. Lows in deer numbers correspond to reduced

hunter success, harvest rates, and hunter participation. "High" deer numbers have often occurred within about five years of lows and correspond to "good" hunter success and harvest levels (Merriam n.d.a).

C. Summary of Seasons and Bag Limits, 1925-84

Table 1 summarizes deer seasons and bag limits in GMUs 1-5 from 1925 to 1984. From 1925 to 1954, deer hunting was limited to bucks only. Doe hunting was established in 1955, and from 1957 to 1970 a bag limit of four deer of either sex was allowed in much of the Southeast Region. During the 1970's, bag limits were drastically reduced in GMSs 1A and 1B and GMUs 2 and 3. The season was closed in GMU 3 from 1975 through 1979 and in GMU 5 in 1980.

Since 1980, GMS 1A and GMU 2 have had a four-month season with a three-buck bag limit, while the bag limit in GMS 1B has been one or two bucks. Deer hunting in GMS 1C and most of GMU 4 has been open for about five months, with a bag limit of four deer. In GMU 3, the season has been closed in the northern portion and limited to one buck in the southern portion. A January deer season with a two-deer limit was established on Admiralty Island in the vicinity of Angoon in the 1983 regulatory year.

D. Data on Human Use

Harvest data on deer have been collected in some manner since at least the 1940's (unpublished notes in deer files, ADF&G, Div. Game, Petersburg). Information discussed will include regional, GMU, sub-GMU harvest reporting areas, and community summaries of harvest data. Presentation will focus on deer harvests since statehood. Deer harvests in GMS 1D and GMU 5 will not be considered further in this report. Deer harvests in GMS 1D were absent or minimal, and only a relatively few deer were harvested annually in GMU 5 during the open seasons in the 1960's and 1970's (Dinneford 1985).

1. Qualifications and limitations of data. Several terms used in this report require clarification. Hunter refers to any person who spent time afield actively hunting deer during a given year. Hunter success is defined as the proportion of people who bagged a deer during a given hunting year relative to the total number of hunters. Hunting efficiency is defined as the relationship between hunting effort and harvests. This statistic is expressed here as the mean number of days spent hunting per deer harvested; hence the larger the number, the less efficient the hunting. One hunter-day is defined as any part of a 24-hour day in which the person is searching for deer with the intent to harvest deer. A hunter-day can thus vary from hunting an hour during the day to hunting during the entire daylight hours. In addition, some hunter-days encompass incidental hunting. For example, carrying a gun in a vehicle or boat while traveling to and

Table 1. General Seasons and Bag Limits for Deer in GMUs 1 to 5, 1925-84

Year(s)	Area	Season	Bag Limit
1925	East of 141°W	Sept. 16-Dec. 15	3 bucks[a]
1926-29	Same as above	Sept. 1-Nov. 30	3 bucks
1930-41	East of 138°W	Aug. 20-Nov. 15	3 bucks
1942-43	Same as above	Sept. 16-Nov. 15	2 bucks
1944-48	Same as above	Sept. 1-Nov. 15	2 bucks[b]
1949	East of 138°W	Sept. 1-Nov. 7	2 bucks[b]
	West of 138°W	Sept. 10-Oct. 10	1 buck
1950	East of 138°W	Sept. 1-Nov. 15	2 bucks[b]
	West of 138°W	Oct. 1-Oct. 10	1 buck
1951	East of 138°W except Sullivan I.-Taiya area[c]	Sept. 1-Nov. 15	2 bucks[b]
	West of 138°W	Sept. 15-Oct. 15	1 buck
1952	All of Southeast Region	Aug. 20-Nov. 15	2 bucks
1953	Same as above	Aug. 20-Nov. 22[b]	2 bucks
1954	Same as above	Aug. 20-Nov. 22	3 bucks
1955	Same as above	Same as above	2 bucks and 1 doe
1956	GMUs 1, 5	Aug. 20-Nov. 26	3 bucks
	GMUs 2, 3, 4	Aug. 20-Nov. 26 (bucks) Nov. 13-Nov. 26 (does)	3 bucks or 2 bucks and 1 doe
1957-58	GMUs 1, 5	Aug. 20-Nov. 30	3 bucks
	GMUs 2, 3, 4	Aug. 20-Nov. 30 (bucks) Oct. 15 - Nov. 30 (does)	4 deer

(continued)

Table 1 (continued)

Year(s)	Area	Season	Bag Limit
1959	GMUs 1, 5	Aug. 20-Nov. 30 (bucks) Oct. 15-Nov. 30 (does)	4 bucks or 3 bucks and 1 doe
	GMUs 2, 3, 4	Same as above	4 deer
1960	GMUs 1, 5	Aug. 20-Dec. 15 (bucks) Oct. 1-Dec. 15 (does)	4 deer (only 2 could be does)[d]
	GMUs 2, 3, 4	Same as above	4 deer
1961	GMUs 1, 5	Aug. 1-Nov. 30 (bucks) Sept. 15-Nov. 30 (does)	4 deer (only 2 could be does)
	GMUs 2, 3, 4	Same as above	4 deer
1962	GMUs 1 through 5	Aug. 1-Dec. 15 (bucks) Sept. 15-Dec. 15 (does)	4 deer
1963-66	Same as above	Aug. 1-Dec. 31 (bucks) Sept. 15-Dec. 31 (does)	4 deer
1967	Same as above	Aug. 1-Dec. 31 (bucks) Oct. 1-Dec. 31 (does)	4 deer
1968	Same as above	Aug. 1-Dec. 15 (bucks) Oct. 15-Dec. 15 (does)	4 deer
1969	Same as above	Same as in 1967	4 deer
1970	GMUs 1, 2, 4, 5	Same as in 1969	4 deer
	Mitkof Island	Aug. 1-Nov. 30	2 bucks

(continued)

Table 1 (continued)

Year(s)	Area	Season	Bag Limit
1970 (cont.)	Remainder of GMU 3	Aug. 1-Dec. 15 (bucks) Nov. 1-Nov. 30 (does)	4 deer
1971	GMSs 1C, 1D, GMU 4	Aug. 1-Dec. 31 (bucks) Sept. 15-Dec. 31 (does)	4 deer
	GMUs 2, 5	Aug. 1-Dec. 31 (bucks) Oct. 1-Dec. 31 (does)	4 deer
	GMU 3 (Mitkof, Wrangell Etolin, and Woronkofski islands)	Aug. 1-Nov. 30	2 bucks
	GMSs 1A, 1B and remainder of GMU 3	Aug. 1-Nov. 30 (bucks) Oct. 1-Oct. 31 (does)	3 deer
1972	GMS 1A, GMU 2	Aug. 1-Nov. 30 (bucks) Nov. 1-Nov. 30 (does)	3 deer
	GMS 1B, GMU 3	Aug. 1-Nov. 30	2 bucks
	GMS 1C, GMUs 4, 5	Aug. 1-Dec. 31 (bucks) Sept.15-Dec. 31 (does)	4 deer
1973-74	GMS 1A, GMU 2	Sept. 1-Nov. 30 (bucks) Nov. 1-Nov. 30 (does)	3 deer (only 1 can be a doe)
	GMS 1B, GMU 3	Sept. 1-Nov. 30	1 buck
	Admiralty Island[e]	Aug. 1-Nov. 30 (bucks) Nov. 1-Nov. 30 (does)	4 deer

(continued)

Table 1 (continued)

Year(s)	Area	Season	Bag Limit
1973-74 (cont.)	GMS 1C and remainder of GMU 4	Aug. 1-Nov. 30 (bucks) Oct. 1-Nov. 30 (does)	4 deer
	GMU 5	Aug. 1-Dec. 31 (bucks) Sept. 15-Dec. 31 (does)	4 deer
1975-77	GMS 1A, GMU 2	Aug. 1-Nov. 30 (bucks), Nov. 1-Nov. 30 (does)	Same as in 1973-74
	GMS 1B	Same as in 1973-74	1 buck
	GMU 3	No open season	
	Southeastern Admiralty I.[f]	Aug. 1-Nov. 30 (bucks) Sept. 15-Nov. 30 (does)	4 deer
	GMS 1C, GMU 5, and remainder of GMU 4	Aug. 1-Dec. 31 (bucks) Sept. 15 - Dec. 31 (does)	4 deer
1978-79	GMS 1A, GMU 2	Aug. 1-Nov. 30	3 bucks
	GMSs 1B, 1C, GMUs 3, 5	Same as in 1975-77	Same as in 1975-77
	GMU 4	Aug. 1-Dec. 31 (bucks) Sept. 15-Dec. 31 (does)	4 deer
1980	GMS 1A, GMU 2	Aug. 1-Nov. 30	3 bucks
	GMU 3 south of Sumner Strait and Eastern Passage, including Level, Vank, Sokolof, Rynda and Kadin islands, GMS 1B	Aug. 1-Nov. 30	1 buck
	Remainder of GMUs 3, 5	No open season	

(continued)

Table 1 (continued)

Year(s)	Area	Season	Bag Limit
1980 (cont.)	GMS 1C, GMU 4, that portion of Admiralty I. north of a line along the divide between Woody Point on the west side and Pleasant Bay on the east side, including Pleasant Bay; and that portion of Chichagof I. east of a line running along the divide between Column Point on the north coast and Point Hayes on the southeast coast in Chatham Strait	Aug 1.-Dec. 31 (bucks) Sept. 15-Nov. 30 (does)[g]	4 deer
	Remainder of Admiralty I.	Aug. 1-Nov. 30 (bucks) Oct. 15-Nov. 30 (does)	3 deer
	Remainder of GMU 4	Same as above	4 deer
1981	GMS 1B	Aug. 1-Nov. 30	2 bucks
	GMSs 1A, 1C, GMUs 2, 3, 4, 5	Same as in 1980	Same as in 1980
1982	GMSs 1A, 1B, 1C, GMUs 2, 3, 5	Same as in 1981	Same as in 1981
	GMU 4, all drainages of Baranof I. north and west of the divide between North Cape and Portage Point and all drainages of Chichagof I. south of the divide between Point Leo and Point Hayes and all adjacent islands within this area, including Kruzof and Catherine islands.	Aug. 1-Dec. 15 (bucks) Oct. 15-Dec. 15 (does)	4 deer
	Remainder of GMU 4	Aug. 1-Dec. 31 (bucks) Sept. 15-Dec. 31 (does)	4 deer

(continued)

Table 1 (continued)

Year(s)	Area	Season	Bag Limit
1983-84	GMUs 1, 2, 3, 5	Same as in 1981[h]	Same as in 1981
	GMU 4, all drainages on the west side of Admiralty I., from Point Marsden to Point Gardner	Aug. 1-Dec. 31 (bucks) Sept. 15-Dec. 31 (does)	4 deer
	Same as above	Jan. 1-31	2 deer
	Remainder of GMU 4	Same as in 1982	Same as in 1982

Source: For years 1925-60: ADF&G 1961 and Merriam n.d.b.; for years 1961-84: annual Alaska game regulation booklets printed each year by ADF&G, Div. Game, Juneau.

[a] From 1925 through 1952, legal bucks were defined as having a three-inch minimum antler length.

[b] From 1946 through 1951, nonresidents could harvest only one buck annually.

[c] Since 1951, the Taiya-Haines area has been closed to deer hunting.

[d] In the early 1960's, a special January deer season was often opened by emergency regulations to allow the harvest of up to two deer, in addition to the regular bag limit, in certain areas of Southeast Alaska.

[e] In 1974, only that portion of Admiralty I. draining into Frederick Sound and Stephens Passage between Pleasant Bay and Point Gardner had the restricted doe season.

[f] That portion between Pleasant Bay and Point Gardner as defined in [e] above.

[g] In 1981, the doe season was from Sept. 15 to Dec. 31.

[h] Conclusion Island was opened to deer hunting in GMU 3 in 1983 and 1984.

from work with the intent of shooting a deer if the person sees one is classified as hunting and constitutes a hunter-day. Thus it is important to note that a hunter-day may not be the same amount of hunting effort when comparing individual hunters or different types of hunting (e.g., "road hunting" vs. "wilderness hunting"). Other factors may also effect hunting efficiency within an area, including the density of the prey, the game regulations (e.g., doe seasons vs bucks-only bag limits), the type of terrain, the number of hunters using the area, and the experience of the hunters.

a. <u>1960-1974</u>. Deer harvest statistics from 1960 through 1974 were derived from samples of hunters who were personally interviewed by ADF&G biologists in the communities of Sitka, Wrangell, Petersburg, Juneau, Ketchikan, and occasionally some of the smaller communities. Interviews were conducted where large numbers of hunters were readily available (Ballard et al. 1979). Only people with hunting licenses were included in the survey and only about 10% of the hunting license holders in each community were sampled. Hunters were asked if they hunted deer and, if so, how many days they hunted, where they hunted, how many deer they killed, and the sex and location of each kill (ibid.).

   The survey was performed in a relatively consistent manner from 1960 through 1974. The 1960 to 1968 data were tabulated and analyzed by Harry Merriam, ADF&G Area Game Management Biologist, Petersburg, and reported in various ADF&G deer reports (ADF&G 1961; Merriam and Batchelor 1963; Merriam 1963, 1965, 1966, 1967, 1968, 1971). In addition to these reports, an unpublished summary of the 1960-1968 data (Merriam n.d.b) was reviewed and evaluated for this report. From 1969 to 1974, the hunter interviews were conducted and discussed in the ADF&G annual reports of surveys-inventory activities (ADF&G 1970, 1971, 1973, 1974a, 1974b, 1976) by individual area game management biologists and in Ballard et al. (1979). The harvest statistics by community in these years were often incompletely reported, and hence certain statistics for certain years were not available for inclusion in this report.

   Deer harvest for the communities of Sitka, Petersburg, Juneau, Wrangell, and Ketchikan (referred to here as the "large communities") was estimated each year from the reported deer kill/licensed hunter (obtained from the interviews) multiplied by the total number of resident hunting licenses sold in that community that year. Harvest by license holders outside these communities was estimated from the number of resident hunting licenses sold in other villages that year times an estimated average deer kill per licensed hunter for all villages combined. The deer kill/licensed hunters in the villages was derived from hunter interviews in five to six villages for the years 1960, 1961, 1964, 1965, and 1968; from the average kill rate/hunter in the "large communities" for the years 1962, 1966, 1972, 1973, and 1974; or from an estimated deer kill/hunter based on previous surveys of villages and the general hunting success in the "large communities" for that particular year. The third estimate assumed that hunters in villages had somewhat higher average kill rates/hunter than the average hunter in the "large communities." The annual deer harvest for GMUs 1 through 4 was then derived from the combined estimated deer harvest in Juneau, Petersburg, Sitka, Wrangell, Ketchikan, and "other villages."

The percentage of licensed hunters hunting deer, the percentage of successful deer hunters, the average number of deer killed per hunter, the average number of days hunting per deer, the average number of days hunting deer per active hunter, and the locations of deer kills were derived for each of the five major communities for each year. These statistics are compared during times of high and low deer abundance.

Ballard et al. (1979) has discussed some of the drawbacks of the hunter interview method for estimating harvest statistics. The sample was not random, did not include hunters under 16 years of age who did not need a license, was apparently biased against sampling women, and did not adequately sample hunters in smaller villages. The underestimation of deer harvest in these smaller, rural communities, especially those with substantial numbers of hunters who did not purchase licenses, may have been considerable (ADF&G 1973, 1974a, 1974b, 1976, 1977). Also, there may be some error in estimating the number of licensed hunters in a community, because some residents purchase hunting licenses outside the community in which they reside. Because the survey method was conducted in a consistent manner over a 15-year period, the results likely provide accurate insight into changes that occurred in hunting success and harvest patterns in the "large communities" when deer numbers declined dramatically.

b. <u>1980-1984</u>. The hunter-interview survey method was discontinued during the period 1974-1979. Beginning in 1980, the Division of Game began to annually estimate deer hunting activities by surveying a sample of deer harvest ticket holders with a mail questionnaire (Flynn in prep.). All hunters were required to obtain a deer harvest ticket to legally hunt deer in Alaska; however, certain hunters do not need harvest tickets to hunt on the Annette Island Indian Reservation (Wood 1986). A random sample of 25 to 100% of the people who obtained deer harvest tickets in each community were sent mail questionnaires (Flynn in prep.).

The 1981 survey was determined to be unreliable because of sampling procedures, and results were not reported (ibid.). In other years, two reminders were mailed to nonrespondents, and an overall sampling response rate of about 60% was obtained (ibid.). The response rate has generally been lower in the smaller communities.

Hunters were asked to identify their hunting activity by the major harvest areas. The zip code of the address on the hunter's deer harvest ticket overlay was used to estimate hunter residency. Total hunting statistics were estimated by extrapolating the information obtained from the surveys to the total number of hunters who obtained deer harvest tickets (ibid.). Data obtained include estimated numbers of active deer hunters, successful deer hunters, deer harvest, and hunter-days by communities and harvest areas.

2. Reported harvest levels and hunting effort. The discussion of harvest levels is separated into three periods. The first period, from 1960 through 1968, corresponds to a period of abundant deer numbers and liberal hunting seasons and bag limits throughout the deer range of Southeast Alaska. The second period, from 1969 through 1974 corresponds to relatively low deer numbers over much of Southeast Alaska and more restricted seasons (table 1). The third period, from 1980 through 1984, reflects the recent deer hunting activities in the Southeast Region, with high deer populations and liberal hunting seasons and bag limits in much of the northern half of the panhandle and lower deer populations and reduced bag limits or closed hunting seasons in the southern half. From 1980 through 1984, the deer population is believed to have increased substantially throughout most of GMUs 1-4 and some of the harvest statistics changed accordingly during that time (Flynn in prep.). Consequently, the harvest data for the years 1983 and 1984 are used to characterize the present deer hunting in the Southeast Region.

a. GMUs 1-4. During the period 1960-1968, the estimated yearly deer harvest in GMUs 1-4 averaged 11,200, with a range of 9,950 to 12,800 (table 2). From 1969 through 1974 the estimated average harvest declined by 53% to 5,210 deer (table 3) in response to a dramatic regionwide decline in deer. The regionwide estimates of deer harvest derived from hunter interviews from 1960 through

Table 2. Deer Harvest Statistics Based on Hunter Interviews, GMUs 1-4, 1960-68

Year	% Success[a]	Deer/Hunter[b]	Hunter-days /Deer	Hunter-days /Hunter	Estimated Harvest[c]	Source
1960	80	2.1	3.4	7.2	12,400	ADF&G 1961
1961	77	2.2	3.1	6.9	11,250	Merriam & Batchelor 1963
1962	76	1.8	3.4	5.9	10,500	Merriam 1963
1963	74	1.8	3.2	5.8	11,100	Merriam 1965
1964	80	2.0	2.4	4.8	9,950	Merriam 1965
1965	73	1.7	2.8	4.8	9,950	Merriam 1966
1966	75	2.0	2.6	5.2	12,300	Merriam 1967
1967	64	1.6	4.1	6.6	10,500	Merriam 1968
1968	72	2.0	2.4	4.8	12,800	Merriam 1971
Mean	75	1.9	3.0	5.8	11,200	

[a] Percentage of hunters killing at least one deer among hunters who hunted deer.

[b] Hunter refers to any person who actively hunted deer during a given year.

[c] Hunter-days/hunter derived from the product of deer/hunter and hunter-days/deer.

[d] Harvest estimate is only for licensed resident hunters and does not include the special January seasons that occurred in some years, nonresident hunters, or hunters who did not need licenses.

Table 3. Deer Harvest Statistics Based on Hunter Interviews, GMUs 1-4, 1969-74

Year	% Success[a]	Deer/Hunter[b]	Hunter-days/Deer	Hunter-days/Hunter[c]	Estimated Harvest[d]
1969	36	0.9	8.4	7.6	4,740
1970	55	1.1	4.5	5.0	6,020
1971	42	1.0	5.8	5.8	5,800
1972	30	0.6	10.8	6.5	2,890
1973	ca. 50	1.1	5.2	5.7	6,800
1974	39	0.8	7.1	5.7	4,990
Mean	42	0.9	7.0	6.1	5,210

Sources: For deer/hunter and estimated kill: Ballard et al. 1979; for % success and hunter-days/deer: Merriam n.d.b for the years 1969-73, and ADF&G (1976) for the year 1974.

[a] Percentage of hunters killing at least one deer among hunters who hunted deer.

[b] Hunter refers to any person who actively hunted deer during a given year.

[c] Hunter-days/hunter derived from the product of deer/hunter and hunter-days/deer.

[d] Harvest estimate is only for licensed resident hunters and does not include nonresident hunters or hunters who did not need licenses.

Table 4. Deer Harvest Statistics Based on Mail Questionnaries, GMUs 1-4, 1980-84

Area	Year	No. of Hunters[a]	% Success[b]	Deer/ Hunter	Hunter-days/ Deer	Hunter-days/ Hunter	Estimated Harvest	No. of Hunter-days
GMUs 1-4	1980	5,110	60	1.1	5.5	6.1	5,690	31,380
	1982	6,940	51	1.1	6.0	6.6	7,550	45,670
	1983	8,220	58	1.3	4.8	6.4	11,050	52,550
	1984	8,600	59	1.4	5.5	6.4	11,930	54,840
	Mean	7,200	57	1.2	5.4	6.4	9,055	46,110
GMS 1A	1980	890	27	0.4	13.1	5.8	395	5,160
	1982	900	29	0.4	12.9	4.9	340	4,370
	1983	960	31	0.5	11.7	5.3	440	5,130
	1984	1,060	42	0.6	13.1	5.5	395	5,820
	Mean	950	32	0.5	12.7	5.3	390	5,120
GMU 2	1980	620	56	1.0	7.5	7.4	615	4,600
	1982	1,150	58	1.0	7.8	8.0	1,185	9,190
	1983	1,560	62	1.1	6.5	7.2	1,740	11,290
	1984	1,910	63	1.0	7.5	6.8	1,880	13,070
	Mean	1,310	60	1.0	7.3	7.4	1,355	9,540
GMS 1B	1980	110	18	0.2	19.6	4.5	25	490
	1982	60	8	0.1	52.0	4.3	5	260
	1983	80	25	0.2	10.0	2.5	20	200
	1984	70	7	0.1	19.6	6.3	25	440
	Mean	80	14	0.15	25.3	4.4	20	350
GMU 3	1980	230	39	0.4	8.4	3.7	100	840
	1982	290	26	0.3	14.3	3.7	75	1,070
	1983	260	27	0.3	15.1	4.7	80	1,210
	1984	400	33	0.3	8.4	3.6	130	1,440
	Mean	295	31	0.3	11.6	3.9	95	1,140
GMS 1C	1980	760	21	0.3	11.3	3.6	245	2,270
	1982	1,030	19	0.3	13.7	3.9	290	3,980
	1983	860	20	0.5	7.8	3.6	400	3,110
	1984	950	41	0.4	11.3	3.8	395	3,610
	Mean	900	25	0.4	11.0	3.7	330	3,370
GMU 4	1980	3,120	59	1.4	4.1	5.6	4,310	17,520
	1982	4,240	58	1.3	4.7	6.3	5,630	26,560
	1983	5,100	66	1.6	3.7	6.1	8,360	31,030
	1984	4,980	72	1.8	4.1	5.8	8,900	28,710
	Mean	4,360	64	1.5	4.2	6.0	6,800	25,960

Source: Flynn in prep. Note the GMU and GMS statistics will not add up to the GMUs 1-4 total because some hunters hunt in more than one GMU/GMS and the location of some hunting effort is not reported to GMU/GMS.

[a] Hunters refers to any person who actively hunted deer during a given year.

[b] Percentage of hunters killing at least one deer among hunters who hunted deer.

1974 are undoubtedly low because they under-represented harvest outside the large communities.

The harvest increased by 110% from 5,690 in 1980 to 11,930 in 1984 (table 4).

From 1983 through 1984, the harvest in GMU 4 accounted for about 75% of the total estimated harvest, or 8,630 deer/year. This statistic reflects the relatively high deer abundance, liberal bag limit, and large number of hunters in that area compared with the relatively low deer abundance and restricted bag limits in the southern portion of the region.

During the period 1960-1968, an estimated average of 5,900 licensed residents spent an average of 5.8 days hunting deer and killed an average of 1.9 deer/hunter each year (table 2). Hunter success averaged 75%. The estimated number of licensed resident deer hunters and the days spent hunting deer were similar during 1969-1974, averaging 5,800 and 6.1 respectively; however, the average hunter harvested only 0.9 deer/year (table 3).

During 1983-1984, an estimated 8,410 hunters spent an average of 6.4 days hunting and killed 1.4 deer/hunter each year (table 4). The estimated number of deer hunters increased dramatically during this time, going from 5,100 in 1980 to 8,600 in 1984, a 69% increase. Alaska Department of Labor statistics indicate that the human population in GMUs 1-4 increased by only 5% during that same time (Corder 1986).

The estimated average number of deer/hunter varied widely throughout the area during those years, ranging from 0.15 deer/hunter in GMS 1B to 1.0 and 1.7 deer/hunter in GMUs 2 and 4, respectively (table 4). The number of days spent deer hunting from 1983 through 1984 was highest in the areas with the highest harvest/-hunter, averaging 7.0 days/hunter/year in GMU 2 and 6.0 days/hunter/year in GMU 4.

Hunter success and efficiency in GMUs 1 through 4 averaged 75% and 3.0 days hunting/deer, respectively, during the period 1960-68 (table 2). During 1969-1974 success declined to 42% and average hunter-days/deer increased by 133% to 7.0 (table 3). From 1983 through 1984, success averaged 58% and the hunter-days/deer averaged 5.2, although varying widely from area to area (table 4).

It is noteworthy that GMU 4, with a doe season, and GMU 2 had similar average success rates from 1983 through 1984 (69 vs. 62%), although it took an average of about

1.8 times as many hunter-days to bag a deer in GMU 2 than in GMU 4 (7.0 vs 3.9 days/deer). The substantially higher average deer/hunter figures in GMU 4 compared to GMU 2 (1.7 vs 1.0), despite comparable hunter success, results from the fact that a higher percentage of hunters in GMU 4 killed two or more deer (Flynn 1986).

It is also of interest that GMSs 1A, 1B, and 1C and GMU 3 all had relatively low hunter success and efficiency from 1983 through 1984 (36 vs 16 vs 30 vs 30% and 12.4 vs 14.8 vs 9.6 vs 11.8 hunter-days/deer, respectively), although bag limits ranged from one antlered deer in GMU 3 to four deer of either sex in GMS 1C. The low success in GMS 1C may be partly attributed to the large number of novice hunters hunting in areas on the Juneau mainland where access is easy but deer numbers low (ibid.).

b. Juneau. Comparisons of deer harvest statistics for the communities of Juneau, Sitka, Petersburg, Wrangell, and Ketchikan among the periods 1960-1968, 1969-1974, and 1980-1984 are given in tables 5 through 11.

A rapid decline in deer harvest by Juneau residents in the late 1960's and early 1970's in response to the decline of deer is evident from the data. The available data suggest that when the number of days it took the average hunter to kill a deer increased from 3.2 to 8.0, the percentage of licensed resident hunters who went deer hunting declined by 25% (table 5). Those hunters who continued to hunt deer during this period of reduced deer numbers did not increase their hunting effort but continued to spend about five days hunting/year (table 6). Consequently, harvest fell dramatically.

Deer hunting for Juneau residents improved greatly during the period 1980 through 1984 and the estimated number of active deer hunters increased by 66% from 1980 to 1984 (Flynn in prep.) while the population of Juneau increased by 22% (Corder 1986). In 1984, an estimated 2,590 Juneau hunters harvested 3,510 deer, with a success ratio of 57% and a hunting efficiency of 3.9 hunter-days/deer.

c. Sitka. The estimated deer harvest by the community of Sitka declined sharply from 1968 to 1969, but recovered to relatively high levels by 1973 and 1974 (table 8). Overall, Sitka showed the least change in deer hunting success between the periods 1960-1968 and 1969-1974 among the major communities.

Average hunter sucess declined from 77% during 1960-1968 to 60% during 1969-1974 (table 6). The deer/hunter figure dropped from 2.0 to 1.7 and hunter-days/deer

Table 5. Comparison of the Annual Number of Licensed Hunters, Deer Hunters, and Deer Harvest in the Largest Communities in Southeast Alaska, 1960-68, 1969-74, and 1983-84

	Hunting Statistics[a]		
Community/Period	No. of Licensed Hunters	No. of Deer Hunters[b]	Estimated Deer Harvest
Juneau			
1960-68	2,530	1,930 (76)	3,200
1969-74	3,330	1,900 (57)	1,260
1983-84	---	2,530	3,300
Sitka			
1960-68	1,150	940 (82)	1,900
1969-74	1,060	860 (81)	1,560
1983-84	---	1,715	3,240
Ketchikan			
1960-68	1,980	1,640 (83)	3,080
1969-74	2,110	1,535 (73)	1,160
1983-84	---	1,655	1,390
Petersburg			
1960-68	730	650 (89)	1,340
1969-74	760	510 (67)	440
1983-84	---	505	810
Wrangell			
1960-68	480	370 (77)	680
1969-74	560	320 (57)	140
1983-84	---	405	300

Source: The 1960-68 data were derived from tables 7-11;, the 1969-74 data were derived from Ballard et al. 1979; and the 1980-84 data are from Flynn in prep.

a Data expressed as yearly mean.

b Percentage of licensed resident hunters who hunted deer in parentheses.

c --- means no data were available.

Table 6. Comparison of the Annual Deer Hunting Success and Hunter Effort by Residents of the Largest Communities in Southeast Alaska, 1960-68, 1969-74, and 1983-84

	Hunting Statistics[a]			
Community/Period	Deer/Hunter	% Success	Hunter-days/Deer	Hunter-days/Hunter
Juneau				
1960-68	1.6	65	3.2	5.1
1969-74	0.8	34	8.2	5.0
1983-84	1.3	54	4.2	5.4
Sitka				
1960-68	2.0	77	2.9	5.6
1969-74	1.7	60	4.7	6.9
1983-84	1.9	72	3.6	6.8
Ketchikan				
1960-68	1.9	74	3.3	6.1
1969-74	0.7	38	8.2	5.1
1983-84	0.8	46	7.9	6.6
Petersburg				
1960-68	2.1	80	3.4	6.9
1969-74	0.8	34	9.1	5.3
1983-84	1.6	66	3.4	5.3
Wrangell				
1960-68	1.9	78	3.2	5.6
1969-74	0.5	31	12.8	5.7
1983-84	0.7	45	6.6	4.8

Source: Derived from tables 7-11.

[a] Data expressed as yearly mean.

Table 7. Deer Harvest Statistics for Juneau Residents, 1960-84

Year	n[a]	% Licensed Hunters Who Hunted	% Success	Deer/Active Hunter	Hunter-days/Deer	Hunter-days/Hunter	Estimated Harvest
1960	100	81	67	1.7	3.5	5.8	3,100
1961	98	88	57	1.5	4.3	6.4	3,280
1962	105	78	61	1.4	3.1	4.5	2,530
1963	103	68	57	1.4	4.5	6.3	2,280
1964	100	69	59	1.3	3.0	3.9	2,240
1965	100	72	62	1.3	3.3	4.3	2,310
1966	100	80	78	2.0	2.3	4.6	4,380
1967	100	70	70	1.8	3.0	5.4	3,650
1968	100	81	77	2.3	2.0	4.6	5,040
1969	---	66	18	0.6	(8[b])	(4.8[b])	1,040
1970	---	54	51	1.2	---	---	2,020
1971	---	62	---	0.9	---	---	1,830
1972	---	51	30	0.5	8.9	4.4	830
1973	257	58	39	0.8	7.0	5.6	1,820
1974	249	53	31	0.6	8.7	5.3	1,200
1980	1,984	(55)[c]	46	1.0	5.8	5.7	1,540
1982	617	(69)[c]	41	.9	6.1	5.5	1,860
1983	478	(75)[c]	51	1.2	4.5	5.6	3,095
1984	512	(71)[c]	57	1.4	3.9	5.3	3,510

Source: The sources for the years 1960-68 are same as those given for the respective years in table 2. The source for the years 1980-84 is Flynn in prep. The % licensed hunters who hunted, the harvest, and the deer/active hunter for 1969-74 are from Ballard et al. 1979. Other data for the years 1969-74 are from ADF&G 1970, 1971, 1973, 1974a, 1974b, 1976.

[a] n means the number of hunters interviewed or the number that responded to mail questionnaires.

[b] Includes Sitka hunters

[c] For the years 1980-84, the number given is the percentage of hunters who obtained deer harvest tickets and reported hunting deer (Flynn in prep.).

--- means no data were available.

Table 8. Deer Harvest Statistics for Sitka Residents, 1960-84

Year	n[a]	% Licensed Hunters Who Hunted	% Success	Deer/Active Hunter	Hunter-days/Deer	Hunter-days/Hunter	Estimated Harvest
1960	100	85	81	2.3	2.8	6.2	2,050
1961	97	87	72	1.8	3.7	6.9	1,610
1962	105	87	82	2.0	2.7	5.5	1,940
1963	110	73	74	1.9	5.1	9.7	2,090
1964	100	90	81	2.0	2.1	4.2	1,980
1965	100	85	65	1.6	3.0	4.8	1,400
1966	100	78	73	2.0	2.1	4.2	1,740
1967	100	81	74	1.8	2.8	5.0	1,750
1968	100	78	92	2.7	1.5	4.0	2,540
1969	100	75	35	0.8	(8[b])	(6.4[b])	490
1970	150	76	78	2.1	---	---	1,720
1971	151	81	61	1.7	3.3	5.6	1,400
1972	125	86	51	1.4	4.9	6.9	1,060
1973	126	84	68	2.4	3.5	8.4	2,670
1974	136	85	70	1.9	3.7	7.0	2,040
1980	1,283	(60)[c]	60	1.4	4.2	6.0	1,570
1982	408	(69)[c]	62	1.4	4.9	7.1	2,210
1983	337	(78)[c]	69	1.9	3.7	6.8	3,160
1984	318	(79)[c]	75	1.9	3.6	6.9	3,320

Source: The sources for the years 1960-68 are same as those given for the respective years in table 2. The source for the years 1980-84 is Flynn in prep. The % licensed hunters who hunted, the harvest, and the deer/active hunter for 1969-74 are from Ballard et al. 1979. Other data for the years 1969-74 are from ADF&G 1970, 1971, 1973, 1974a, 1974b, 1976.

[a] n means the number of hunters interviewed or the number that responded to mail questionnaires.

[b] Includes Juneau hunters

[c] For the years 1980-84, the number given is the percentage of hunters who obtained deer harvest tickets and reported hunting deer (Flynn in prep.).

--- means no data were available.

Table 9. Deer Harvest Statistics for Petersburg Residents, 1960-84

Year	n[a]	% Licensed Hunters Who Hunted	% Success	Deer/Active Hunter	Hunter-days/Deer	Hunter-days/Hunter	Estimated Harvest
1960	75	92	83	2.4	3.1	7.5	1,320
1961	79	88	97	3.5	2.8	9.7	1,920
1962	83	88	80	2.0	4.0	7.8	1,180
1963	289	91	85	2.1	3.1	6.5	1,160
1964	100	87	92	2.3	2.6	6.0	1,400
1965	150	89	79	1.8	3.5	6.3	1,260
1966	100	83	82	2.4	2.4	5.8	1,730
1967	150	88	64	1.3	4.9	6.4	1,030
1968	150	92	58	1.4	4.2	5.9	1,090
1969	---	79	(30[b])	0.5	11.6	5.8	320
1970	---	70	(40[b])	1.4	4.3	6.0	800
1971	80	75	38	0.8	---	---	510
1972	70	66	20	0.3	15.0	4.5	130
1973	80	58	---	1.1	---	---	510
1974	80	54	42	0.9	5.6	4.9	340
1980	440	(41)[c]	57	1.3	4.3	5.7	300
1982	126	(59)[c]	64	1.6	3.7	5.9	575
1983	112	(68)[c]	76	1.9	3.1	5.7	865
1984	125	(73)[c]	55	1.4	3.6	4.9	750

Source: The sources for the years 1960-68 are same as those given for the respective years in table 2. The source for the years 1980-84 is Flynn in prep. The % licensed hunters who hunted, the harvest, and the deer/active hunter for 1969-74 are from Ballard et al. 1979. Other data for the years 1969-74 are from ADF&G 1970, 1971, 1973, 1974a, 1974b, 1976.

[a] n means the number of hunters interviewed or the number that responded to mail questionnaires.

[b] Includes Wrangell hunters

[c] For the years 1980-84, the number given is the percentage of hunters who obtained deer harvest tickets and reported hunting deer (Flynn in prep.).

--- means no data were available.

Table 10. Deer Harvest Statistics for Wrangell Residents, 1960-84

Year	n[a]	% Licensed Hunters Who Hunted	% Success	Deer/Active Hunter	Hunter-days/Deer	Hunter-days/Hunter	Estimated Harvest
1960	74	85	86	2.5	2.7	6.8	920
1961	77	88	76	2.2	2.7	6.0	780
1962	49	94	85	2.0	3.4	5.8	860
1963	100	68	81	2.4	2.2	5.3	820
1964	80	64	77	2.1	1.8	3.8	670
1965	99	73	69	1.5	2.8	4.2	420
1966	100	78	64	1.4	3.4	4.8	570
1967	87	76	59	1.4	5.0	7.0	590
1968	90	73	53	1.3	5.0	6.5	520
1969	---	86	(30[b])	0.6	ca. 11.0	ca. 6.6	250
1970	---	70	(40[b])	0.4	---	---	140
1971	---	55	33	0.4	---	---	130
1972	60	53	22	0.3	20.0	6.0	90
1973	---	35	---	0.6	---	---	130
1974	63	46	28	0.6	7.4	4.6	120
1980	416	(38)[c]	48	0.7	6.3	4.5	150
1982	133	(49)[c]	45	0.8	7.8	6.3	250
1983	115	(54)[c]	40	0.6	7.3	4.5	240
1984	113	(64)[c]	50	0.9	5.8	5.1	370

Source: The sources for the years 1960-68 are same as those given for the respective years in table 2. The source for the years 1980-84 is Flynn in prep. The % licensed hunters who hunted, the harvest, and the deer/active hunter for 1969-74 are from Ballard et al. 1979. Other data for the years 1969-74 are from ADF&G 1970, 1971, 1973, 1974a, 1974b, 1976.

[a] n means the number of hunters interviewed or the number that responded to mail questionnaires.

[b] Includes Petersburg hunters.

[c] For the years 1980-84, the number given is the percentage of hunters who obtained deer harvest tickets and reported hunting deer (Flynn in prep.).

--- means no data were available.

Table 11. Deer Harvest Statistics for Ketchikan Residents, 1960-68

Year	n[a]	% Licensed Hunters Who Hunted	% Success	Deer/Active Hunter	Hunter-days/Deer	Hunter-days/Hunter	Estimated Harvest
1960	101	100	89	2.4	3.1	7.5	4,180
1961	97	88	69	1.9	3.8	7.0	2,810
1962	100	89	73	1.9	3.2	6.0	3,080
1963	106	85	84	2.0	3.5	7.0	3,560
1964	104	76	76	1.9	2.8	5.3	2,460
1965	100	85	81	2.1	2.2	4.6	3,740
1966	100	67	79	2.1	3.2	6.7	3,090
1967	100	76	53	1.2	4.9	5.9	2,190
1968	100	83	64	1.5	3.0	4.5	2,610
1969	---	78	56	1.2	5.1	6.1	1,950
1970	---	74	52	1.1	5.1	5.6	1,760
1971	---	74	39	0.7	8.0	5.6	1,150
1972	197	64	23	0.4	13.6	5.4	490
1973	200	76	32	0.6	6.8	4.1	1,090
1974	202	70	25	0.4	10.4	3.7	520
1980	1,469	(54)[b]	39	0.7	10.6	7.4	810
1982	483	(61)[b]	43	0.7	10.0	6.7	960
1983	313	(66)[b]	49	0.8	8.0	6.7	1,300
1984	322	(74)[b]	43	0.8	7.8	6.6	1,480

Source: The sources for the years 1960-68 are same as those given for the respective years in table 2. The source for the years 1980-84 is Flynn in prep. The % licensed hunters who hunted, the harvest, and the deer/active hunter for 1969-74 are from Ballard et al. 1979. Other data for the years 1969-74 are from ADF&G 1970, 1971, 1973, 1974a, 1974b, 1976.

[a] n means the number of hunters interviewed or the number that responded to mail questionnaires.

[b] For the years 1980-84, the number given is the percentage of hunters who obtained deer harvest tickets and reported hunting deer (Flynn in prep.).

--- means no data were available.

increased by 62% to 4.7 days/deer in those two time periods. Sitka hunters compensated to some degree for the poorer hunting conditions by hunting an average of 1.8 extra days/year during the period 1969 through 1974.

When comparing harvest statistics among the large communities (tables 6 and 7), three things are especially noteworthy about the Sitka hunting during 1969-1974: 1) Sitka was the only large community that still had relatively reasonable hunting efficiency (4.7 hunter-days/deer compared to an average of 9.6 hunter-days/deer for the other four communities); 2) Sitka was the only large community where hunter effort was substantially increased between 1960-1968 and 1969-1974; and 3) Sitka was the only large community that did not show a marked decline in hunter participation during the low in deer numbers.

The estimated percentage of success and deer/hunter figures for Sitka for the period 1983-1984 were slightly lower than the estimates for 1960-1968, while the estimated number of active deer hunters and average harvests were considerably higher (tables 5 and 6). Hunter participation and success rose rapidly from 1980 to 1984, (table 8). In 1984, an estimated 1,730 hunters harvested 3,320 deer, with a success ratio of 75% and a hunting efficiency of 3.6 hunter-days/deer.

A random survey of Sitka households conducted through the ADF&G Division of Subsistence indicated that in 1982 the average household harvested 1.2 deer, which suggests a community harvest of about 2,930 deer (Gmelch and Gmelch 1986). This harvest estimate is about 33% higher than the estimate of 2,210 deer from the mail survey (Flynn in prep.). The household survey indicated an average harvest of 1.71 deer/hunter compared to the mailed survey estimate of 1.44. The exact reasons for the differences in the survey results are not known.

d. Petersburg and Wrangell. Harvests by both Petersburg and Wrangell residents declined in 1969 and have remained at relatively low levels since that time (tables 9 and 10). From the period 1960-1968 to the period 1969-1974, the estimated hunting efficiency changed from 3.4 to about 9 hunter-days/deer for Petersburg residents and from 3.2 to about 13 hunter-days/deer for Wrangell residents. Hunters in both communities did not increase hunting effort to compensate for the greater difficulty in bagging a deer. Instead, hunter success declined from about 80% to less than 35% (table 6), while the percent of licensed hunters who hunted deer declined by 12% for Petersburg residents and 26% for Wrangell residents.

Community deer harvest and the number of active deer hunters in Petersburg and Wrangell from 1983 through 1984 remained low compared to the 1960-1968 levels. One anomaly of the data is that, during 1983-1984, hunter success, deer/hunter, and days/deer were relatively high for Petersburg hunters (table 6). This apparent inconsistency is explained by the fact that many of the Petersburg deer hunters traveled to GMU 4, where deer-hunting success was relatively good. However, the absence of liberal seasons and good deer hunting around the immediate area of the communities has resulted in fewer active deer hunters, especially with respect to the population size of these communities, which have grown since the 1960's. Some hunters were able to travel to areas with good deer hunting, while others were unable to or did not choose to because of such factors as increased costs, increased time involved, and problems associated with the weather. It is also noteworthy that far fewer Wrangell hunters traveled to GMU 4 to hunt deer compared to Petersburg hunters (discussed in subsequent sections). Deer hunting in the southeast corner of GMU 4 is about 55 mi from Petersburg and 90 mi from Wrangell by air and somewhat farther by boat.

e. Ketchikan. The pattern of deer harvests for the community of Ketchikan from 1960 through 1984 is similar in many respects to that described for Petersburg and Wrangell. When deer populations declined in the late 1960's and early 1970's, community deer harvests, average number of deer killed/hunter, hunter success, the percentage of licensed resident hunters who hunted deer, and the days spent hunting deer all declined, while the average number of hunter-days/deer increased from 3.3 to 8.2 (table 6). One difference among Ketchikan, Petersburg, and Wrangell is that during 1980-1984 the Ketchikan area had a three-buck bag limit, while the Wrangell area had a one-buck bag limit, and much of the area around Petersburg was closed to deer hunting. Nevertheless, the deer harvests around Ketchikan have remained low in 1983 and 1984, compared to harvests from 1960 through 1968 (tables 5 and 6). The estimated Ketchikan deer harvest increased in the early 1980's, however, going from 750 deer in 1980 to 1,480 in 1984, as have the numbers of active deer hunters which rose from 1,090 to 1,750, while the estimated number of hunter-days/deer declined from 10.8 in 1980 to 7.8 in 1984 (Flynn in prep., and table 11). The population of Ketchikan is estimated to have increased by 12% from 1980 to 1984 (Corder 1986).

f. Other southeastern Alaskan communities. As indicated earlier, few surveys were made of deer harvests in the smaller communities of Southeast Alaska. The response rate to mail questionnaires regarding deer harvest is generally lower by residents of the smaller communities compared to residents of the larger communities in Southeast Alaska (Flynn 1986). Also there seems to have been a tendency for a higher percentage of deer hunters in the smaller communities not to obtain hunting licenses or harvest tickets compared to deer hunters in the large communities. For these reasons, there has been a general feeling among game biologists that estimates of deer harvest statistics based on the results of mail questionnaires or hunter interviews extrapolated to the number of licensed deer hunters are less accurate for the smaller communities. The biases associated with these surveys are uncertain; however, some results suggest that the estimates of deer harvests in the smaller communities have often been low.

Communities other than Sitka, Petersburg, Wrangell, Juneau, and Ketchikan sold an average of 8% of the resident hunting licenses in GMUs 1-4 during 1960-1974 (range 6-16%) and accounted for an estimated 10% of the total Southeast Region deer harvest displayed in tables 2 and 3 (average 820 deer/year, range 280 to 1,220) (ADF&G 1961; Merriam and Batchelor 1963; Merriam 1963, 1965, 1966, 1967, 1968, 1971; Ballard et al. 1979).

The limited hunter interviews of residents of smaller communities suggested that the average hunter harvested more deer than hunters in larger communities. Estimates ranged from 1.8 to 2.5 deer/hunter during 1960-1968 (Merriam and Batchelor 1963, Merriam 1966). The biases associated with such hunter interviews, however, where contact with ADF&G personnel was less frequent than in the larger communities where game biologists resided, were uncertain.

These village interviews also suggested that hunters in smaller villages averaged fewer hunter-days/deer killed than hunters in the larger communities: 3.7 in 1960 (ADF&G 1961); 2.5 in 1961 (Merriam and Batchelor 1963); 1.9 in 1964 (Merriam 1965); 2.3 in 1965 (Merriam 1966); and 2.0 in 1968 (Merriam 1971).

As the human population in Southeast Alaska has increased and use of natural resources intensified, more attention has been focused on the fish and wildlife uses by residents of the smaller communities. Loyal Johnson, area game management biologist in Sitka, evaluated deer harvests in GMU 4 during the early 1970s (ADF&G 1973, 1974a, 1974b, 1976, 1977) and noted that six smaller communities (Hoonah, Pelican, Angoon, Tenakee Springs, Elfin Cove, and Port Alexander) plus about 14 active logging and mining camps and fish-processing plants occurred within the area, in addition to communities and camps adjacent to the area (e.g., Kake, Gustavus). The estimated harvest of deer in GMU 4 by residents outside Juneau, Sitka, Petersburg, and Wrangell, based on his best judgement, was 500 in 1971 (a year of extremely poor deer hunting), 700 in 1972, 1,900 in 1973, and 3,050 in 1974 (ADF&G 1973, 1974a, 1974b, 1976). These estimates, based on professional conjecture, are extremely valuable in highlighting the likely large underestimation of deer harvests based on license sales and the need to obtain accurate information on deer harvest in smaller communities and in logging and mining camps. For example, the estimated 1974 harvest of 3,050 deer in GMU 4 by residents from smaller communities (ADF&G 1976) contrasts sharply with the harvest estimate of 5,000 deer for all of Southeast Alaska based on license sales and hunter interviews (Ballard et al. 1979 and table 3).

The ADF&G Division of Subsistence has recently initiated intensive human-use studies in several Southeast Alaska communities. One study completed in Angoon estimated that each hunter killed a yearly average of 2.0 deer during 1980-1982, with an average of 3.1 deer/household/year or about 4.2 deer/household that hunted (George and Kookesh 1983). Extrapolating the results of this random sample of 25% of the households suggests a harvest of about 410 deer/year for the community of Angoon. George and Kookesh (ibid.) do not relate whether the 1980-1982 Angoon deer harvests were considered low, average, or high by the long-time hunters.

The 1980-1984 deer harvest surveys by the Division of Game have sampled all Southeast Alaska communities (Flynn in prep.). Harvest estimates for the smaller communities from 1980 through 1984 are given in tables 12-15. These figures suggest that an average of 15% of the Southeast Alaska deer harvest was by Southeast Alaska residents outside the communities of Juneau, Sitka, Petersburg, Wrangell, and Ketchikan (range 14-17%). These hunters accounted for an estimated 20.5% of the total deer harvest during those years (range 19-22), with an average harvest of 1,840 deer (range 1,260-2,280). In general, hunters from smaller communities killed more deer/hunter than hunters from the nearest major community.

The 1980 and 1982 Angoon estimate from the mail survey (tables 12 and 13) averaged 175 deer compared to the 1980-1982 deer harvest estimate of about 410 derived from household interviews (George and Kookesh 1983). Interestingly, the mail survey showed higher kill rates per hunter than household interviews (2.5 vs 2.0

Table 12. Deer Harvest Statistics for Smaller Communities in Southeast Alaska Based on Mail Questionnaires, 1980

Community	No. of Hunters	% Success	Hunter-days/ Hunter	Estimated Harvest	Deer/ Hunter	Hunter-days/ Deer
Angoon	55	91	6.7	140	2.55	2.6
Elfin Cove	10	100	8.0	30	3.00	2.7
Gustavus	20	75	6.5	40	2.00	3.3
Haines	40	63	5.0	60	1.50	3.3
Hoonah	140	79	8.9	310	2.21	4.0
Kake	40	88	3.5	95	2.38	1.5
Pelican	60	67	5.5	110	1.83	3.0
Port Alexander	5	100	6.0	15	3.00	2.0
Skagway	10	50	4.0	15	1.50	2.7
Tenakee Springs	30	67	6.0	50	1.67	3.6
Funter Bay	5	100	24.0	15	3.00	8.0
Meyers Chuck	10	50	4.0	10	1.00	4.0
Craig	90	67	6.4	125	1.39	4.6
Hydaburg	10	50	5.0	15	1.50	3.3
Hyder	5	0	2.0	0	0.00	
Kasaan	5	0	14.0	0	0.00	
Klawock	50	60	6.6	55	1.10	6.0
Metlakatla	25	40	4.4	20	0.80	5.5
Point Baker	10	50	4.0	10	1.00	4.0
Thorne Bay	70	71	10.1	85	1.21	8.4

Source: Flynn in prep.

Table 13. Deer Harvest Statistics for Smaller Communities in Southeast Alaska Based on Mail Questionnaires, 1982

Community	No. of Hunters	% Success	Hunter-days/ Hunter	Estimated Harvest	Deer/ Hunter	Hunter-days/ Deer
Angoon	85	82	6.9	210	2.47	2.8
Elfin Cove	8	63	5.0	5	0.63	8.0
Gustavus	40	50	6.0	50	1.25	4.8
Haines	70	29	5.0	50	0.71	7.0
Hoonah	220	77	13.7	490	2.23	6.2
Kake	40	75	4.0	40	1.00	4.0
Pelican	60	83	6.7	120	2.00	3.3
Port Alexander	10	100	1.5	15	1.50	1.0
Skagway	20	75	5.5	30	1.50	3.7
Tenakee Springs	30	67	5.7	40	1.33	4.3
Funter Bay	5	100	20.0	20	4.00	5.0
Meyers Chuck	15	100	3.0	25	1.67	1.8
Craig	150	73	7.0	230	1.53	4.6
Hydaburg	30	33	5.7	15	0.50	11.3
Hyder	0	--		0		
Kasaan	2	0	5.0	0	0.00	
Klawock	80	50	7.9	80	1.00	7.9
Metlakatla	30	67	2.7	40	1.33	2.0
Point Baker	20	25	5.0	5	0.25	20.0
Thorne Bay	110	55	14.5	120	1.09	13.3

Source: Flynn in prep.

Table 14. Deer Harvest Statistics for Smaller Communities in Southeast Alaska Based on Mail Questionnaires, 1983

Community	No. of Hunters	% Success	Hunter-days/ Hunter	Estimated Harvest	Deer/ Hunter	Hunter-days/ Deer
Angoon	80	75	16.8	215	2.69	6.2
Elfin Cove	8	38	5.0	5	0.63	8.0
Gustavus	40	50	4.5	70	1.75	2.6
Haines	60	37	1.4	100	1.67	2.7
Hoonah	300	77	8.8	650	2.17	4.1
Kake	70	71	3.7	105	1.50	2.5
Pelican	65	69	5.1	105	1.62	3.1
Port Alexander	10	100	7.0	30	3.00	2.3
Skagway	25	20	6.2	15	2.60	10.3
Tenakee Springs	40	75	6.8	90	2.25	3.0
Funter Bay	2	100	25.0	5	2.50	10.0
Meyers Chuck	20	50	2.3	20	1.00	2.3
Craig	250	62	7.7	290	1.16	6.7
Hydaburg	30	33	6.0	15	0.50	12.0
Hyder	5	0	2.0	0	0	
Kasaan	5	0	4.0	0	0	
Klawock	165	73	8.7	210	1.27	7.6
Metlakatla	40	63	7.8	50	1.25	6.2
Point Baker	30	67	4.3	55	1.83	2.4
Thorne Bay	120	83	10.1	205	1.71	5.8

Source: Flynn in prep.

Table 15. Deer Harvest Statistics for Smaller Communities in Southeast Alaska Based on Mail Questionnaires, 1984

Community	No. of Hunters	% Success	Hunter-days/ Hunter	Estimated Harvest	Deer/ Hunter	Hunter-days/ Deer
Angoon	95	53	12.6	180	1.89	6.7
Elfin Cove	20	0	1.0	0	0.00	
Gustavus	30	100	3.0	50	1.67	1.8
Haines	60	67	3.8	110	1.83	2.1
Hoonah	260	77	8.7	560	2.15	4.5
Kake	35	36	3.7	80	2.29	1.6
Pelican	60	83	5.7	150	2.50	2.3
Port Alexander	15	100	2.7	50	3.33	0.8
Skagway	10	50	5.0	5	0.50	10.0
Tenakee Springs	40	75	5.0	75	1.86	2.7
Funter Bay	10	100	15.0	40	4.00	3.8
Meyers Chuck	10	50	1.0	10	1.00	1.0
Craig	250	68	7.4	300	1.20	6.1
Hydaburg	30	67	5.3	40	1.33	4.0
Hyder	0			0		
Kasaan	10	100	21.0	20	2.00	10.5
Klawock	195	56	13.8	300	1.54	8.0
Metlakatla	50	40	4.3	30	0.60	7.7
Point Baker	40	75	3.3	70	1.75	1.9
Thorne Bay	160	56	8.9	210	1.31	7.5

Source: Flynn in prep.

Table 16. Deer Harvest by Harvest Reporting Area by Hunters from the Five Major Southeast Alaskan Communities, 1960-68

Harvest report area[b]	Estimated Deer Harvest By Community[a]				
	Sitka	Juneau	Petersburg	Wrangell	Ketchikan
Douglas I. (1-1)	0	290	0	0	0
Mainland N. of Stikine R. (1-2)	0	90	50	5	10
Mainland S. of Stikine R. (1-3)	0	4	5	10	340
Revilla I. group (1-4)	0	30	1	0	2,120
West P.W.I. group (2-1)	1	0	3	0	90
East P.W.I. group (2-2)	10	30	2	10	280
Kuiu I. group (3-1)	1	40	40	10	80
Kupreanof I. group (3-2)	10	210	560	60	80
Mitkof I. (3-3)	2	30	550	30	10
Wrangell I. group (3-4)	0	0	3	550	80
Chichagof I. group (4-1)	410	750	2	1	0
Admiralty I. group (4-2)	10	1,610	60	0	20
Baranof I. group (4-3)	1,490	110	0	0	10
No. hunters interviewed[c]	815	808	1,097	679	811
No. deer killed by interviewers[c]	1,259	997	1,877	891	1,283

[a] Data expressed as estimated mean annual deer harvest as determined from hunter interviews (ADF&G 1961, Merriam n.d.b.). The 1961 data are missing.

[b] ADF&G harvest reporting area designation given in parentheses. See reference maps in the Alaska Habitat Management Guide for the Southeast Region, vol. 1, for locations of the harvest report area boundaries.

[c] Total for all years combined.

deer/hunter) but estimated considerably fewer active hunters (70 vs 210). The lower estimated number of hunters accounts for much of the difference in the harvest estimates.

Unpublished survey data from the Division of Subsistence indicated a mean household harvest of 1.6 deer/year in Klawock and Tenakee Springs (Bosworth 1986). When households were asked about the number of deer that would be desired by the household if there were no limitations on the harvesting of deer, the mean number of deer desired per household was 2.6 in Klawock, 7.0 in Angoon, and 3.0 in Tenakee Springs (ibid.).

g. <u>Harvests by nonresidents and resident hunters outside the Southeast Region</u>. The 1980-1984 mail surveys provide the first estimate of deer harvest by nonresidents and residents outside Southeast Alaska. In 1980 and 1982-1984, an average of 160 Alaskan hunters residing outside Southeast Alaska spent an average of 740 days hunting deer in the Southeast Region and killed an average of 130 deer, with an average hunter success of 43% (Flynn in prep.). In those same years, an average of 65 nonresident hunters spent an average of 310 days hunting deer in the Southeast Region and killed an average of 40 deer, with an average hunter success of 50% (ibid.). This harvest is only about 2% of the total regional deer harvest (table 4).

3. <u>Significance of particular use areas</u>

a. <u>1957-68</u>. The estimated deer harvest by licensed resident hunters from the communities of Juneau, Sitka, Petersburg, Wrangell, and Ketchikan is shown for the years 1960 and 1962-1968 by harvest-reporting area in table 16 and displayed on 1:1,000,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 1. Additional information on the location of deer-hunting effort and harvest by hunters in these communities during the years 1957 to 1959 is given in tables 17-19. These data correspond to a period of relatively high deer numbers throughout Southeast Alaska.

During this period of relatively high deer abundance, the majority of the deer harvest by each community occurred in close proximity to that community. For example, on the average, over 80% of the Wrangell deer harvest occurred in the Wrangell-Zarembo-Vank-Woronkoski-Etolin-Shrubby Island harvest-reporting area, and nearly 90% of the Petersburg deer harvest occurred on Kupreanof, Woewodski, and Mitkof islands. Most of the

Table 17. Distribution of Deer Harvest by Residents of the Five Largest Communities in Southeast Alaska, 1957

Hunting Area	Percentage of Hunters From Each Town Using Area for Hunting				
	Juneau (n=100)[a]	Sitka (n=70)	Petersburg (n=100)	Wrangell (n=75)	Ketchikan (n=100)
GMU 1					
Douglas I.	29	---	---	---	---
Juneau Area Mainland	9	---	---	---	---
Cleveland Peninsula	---	---	---	---	18
Revillagigedo I.	---	---	---	---	55
Gravina I.	---	---	---	---	12
GMU 2	---	---	---	---	23
GMU 3					
Mitkof I. only	---	---	14	19	---
Kupreanof I. only	N/A	---	43	---	N/A
Mitkof I. and Kupreanof I.	N/A	---	95	N/A	N/A
Kupreanof and Kuiu I.	7	---	N/A	---	14
Wrangell I.	---	---	---	37	---
Zarembo I.	---	---	---	35	6
Etolin I.	---	---	---	28	6
Woronkofski I.	---	---	---	17	---
Vank I.	---	---	---	8	---
Sokolof I.	---	---	---	7	---
Onslow-Stone I. Area	---	---	---	---	4
GMU 4					
Admiralty I.	69	---	---	---	---
Chichagof I.	11	b	---	---	---
Baranof I.	4	b	---	---	---
Kruzof I.	---	11	---	---	---
Unspecified Locations	5	11	6	19	7

Source: USFWS 1958.

[a] Number of hunters interviewed is given in parentheses.

[b] USFWS (1958) reported that 70% of the Sitka deer hunters hunted adjacent to the channels south of Salisbury Sound, including Sitka Sound, while 23% hunted adjacent to Sergius Narrows and Peril Strait.

--- means no harvest was reported.

N/A means area not applicable because the community harvest was reported by a different geographic unit.

Table 18. Distribution of Deer Harvest by Residents of the Five Largest Communities in Southeast Alaska, 1958

Location Of Kill	Percentage of Kill by Hunters From Each Town				
	Juneau (n=190)[a]	Sitka (n=165)	Petersburg (n=280)	Wrangell (n=155)	Ketchikan (n=290)
GMU 1					
Douglas I.	12	---	---	---	---
Juneau Area Mainland	2	---	---	---	---
Cleveland Peninsula	---	---	---	---	12
Revillagigedo I.	---	---	---	---	26
Gravina I.	---	---	---	---	5
GMU 2	---	---	---	---	21
GMU 3					
Mitkof I.	---	---	24	9	---
Kupreanof I.	N/A	---	71	9	N/A
Etolin I.	---	---	---	29	---
Zarembo I.	---	---	---	24	---
Wrangell I.	---	---	---	17	---
Woronkofski I.	---	---	---	7	---
Etolin and Onlsow I.	---	---	---	---	5
Kupreanof and Kuiu I.	14	---	N/A	---	20[b]
GMU 4					
Admiralty I.	62	---	---	---	---
Chichagof I.	10	*[c]	---	---	---
Baranof I.	---	*[c]	---	---	---
Kruzof I.	---	10	---	---	---
Unspecified Locations	0	2	3	5	11

Source: USFWS 1959.

[a] Sample size of deer kill locations in parentheses.

[b] This harvest was almost entirely from Duncan Canal and Rocky Pass.

[c] USFWS (1959) reported that 57% of the Sitka deer harvest was from lands adjacent to the channels south of Salisbury Sound, including the Sitka Sound area, while 31% of the harvest was from lands adjacent to Sergius Narrows and Peril Strait.

N/A means area not applicable because the community harvest was reported by a different geographic unit.

--- means no harvest was reported.

Table 19. Distribution of Deer Harvest by Residents of the Five Largest Communities in Southeast Alaska, 1959

	Percentage of Kill by Hunters from Each Town				
Location of Kill	Juneau	Sitka	Petersburg	Wrangell	Ketchikan
	(n=130)[a]	(n=90)	(n=240)	(n=110)	(n=180)
GMU 1					
N. of Cape Fanshaw Mainland	12	---	---	---	---
Douglas Island	9	1	---	---	---
S. of Cape Fanshaw Mainland[b]	---	---	4	---	---
Cleveland Peninsula	---	---	---	---	15
Revilla Island	1	---	---	1	40
Gravina Island	---	---	---	---	8
Grant Island	---	---	---	---	1
Bell Island	---	---	---	---	2
Bold Island	---	---	---	---	1
Ruth Island	---	---	1	---	---
GMU 2					
Prince of Wales Island	---	---	---	3	18
Kosciuske Island	---	4	---	---	2
GMU 3					
Kupreanof Island	12	---	61	5	3
Mitkof Island	3	---	29	---	---
Kuiu Island	---	---	---	2	4
Level Island	1	---	---	---	---
Etolin Island	---	---	1	27	3
Wrangell Island	---	---	---	18	---
Zarembo Island	---	---	---	19	---
Woronkofski Island	---	---	---	17	---
Vank Island	---	---	---	7	---
Stone & Onslow Islands	---	---	1	1	2
Woewodski Island	---	---	1	---	---
GMU 4					
N. Admiralty Island	35	2	---	---	---
S. Admiralty Island	10	---	2	---	1
Chichagof Island	15	12	---	---	---
N. Baranof Island	--	48	---	---	---
S. Baranof Island	--	22	---	---	---
Pleasant Island	2	---	---	---	---
Halleck Island	--	5	---	---	---
Kruzof Island	--	2	---	---	---
Krestof Island	--	2	---	---	---
Moser Island	--	2	---	---	---

Source: ADF&G 1960.

a Number of deer kill locations in parentheses.

b Excluding the Cleveland Peninsula.

--- means no harvest reported.

reported harvest of deer by Sitka residents occurred on Baranof, Kruzof, and Chichagof islands.

Approximately 2,120 deer were killed each year from 1960-1968 in the Revillagigedo Island area by Ketchikan hunters (table 16), accounting for 68% of their total harvest. A substantial portion of the 1960-1968 Ketchikan harvest also came from Prince of Wales Island (12%) and the nearby mainland (11%). The Juneau deer harvest by harvest-reporting area (table 16) occurred largely on Admiralty (50%), Chichagof (23%), Douglas (9%), and Kupreanof islands (7%), with lesser amounts elsewhere throughout Southeast Alaska.

b. 1969-74. Harvest location information collected during hunter interviews during 1969-1974 was not consistently reported in annual reports of the Division of Game survey and inventory (S&I) activities, and the use of the 1960-1968 harvest-reporting areas was discontinued. The limited data provided in the S&I reports are used here to evaluate changes in the selection of hunting areas as a result of a decline in deer numbers (ADF&G 1970, 1971, 1973, 1974a, 1974b, 1976).

During this time, Ketchikan hunters continued to hunt largely in the Ketchikan area, with over 80% of their deer harvest occurring in GMS 1A. Prince of Wales Island (GMU 2) accounted for 12 to 21% of the Ketchikan harvest from 1969 to 1972. This fell to 6% in 1973 and to 0% in 1974 (the latter figure based on 202 hunters interviewed from Ketchikan) and corresponded with extremely poor deer-hunting success in the Ketchikan area (table 11). Apparently hunters quickly became discouraged from traveling far to hunt for deer in areas with low success. Ketchikan hunters avoided hunting in GMU 3 during this time, compared to an average harvest of over 250 deer in 1960-1968. Instead they increased their take of deer in GMU 4, which had the best deer hunting, harvesting an average of 65 deer in 1971-1974.

As noted earlier, Wrangell hunters experienced the greatest decline in deer-hunting success of the five large communities sampled (table 6) and about 25% fewer licensed hunters hunted deer during this period (table 5). Wrangell residents who continued to hunt deer hunted largely in GMU 3 and had poor success. For example, in 1973 61% of the hunting effort by Wrangell hunters was in GMU 3, which accounted for only about 25% (31 deer) of their total harvest. Beginning in 1973, hunting effort increased significantly in GMU 4. An estimated 83 and 100 deer were taken by Wrangell hunters in GMU 4 in 1973 and 1974, respectively, representing 64 and 83% of that community's estimated total deer harvest in those respective years.

Petersburg hunters had extremely poor hunting success in GMU 3 after the winter of 1971-1972. Of 150 Petersburg hunters interviewed in 1972 and 1973, none had taken a deer in GMU 3, even though about 23% of the hunting effort by Petersburg hunters in 1973 occurred in GMU 3.

Beginning in 1971, certain Petersburg hunters began making increasing use of Admiralty Island for deer hunting. The estimated deer harvest in GMU 4 by Petersburg residents in 1971, 1972, 1973, and 1974 was 200, 123, 425, and 320 deer, respectively, accounting for about 95% of the total estimated legal harvest by Petersburg residents from 1972 to 1974.

During 1971-1974, deer harvest by Petersburg and Wrangell residents dropped to nearly zero in GMS 1B.

Juneau and Sitka hunters continued to rely largely on GMU 4 for their deer hunting. A marked change in hunting locations by Juneau residents resulted from a decrease in hunting effort south of Frederick Sound as a result of the low deer numbers in those areas.

c. 1980-1984. Efforts by the ADF&G to delineate deer harvest locations in Southeast Alaska have increased in the 1980's. The deer hunter surveys by the Division of Game (Flynn in prep.) have provided estimates of deer harvest to GMU and major harvest area by residency of the hunters of all communities for the years 1980, 1982, 1983, and 1984. For 1:250,000-scale reference maps showing deer harvests, number of hunters, and hunter effort for the years 1980 and 1982-1984 by major harvest areas, see the Alaska Habitat Management Guide for the Southeast Region, volume 1. The 1983 data are given in tables 20 and 21. The Division of Subsistence has undertaken a number of studies identifying hunting areas of certain communities, using interviews of randomly selected households. Some of these studies have been completed (George and Kookesh 1983, Ellanna and Sherrod 1986, Gmelch and Gmelch 1986). Reference maps showing the locations of deer hunting areas for the communities of Angoon, Tenakee Springs, Yakutat, and Klawock are given in the Alaska Habitat Management Guide for the Southeast Region, volume 2.

The 1983 deer harvest by Juneau residents occurred primarily on Admiralty, Chichagof, and Douglas islands and the Baranof Island area draining into Peril Strait and, secondarily, on Lincoln and Shelter islands and the mainland in the vicinity of Juneau (table 21). Limited deer hunting by Juneau residents occurred throughout much of the rest of GMUs 1-4.

Sitka hunters in 1983 reported hunting nearly exclusively on Baranof, Kruzof, and Chichagof islands and adjacent smaller islands (table 21), a pattern similar to the period 1960-1968 (Table 16). Petersburg residents harvested deer primarily in GMUs 2 (135 deer) and 4 (730 deer) in 1983 and reported no harvests in GMS 1B and GMU 3 (table 20). In the former areas, hunting activity and harvest were highest on the southern half of Admiralty Island, the northern half of Prince of Wales Island, and in the Peril Straits area.

Wrangell residents harvested deer mainly in GMU 4 (125 deer), the south half of GMU 3 (60 deer), GMU 2 (35 deer), and GMS 1B (20 deer) in 1983.

Ketchikan residents harvested deer primarily in GMU 2 (795 deer), GMS 1A (360 deer), and GMU 4 (135 deer). The high proportion of deer harvested on Prince of Wales Island by Ketchikan residents is noteworthy and differs from the period 1957-1974 when most of the Ketchikan deer harvest occurred in GMS 1A. The relatively poor deer hunting close to home is no doubt responsible for the tendency for a higher percentage of Petersburg, Wrangell, and Ketchikan hunters to travel farther from their communities to hunt deer in 1983 than during the period 1960-1968.

Most of the deer harvest by the smaller communities occurred in the vicinity of those communities (table 21). Some residents in certain communities, such as Craig, Haines, and Skagway, traveled to GMU 4 to harvest deer.

Nonresidents and hunters outside Alaska hunted primarily in GMU 4 in 1983 (table 20).

4. <u>Location of hunting effort within a typical watershed.</u> Available studies indicate that hunters use a variety of habitats within a given watershed for deer hunting. Post-season interviews with 425 hunters in Juneau, Ketchikan, Sitka, Wrangell, and Petersburg indicate that 11% of the 1959 deer harvest occurred in alpine, 26% in muskeg, 37% in low elevation timber, and 9% on the beach (ADF&G 1960). A similar interview, based on 1,143 deer kills by hunters in these large communities, as well as Kake, Angoon, Pelican, Hoonah, Craig, and Klawock, indicated that 10% of the deer harvest occurred in alpine, 19% in high-elevation timber or muskeg, 64% in low-elevation timber or muskeg, and 7% on the beach (ADF&G 1961).

Table 20. Deer Harvest Statistics for GMUs 1-4, by Residence of Hunter, Based on a Mail Survey, 1983

GMU/GMS	Residence of Hunter	No. of Hunters	No. of Successful Hunters	Total Hunter-Days	Estimated Deer Harvest
1A	Juneau	10	0	30	0
	Ketchikan	880	250	4,720	360
	Meyers Chuck	20	10	40	20
	Klawock	10	10	20	10
	Metlakatla	40	30	310	50
	Other Alaska	10	0	10	0
	Subtotal	960	300	5,130	440
1B	Juneau	5	0	10	0
	Petersburg	35	0	130	0
	Wrangell	40	20	60	20
	Subtotal	80	20	200	20
1C	Juneau	780	155	2,840	360
	Haines	20	15	90	40
	Pelican	10	0	60	0
	Petersburg	5	0	5	0
	Skagway	5	0	10	0
	Ketchikan	10	0	10	0
	Other Alaska	30	0	120	0
	Subtotal	860	170	3,110	400
2	Juneau	10	10	80	5
	Haines	5	5	40	15
	Petersburg	100	70	470	135
	Ketchikan	780	470	5,360	795
	Craig	240	150	1,700	270
	Hydaburg	30	10	180	15
	Kasaan	5	0	20	0
	Klawock	160	110	1,600	210
	Wrangell	40	25	290	35
	Thorne Bay	120	100	1,210	205
	Other Alaska	5	0	100	0
	Outside Alaska	30	0	100	0
	Hyder	5	0	10	0
	Pt. Baker	30	20	130	55
	Subtotal	1,560	970	11,290	1,740

(continued)

Table 20. (continued)

GMU/GMS	Residence of Hunter	No. of Hunters	No. of Successful Hunters	Total Hunter-Days	Estimated Deer Harvest
3	Juneau	5	5	15	10
	Petersburg	25	0	160	0
	Ketchikan	15	5	65	10
	Wrangell	220	60	970	60
	Subtotal	260	70	1,210	80
4	Juneau	1,990	1,190	10,255	2,700
	Angoon	85	60	1,340	215
	Elfin Cove	10	5	40	5
	Gustavus	40	20	180	70
	Haines	40	20	135	45
	Hoonah	300	230	2,695	650
	Kake	70	45	260	105
	Pelican	60	50	330	105
	Petersburg	330	300	1,875	730
	Sitka	1,690	1,180	11,560	3,160
	P. Alexander	10	10	70	30
	Skagway	20	5	155	15
	Tenakee Springs	40	30	270	85
	Funter Bay	2	2	50	5
	Ketchikan	55	95	265	135
	Craig	20	10	230	20
	Wrangell	130	80	480	125
	Other Alaska	180	80	680	125
	Outside Alaska	60	45	180	30
	Subtotal	5,100	3,390	31,030	8,360
	Unknown unit	110	10	580	10
Southeast Region total		8,220	4,750	52,550	11,050

Source: Flynn in prep.

ɔle 21. Southeast Alaska Deer Harvest Statistic: _ Major Harvest Area, by Residence of Hunter, Based on a Mail Survey, 1983

GMU/GMS	Major Harvest Area[a] / Residence of Hunter	No. of Hunters	No. of Successful Hunters	Hunter-days	Estimated Deer Harvest
1A	Gravina Island (1)				
	Ketchikan	330	110	1,270	140
	Klawock	10	10	15	10
	Other Alaska[b]	5	0	5	0
	Subtotal	345	120	1,290	150
1A	Revilla Island, S. (4)				
	Ketchikan	420	90	1,780	100
	Metlakatla	35	25	310	50
	Subtotal	450	115	2,090	150
1A	Revilla Island, N. (5)				
	Ketchikan	320	70	1,300	90
	Other Alaska	5	0	5	0
	Subtotal	325	70	1,305	90
1A	Cleveland Penninsula (6)				
	Juneau	5	0	30	0
	Ketchikan	140	20	320	30
	Meyers Chuck	20	10	45	20
	Subtotal	165	30	395	50
1A	Mainland (7)				
	Ketchikan	15	0	50	0
1B	Fanshaw-Thomas Bay (16)				
	Petersburg	30	0	100	0
1B	Stikine-Leconte (17)				
	Petersburg	10	0	25	0
	Wrangell	5	5	5	5
	Subtotal	15	5	30	5

(continued)

Table 21. (continued)

GMU/GMS	Major Harvest Area[a] / Residence of Hunter	No. of Hunters	No. of Successful Hunters	Hunter-days	Estimated Deer Harvest
1B	South Mainland (18)				
	Juneau	5	0	15	0
	Wrangell	30	10	55	15
	Subtotal	35	10	70	15
1C	Sullivan-Endicott (22)				
	Haines	20	15	90	40
	Petersburg	5	0	5	0
	Subtotal	30	15	95	40
1C	Chilkat Range (23)				
	Juneau	5	5	35	10
1C	Berners Bay (24)				
	Juneau	15	5	20	10
	Pelican	15	0	60	0
	Subtotal	30	5	80	10
1C	Juneau Mainland (25)				
	Juneau	125	40	265	50
1C	Shelter Island (26)				
	Juneau	140	35	540	50
1C	Tracy-Endicott (28)				
	Juneau	30	10	90	10
1C	Port Houghton (29)				
	Other Alaska	5	0	5	0
1C	Douglas Island (27)				
	Juneau	570	75	1,870	230
	Skagway	5	0	10	0
	Ketchikan	10	0	10	0
	Other Alaska	20	0	110	0
	Subtotal	595	75	2,000	230

(continued)

ble 21. (continued)

GMU/GMS	Major Harvest Area[a] Residence of Hunter	No. of Hunters	No. of Successful Hunters	Hunter-days	Estimated Deer Harvest
2	P. of Wales Outer Is. (4)				
	Ketchikan	10	10	10	10
	Craig	45	10	230	30
	Subtotal	55	20	240	40
2	Heceta Island (10)				
	Petersburg	5	5	25	10
	Ketchikan	35	25	140	20
	Craig	10	10	90	30
	Klawock	10	40	20	0
	Outside Alaska[c]	10	0	10	0
	Subtotal	70	40	285	60
2	P. of Wales Southwest (11)				
	Haines	5	5	40	15
	Ketchikan	110	55	520	75
	Craig	10	0	45	0
	Klawock	10	10	10	10
	Wrangell	5	5	170	5
	Hydaburg	30	10	180	15
	Subtotal	170	85	965	120
2	P. of Wales Southeast (12)				
	Petersburg	5	5	25	5
	Ketchikan	130	35	270	70
	Craig	10	10	90	30
	Klawock	10	0	50	0
	Thorne Bay	5	5	40	5
	Subtotal	160	55	475	110
2	P. of Wales North (13,14,15)				
	Juneau	5	5	75	5
	Petersburg	95	65	430	120
	Ketchikan	580	360	4,390	620
	Craig	220	130	1,300	180
	Klawock	140	100	1,490	200

(continued)

Table 21. (continued)

GMU/GMS	Major Harvest Area[a] / Residence of Hunter	No. of Hunters	No. of Successful Hunters	Hunter-days	Estimated Deer Harvest
	Wrangell	35	20	120	30
	Thorne Bay	120	95	1,170	200
	Other Alaska	5	0	100	0
	Outside Alaska	30	0	90	0
	Kasaan	5	0	20	0
	Pt. Baker	30	20	130	55
	Hyder	5	0	10	0
	Subtotal	1,270	795	9,325	1,410
3	Eastern Islands (19)				
	Juneau	5	5	15	10
	Petersburg	25	0	90	0
	Ketchikan	15	5	70	10
	Wrangell	220	55	970	60
	Subtotal	265	65	1,145	80
3	Western Islands (20)				
	Petersburg	20	0	65	0
4	Sitka Area (30)				
	Juneau	20	5	60	10
	Haines	5	10	20	0
	Sitka	1,100	620	5,590	1,340
	Craig	20	10	230	20
	Other Alaska	70	30	300	40
	Subtotal	1,215	665	620	1,410
4	Tenakee Inlet (36)				
	Juneau	230	180	1,240	420
	Gustavus	10	10	20	20
	Haines	5	5	30	20
	Hoonah	30	20	120	30
	Petersburg	20	5	40	10
	Sitka	45	30	390	90
	Tenakee	30	20	180	70
	Wrangell	10	5	40	5

(continued)

Table 21. (continued)

GMU/GMS	Major Harvest Area[a] Residence of Hunter	No. of Hunters	No. of Successful Hunters	Hunter-days	Estimated Deer Harvest
	Other Alaska	15	5	60	10
	Subtotal	395	280	2,120	675
4	S. Baranof (37)				
	Juneau	5	5	30	10
	Hoonah	10	10	40	10
	Petersburg	30	20	100	50
	Sitka	140	110	570	230
	Ketchikan	10	10	30	25
	Wrangell	5	5	10	5
	Outside Alaska	10	0	10	0
	P. Alexander	10	10	70	30
	Subtotal	220	170	860	360
4	N. Admiralty (38)				
	Juneau	640	300	2,100	485
	Hoonah	10	10	10	20
	Petersburg	20	0	80	0
	Funter Bay	2	2	50	5
	Other Alaska	15	0	35	0
	Subtotal	687	312	2,275	510
4	S.E. Admiralty (39)				
	Juneau	180	110	770	190
	Kake	55	35	200	70
	Petersburg	210	190	1,120	440
	Ketchikan	30	30	200	80
	Wrangell	30	25	150	60
	Outside Alaska	10	10	20	10
	Subtotal	515	400	2,460	850
4	Goddard (32)				
	Sitka	220	115	770	210
	Other Alaska	20	10	100	10
	Subtotal	240	125	870	210

(continued)

Table 21. (continued)

GMU/GMS	Major Harvest Area[a] / Residence of Hunter	No. of Hunters	No. of Successful Hunters	Hunter-days	Estimated Deer Harvest
4	W. Admiralty (40)				
	Juneau	260	120	790	170
	Angoon	80	60	1,240	195
	Kake	15	15	60	35
	Petersburg	30	20	100	55
	Sitka	15	5	30	5
	Wrangell	25	10	140	40
	Subtotal	425	230	2,360	500
4	Kruzof Island (31)				
	Juneau	30	5	40	10
	Haines	5	0	20	0
	Sitka	510	330	2,180	610
	Other Alaska	5	0	5	0
	Subtotal	550	335	2,245	610
4	Peril Strait (33)				
	Juneau	100	75	400	130
	Angoon	30	10	100	20
	Haines	5	5	30	20
	Hoonah	10	10	60	30
	Petersburg	80	70	350	115
	Sitka	320	200	1,400	390
	Tenakee	10	10	90	20
	Ketchikan	5	5	25	30
	Wrangell	10	5	25	5
	Other Alaska	20	10	50	10
	Outside Alaska	30	20	130	20
	Subtotal	615	420	2,660	790
4	W. Chichagof (34)				
	Juneau	120	110	570	260
	Haines	5	5	5	5
	Hoonah	10	10	35	20
	Pelican	60	50	330	105
	Petersburg	5	5	25	20

(continued)

ble 21. (continued)

GMU/GMS	Major Harvest Area[a] Residence of Hunter	No. of Hunters	No. of Successful Hunters	Hunter-days	Estimated Deer Harvest
	Sitka	170	120	480	260
	Other Alaska	15	15	90	30
	Elfin Cove	10	5	40	5
	Subtotal	395	320	1,575	705
4	N. Chichagof (35)				
	Juneau	130	60	690	125
	Gustavus	40	20	160	50
	Hoonah	270	220	2,410	540
	Petersburg	5	5	20	20
	Sitka	20	15	80	35
	Skagway	15	5	130	15
	Ketchikan	10	0	10	0
	Wrangell	20	5	110	5
	Other Alaska	15	5	30	20
	Subtotal	525	275	3,640	810
4	Seymour Canal (41)				
	Juneau	810	440	3,515	890
	Petersburg	10	10	40	20
	Sitka	5	0	70	0
	Skagway	5	0	25	0
	Wrangell	5	5	5	5
	Other Alaska	35	5	90	5
	Outside Alaska	10	0	20	0
	Subtotal	880	460	3,765	920

Source: Flynn in prep.

[a] Major harvest area number given in parentheses. See 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 1, for the location of major harvest area boundaries.

[b] "Other Alaska" refers to resident hunters with residencies outside of the Southeast Region.

[c] " Outside Alaska" refers to nonresident hunters.

George and Kookesh (1983) reported that, for Angoon residents in 1982, 15% of all deer hunting trips occurred in alpine, 28% in meadows (including muskegs), 14% in forest, and 43% on the beach. The higher incidence of beach hunting by this community compared to the above regionwide percentages is noteworthy.

Both Johnson and Wood (1979) and George and Kookesh (1983) have described the seasonal use of various habitats by deer hunters. The alpine hunts are most prevalent in August and September, prior to fall frosts, and are often considered to be a "high quality" type of hunt. Johnson and Wood (1979) estimate that less than 4% of all deer in Southeast Alaska are killed by alpine hunting.

Beach hunting occurs throughout the hunting season but is most intensive during November and December, when heavy snows force deer into lower elevations (George and Kookesh 1983). Hunters also venture inland to hunt deer on their winter range during this time (Johnson and Wood 1979). Johnson and Wood (ibid.) have classified this type of hunting as "primarily a meat hunt".

One important consideration is that, because deer hunters will range widely over a watershed, any major alteration of habitat (such as road construction or logging) in a watershed that receives hunting use is likely to directly affect the quality of the deer hunting experience (whether positively or negatively) and perhaps change hunting patterns. These impacts on hunting recreation will be in addition to impacts on the deer population as a result of habitat changes.

E. Regional Summary

Deer comprise over 90% of the total big game animals harvested annually in the Southeast Region. During 1960-1968, deer were abundant from Dixon Entrance to the Admiralty-Baranof-Chichagof islands and yearly estimated harvests by licensed resident hunters averaged about 11,200. In the late 1960's and early 1970's, the deer population crashed throughout the Panhandle and the estimated average harvest during 1969-1974 declined to about 5,200. Since this decline, deer populations have increased to and remained at relatively high densities in GMU 4 and remained at low-to-moderate densities in most of the remainder of Southeast Alaska. In 1983-1984, an estimated 8,410 hunters harvested an estimated 11,500 deer. During 1980-1984, total harvests, number of deer hunters, and total hunter-days all increased dramatically. About 75% of the estimated deer harvest during 1983-1984 occurred in GMU 4.

Surveys of hunters suggest that during 1960-1968, when deer populations were high, seasons were liberal, and the bag limit was four deer of either sex over most of the Southeast Region, hunters in the communities of Juneau, Sitka, Wrangell, Ketchikan, and Petersburg killed an average of about two deer/hunter, spent an average of six days hunting deer each year, and had an average hunter-success rate of 75%. From 1969 through 1974, the hunter-success rate dropped to about 40% (with substantial variations among communities), the deer/hunter figure declined to less than one, and the average number of hunter-days/deer killed went from three to seven regionwide. Interestingly, the average days spent hunting deer/hunter remained at six/year. However, a substantial decline in the percentage of licensed hunters who hunted deer occurred in large communities where the average effort/harvest around the community increased to the range of 8-13 hunter-days/-deer.

Surveys in the 1960's, 1970's, and 1980's suggested that hunters from smaller communities in the Southeast Region generally have somewhat higher hunter success rates and higher average deer harvests/hunter than hunters in the larger communities, if nearby deer densities are similar. Evidence suggests that deer harvests by rural residents and residents in smaller communities may have been considerably underestimated in estimates of regionwide deer harvests. Hence, the Southeast deer harvests have probably been higher than the estimates suggest. Estimates from 1980 through 1984 have indicated that 15% of the people who picked up deer harvest tickets were Southeast Alaska residents outside the communities of Juneau, Sitka, Wrangell, Ketchikan, and Petersburg and that these people harvested an average of 20% of the deer taken in the Southeast Region.

Only a minor percentage of the Southeast deer harvest is currently by nonresident hunters and Alaskan hunters who reside outside the Southeast Region.

Hunter surveys have shown that when deer populations are high around a community most of the community deer harvest occurs within about 30 mi of the community. When deer populations decline in the vicinity of a community, some hunters travel to other areas where deer populations are abundant and/or seasons are more liberal (e.g., Petersburg and Wrangell hunters have increased their hunting efforts in GMU 4 since deer have declined in GMU 3). However, fewer hunters engage in deer hunting when they must travel greater distances, and the number of active deer hunters, in relation to the number of licensed hunters, and the community deer harvests decline in those areas where deer are not locally abundant.

Dramatic changes in regional and community deer harvests, hunter success, average hunter-days/deer killed, average deer/hunter, and number of active deer hunters appear to be related to changes in deer densities. General patterns discussed in this chapter may be useful in modeling the effect of reductions in deer numbers as a result of habitat loss (Schoen et al. 1985) on deer harvests, hunter success, and hunter participation.

IV. HUMAN USE OF MOOSE

A. Introduction

This chapter summarizes the reported harvest of moose in the Southeast Region during 1960-1984. The major focus is to compile the available information on reported harvest levels and number of hunters and hunter-days spent hunting moose. Management considerations are briefly addressed.

B. Management Considerations

1. Limited prime habitat and isolated populations. In the Southeast Region, moose populations are generally associated with mainland riparian habitats with suitable forage. The regional distribution and abundance of moose, together with forage and habitat selection studies, strongly indicate that the preferred habitats of moose are areas with abundant quantities of preferred browse, especially willow (Salix spp.) and red osier dogwood (Cornus stolonifera) (LeResche 1974; Doerr 1983, 1984; Hundertmark et al. 1983; Craighead et al. 1984).

   Throughout Southeast Alaska, such habitats are limited. Consequently, moose populations are relatively small and often isolated. Because moose tend to occur in relatively discrete populations in Southeast Alaska, hunting regulations and the collection of harvest data have often been directed toward the management of specific populations.

   Furthermore, the protection and/or enhancement of prime riparian habitat is a major management concern for moose in the Southeast Region. For additional information regarding habitat management concerns of moose, see Sigman (1985).

2. Changes in population abundance. Moose have established themselves in the Southeast Region since the mid 1800's (Klein 1965, LeResche et al. 1974). In some areas, such as GMS 6A (ADF&G 1984a, 1985a), Glacier Bay National Park and Preserve (Vequist 1985), and southern portions of the Chilkat Range (Zimmerman 1985), moose have recently expanded their range and increased in numbers. These changes may be attributed to successional habitat changes resulting from a recent warming pattern that has prompted deglaciation or to a gradual build-up of moose in adjacent, peripheral areas often containing marginal moose habitat, following the initial colonization of moose along major river systems of the "Southeast Panhandle." Moose also appear to be colonizing and increasing their numbers on certain islands of the coastal archipelago (ADF&G 1984a, Young 1985, Zimmerman 1985) as outlined on the 1:250,000-scale reference maps of moose distribution in the Alaska Habitat Management Guide for the Southeast Region, volume 1.

Conversely, the two largest moose populations in Southeast Alaska, occupying the Yakutat Forelands and the Chilkat River system, have experienced drastic declines in numbers due to a variety of reasons (Dinneford 1986). The moose carrying capacity of the Yakutat Forelands may be declining as a result of a lack of habitat manipulations and changes from mesic to more zeric conditions due to isostatic uplift (ibid.).

Harvests of moose have fluctuated in response to populations dynamics and are often not constant. In areas where moose harvest occurs, it is therefore important to assess whether the population is well established and stable, still in the process of expanding its range, or possibly experiencing a long-term decline in numbers.

3. High demand for moose hunting relative to hunting opportunities. Moose hunting is extremely popular in the Southeast Region, and the public demand for quality moose hunting, both in the sense of having a high probability of bagging a moose and hunting in relatively uncrowded situations, exceeds the available opportunity. Given the limited areas that can sustain a substantial harvest, restrictive hunting regulations (discussed in section C) and relatively low hunter success are common. In 1985, three hunting areas (Berners Bay, GMS 1D, and GMS 5A, except Nunatak Bench) were restricted to Tier II hunting permits (ADF&G 1985b).

4. Effects of changes in human access. The large size of moose, compared to Sitka black-tailed deer, mountain goat, and black bear, makes "packing out" the meat more difficult and tends to concentrate moose hunters near access areas more than is necessary for other big game hunters. Consequently, areas of moose hunting are generally close to some transportation means, chiefly waterways (salt water and fresh water), roads, and aircraft landing sites. Areas that receive limited hunting pressure within the range of a heavily-hunted population, may serve as important reserves that reduce the chances of overharvesting (Dinneford 1986). Increased access, because of new road construction or use of all-terrain vehicles, in areas with sufficient existing access may lead to increased hunting pressure and result in further restrictions in seasons or the creation of management schemes to limit participation.

C. Summary of Seasons and Bag Limits

General hunting seasons and bag limits for moose during 1969-1984 are given in table 22. In GMSs 1A, 1B, and 1C, excluding Berners Bay, hunting has been mostly limited to a one-month bull season. One exception is the area of GMS 1B north of LeConte Bay (which includes the Thomas Bay moose population), where the season was

Table 22. General Hunting Seasons and Bag Limits for Moose by Area in Southeast Alaska, 1960-84

Area	Year(s)	Season[a]	Bag Limit
GMU 1A[b]	1960-84	Sept.15-Oct.15	1 bull
GMU 1B	1960-70	Sept.15-Oct.15	1 bull
	1971	Stikine River: Sept.15-Oct.31 Remainder of GMS 1B: Sept.15-Oct.15	1 bull
	1972-73	Stikine River: Sept.15-Sept.30 (anterless)[c] Oct.10-Oct.25 (bull) Remainder of GMS 1B: Sept.15-Oct.15	1 moose 1 bull
	1974-76	Sept.15-Oct.15	1 bull
	1977-81	Stikine River: Sept.15-Oct.15 Remainder of 1B[d]: Oct.1-Oct.31	1 bull
	1982-83	South of LeConte Glacier: Sept.15-Oct.15 North of LeConte Glacier: No open season	1 bull
	1984	South of LeConte Glacier: Sept.15-Oct.15 North of LeConte Glacier[c]: Oct.1-Oct.15	1 bull[e]
GMU 1C, excluding Berners Bay	1960-84	Sept.15-Oct.15	1 bull[f]
Berners Bay drainages	1960-62	No open season	
	1963-64	Sept-15-Sept.30	1 bull
	1965-70	Sept.15-Oct.15	1 bull
	1971	Sept.15-Oct.15	1 moose[c]
	1972	Sept.15-Oct.15	1 moose[c]
	1973-74	Sept.15-Oct.15	1 moose[c]

(continued)

Table 22 (continued).

Area	Year(s)	Season[a]	Bag Limit
	1975-77	No open season	
	1978-82	Sept.15-Oct.15	1 bull[c]
	1983-84	Sept.15-Oct.15	1 antlerless moose[c]
GMUs 2, 3, and 4	1960-61	Sept.15-Oct.15	1 bull
	1962-64	No open season	
	1965-67	Sept.15-Oct.15	1 bull
	1968-84	No open season	
GMS 1D[g]	1960-61	Sept.15-Oct.15	1 bull
	1962-63	Sept.1-Oct.15	1 bull
	1964	Sept.1-Oct.15 (bulls) Oct.9-Oct.15 (antlerless)	1 moose
	1965-67	Sept.1-Oct.15 (bulls) Oct.14-Oct.15 (antlerless)	1 moose
	1968-73[h]	Sept.1-Oct.15	1 moose[i]
	1974	Sept.15-Sept.19	1 moose[c]
	1975	Sept.15-Sept.18	1 moose[c]
	1976	Sept.15-Sept.30 (bulls) Sept.15-Sept.16 (anterless)	1 moose[c]
	1977-82	Sept.15-Sept.30	1 bull
	1983	Sept.22-Oct.6	1 bull
	1984	Sept.15-Sept.27	1 bull[c]
GMU 5	1960	Aug.20-Sept.30 Nov.1-Nov.30	1 bull
	1961	Aug.10-Nov.30 (bulls) Nov.1-Nov.30 (antlerless)	1 moose
	1962-72	Aug.10-Nov.30	1 moose

(continued)

Table 22 (continued).

Area	Year(s)	Season[a]	Bag Limit
GMU 5 (cont.)	1973	Portion lying west of Yakutat Bay and Hubbard Glacier: Aug.10-Nov.30 Remainder of GMU 5: Aug.10-Sept.30	1 moose
	1974	Portion lying north of Nunatak and Russell Fiord from east Nunatak Glacier, including area west of Yakutat Bay: Oct.15 until closed by commissioner's announcement Remainder of GMU 5: No open season	1 moose[c]
	1975	"West of Yakutat Bay" as described for 1974 above: Sept.15-Oct.5 Remainder of GMU 5: No open season	1 moose[c]
	1976-77	"West of Yakutat Bay": Sept.15-Oct.15 Remainder of GMU 5: No open season	1 moose
	1978-79	GMS 5A, except drainages into Disenchantment Bay: Oct.15-Nov.15 GMS 5A, drainages into Disenchantment Bay: No open season GMS 5B: Sept.15-Oct.15	1 bull[c]
	1980	GMS 5A, except Nunatak Bench: Oct.15-Oct.18 Nunatak Bench: Nov.15-Dec.15[c] GMS 5B: Sept.15-Oct.15[c]	1 bull
	1981	GMS 5A: Oct.15-Nov.15[c] GMS 5B: Sept.1-Oct.31[c]	1 bull

(continued)

Table 22 (continued).

Area	Year(s)	Season[a]	Bag Limit
	1982-84	GMS 5A, except Nunatak Bench: Oct.15-Nov.13; Nunatak Bench Nov.15-Feb.15; GMS 5B: Sept.1-Oct.31	1 bull[c,j]
GMS 6A	1960	Aug.20 until closed by commissioner's announcement	1 bull
	1961	No open season	
	1962-63	Same as 1960	1 bull[c]
	1964	Open and closed by field announcement	1 bull
	1965-67	Aug.20-Sept.30	1 bull
	1968	Aug.20-Sept.30, Nov.1-Nov.30	1 bull
	1969-71	Same as 1968	1 moose[c,k]
	1972-77	Aug.20-Nov.30	1 moose[c]
	1978-79	Sept.1-Nov.30	1 moose[c]
	1980-84	Sept.1-Dec.31	1 moose[c]

Source: ADF&G general harvest regulation booklets, 1960-84, and Dinneford 1986.

a Season length was sometimes reduced by emergency orders.

b The Chickamin River drainage was closed to moose hunting during 1971.

c Permit hunt, sometimes with limited permits and/or harvest quotas.

d In 1981, the Thomas Bay Area was closed to moose hunting by emergency order after six days of hunting.

e Bulls taken north of LeConte Glacier must have at least three tines on one antler.

f Registration permit hunt in 1984.

(continued)

Table 22. (continued).

[g] Prior to 1971, GMS 1D was called GMS 1C and what are currently GMSs 1B and 1C were GMS 1B.

[h] All drainages into Taiya Inlet were closed to moose hunting from 1968 through 1975.

[i] During 1969-72, the anterless moose season was to be closed by emergency order when 50 anterless moose were taken. In 1972 and 1973, the anterless moose season lasted only 10 and 9 days, respectively.

[j] One moose of either sex could be taken in the Nunatak Bench Area in 1982 and 1983.

[k] Permits not required for bulls in 1969 and 1970.

closed in 1982 and 1983 and limited to 6 and 15 days in 1981 and 1984, respectively.

GMS 1D has had the moose hunting season shortened from 45 days during the years 1962-1973 to less than 17 days during the period 1974-1984. Antlerless moose hunting has not been permitted in GMS 1D since 1976. Hunting seasons in GMU 5 have shown similar patterns with three and one-half month, either-sex seasons during much of the 1960's and early 1970's and closed season or very restricted bulls-only hunting in most of GMS 5A since 1973 (table 22). Moose hunting in GMS 5B has been limited to bulls since 1977; however, in 1981-1984, the season lasted two months.

Two areas in the Southeast Region have had increased hunting opportunities over the last decade: GMS 6A and the Nunatak Bench Area of GMS 5A. In GMS 6A, seasons were very restrictive in the early 1960's as the moose population became established and gradually increased (table 22). During 1980-1984, the season lasted from September through December, with a bag limit of one moose. A special hunting season was established for the Nunatak Bench area of GMS 5A in 1980. During 1982-1984 the season lasted from mid November to mid February, and in 1982 and 1983, moose of either sex could be harvested.

D. Data on Human Use

1. Qualifications and limitations of data. The information presented here is based on harvest data summarized in various ADF&G annual moose reports, annual survey and inventory progress reports, and additional information provided by the Division of Game for the 1984 season (ADF&G 1985c, Griese 1986). The harvest levels discussed in this report do not account for moose that may have been taken illegally out-of-season.

   The basis for estimating the magnitude of the harvest varied for the different moose populations and over time. Estimates of the number of animals harvested in some populations was based on a combination of hunter interviews, field checking stations, and field contact with hunters. These data were sometimes used with harvest-report tickets to estimate the total harvest. Adjustments were sometimes made in the reported harvest to reflect estimates by area game management biologists of additional unreported kills during the season.

   An early estimate of harvest levels on the Yakutat Forelands was based on determining the number of moose carcasses transported from Yakutat on commercial airlines and assuming that this number represented 50% of the legal harvest (Atwell 1963).

   Since 1963, moose hunters have been required to obtain a harvest ticket or harvest permit and report their hunting activities. The requirement to return harvest tickets was not strictly enforced (Flynn 1986), and estimates of the number of hunters and moose killed based on harvest tickets have been substantially lower than those derived from hunter interviews and field checks. On the other hand, nearly all permits have been returned because the reporting requirements are strictly enforced (ibid.).

Permit hunts have become increasingly common in the Southeast Region. In 1984, all moose hunters except those hunting in GMS 1A and portions of GMS 1B were required to obtain permits (table 22). Permit hunt reports have been the primary source of moose harvest information for Berners Bay, GMU 6, and, since 1973, GMU 5.

Some reported harvest figures are undoubtedly low because of unreported kills by hunters missed at check stations or successful hunters who did not return harvest tickets. Harvest data for specific moose populations are also limited in some years by a tendency for ADF&G reports to combine data from several herds when summarizing harvest statistics for a GMU. This tendency to lump harvest data from several populations was particularly prevalent for the smaller moose populations. For example, the harvest of moose in GMS 1B outside of the Stikine River and Thomas Bay was often reported only for the entire area and not for specific drainages within GMS 1B. Consequently, harvest data for these smaller populations are limited.

Despite the above limitations, the reported harvest levels are considered to be sufficiently accurate estimates of the legal harvest to meet management needs.

2. Reported moose harvest levels and hunting effort, 1960-1984. This section discusses moose harvests and hunting effort by GMU/GMS.

   a. GMS 1A. Moose harvests in this subunit have been based primarily on harvest ticket returns and, secondarily, on hunter interviews. Few moose kills were reported prior to the mid 1970's. However, since 1976, several moose have been reported as taken each year by hunters, with record reported harvests of five and seven in 1983 and 1984, respectively (ADF&G 1979, 1980a, 1983a, 1985a, 1985c).

   The number of moose hunters and the number of hunter-days has not been summarized in annual ADF&G reports for most years. In 1984, a minimum of 42 hunters reported hunting a total of 191 days in GMS 1A (ADF&G 1985c).

Table 23. Annual Reported Moose Harvests and Number of Hunters in the Stikine River Drainage, 1960-62 and 1970-84[a]

Year	Harvest	No. of Hunters	Source
1960	39	130	ADF&G 1961a
1961	28	150	Atwell et al. 1963
1962	35	120	Atwell 1963
1970	28	---	ADF&G 1971
1971	25	125	ADF&G 1983a
1972	26	130	ADF&G 1983a
1973	47	190	ADF&G 1983a
1974	24	150	ADF&G 1976a
1975	16	150+	ADF&G 1977a
1976	21	---	ADF&G 1983a
1977	21	---	ADF&G 1979
1978	29	---	ADF&G 1980a
1979	26	---	ADF&G 1983a
1980	33	---	ADF&G 1983a
1981	33	150+	ADF&G 1983a
1982	31	130	ADF&G 1984a
1983	41	---	ADF&G 1985a
1984	41	210	ADF&G 1985c

[a] Harvests and number of hunters were based on field checks and hunter interviews.

--- = means no data were available.

Table 24. Annual Reported Moose Harvests in the Thomas Bay Area, 1960-61 and 1970-84

Year	Harvest[a]	Source
1960	5	ADF&G 1961a
1961	11	Atwell et al. 1963
1970	12	ADF&G 1971
1971	Min.10	ADF&G 1973
1972	5	ADF&G 1974c
1973	3	ADF&G 1983a
1974	4	ADF&G 1976a
1975	8	ADF&G 1977a
1976	16	ADF&G 1983a
1977	14	ADF&G 1979
1978	14	ADF&G 1980a
1979	21	ADF&G 1983a
1980	17	ADF&G 1983a
1981	10	ADF&G 1983a
1982	Closed	
1983	Closed	
1984	11	ADF&G 1985c

[a] Harvests from 1973-76 were based on harvest-report tickets. The 1984 harvest was based on registration permit returns. The harvests in the remaining years were based on field checks and hunter interviews.

Nearly all the harvest has occurred on the Unuk River (Wood 1986). One moose was reported shot on the Chickamin River in 1977 (ADF&G 1979).

b. GMS 1B. The Stikine River drainage has had a consistent moose harvest since at least 1957, ranging from 16 to 47, with a mean of 30 (ADF&G 1971, table 23). Hunter interviews and field checks suggest that between 120 and 210 people hunt moose on the Stikine River each year (table 23). The amount of effort spent hunting moose on the Stikine River was estimated at about 650, 770, 360, and 1,624 hunter-days in the years 1960, 1961, 1962 and 1984, respectively (ADF&G 1961a, 1985c; Atwell et al. 1963; Atwell 1963).

The moose harvest at Thomas Bay has varied from 0 to 21 since 1959, with harvests of 10 or more moose occurring in 1961, 1970, 1971, 1976 through 1981, and 1984 (Table 24). In 1981, over 100 people hunted during the six-day season (ADF&G 1983a). In 1984, 92 hunters spent an estimated 278 days in the field (ADF&G 1985c). Moose harvests at Thomas Bay from 1962 to 1969 were not available.

A small harvest of moose has been reported for various other areas in GMS 1B. Specific areas where this harvest has occurred include Aaron Creek (one moose reported harvested in 1973, two in 1983, and one in 1984), Farragut Bay (one in 1975, 1977, and 1984), Virginia Lake (one in 1983), and Crittenden Creek (one moose in 1978) (ADF&G 1975, 1977a, 1979, 1980a, 1985a, and 1985c). These figures substantially underestimate the actual harvest in some years because most ADF&G moose harvest reports have not provided specific kill-location information on moose harvest outside of the major hunting areas. For example, the ADF&G (1984a) reports that four moose were killed on the mainland in the "vicinity of Blake Channel" during 1982, and in 1981 four moose were killed in other unspecified areas of GMS 1B outside the Stikine River and Thomas Bay (ADF&G 1983a).

c. GMUs 2, 3, and 4. Moose seasons were open in GMUs 2, 3, and 4 during the years 1960-1961 and 1965-1967. Two moose were reported harvested on Mitkof Island in 1960 (ADF&G 1961a). GMUs 2 and 4 are outside the known general distribution of moose.

d. GMS 1C. There are three major moose hunting areas in this subunit: the Taku River drainage, Berners Bay area, and the Chilkat Range (Zimmerman 1986).

Reported harvests in the Taku River drainage have ranged from five in 1975 to a high of 31 in 1978, with a typical harvest of about 20 to 25 moose (table 25). About 150 hunters were reported in 1973 and their success ratio was approximately 20% (ADF&G 1975). In recent years, 65 to 85 people reportedly hunted moose annually on the Taku River (table 25).

In 1983 and 1984, 490 and 380 hunter-days, respectively, were spent hunting moose in the Taku River drainage for an average of 5.8 and 4.8 days/hunter, respectively (ADF&G 1985a).

The Berners Bay moose population resulted from a transplant in 1958 (Burns and McKnight 1973). The season first opened in 1963 and has remained open until the present, except for a closure during 1975-1977. Harvests have been regulated by a permit system since 1971 and closely monitored (table 26). Harvests have varied according to the number of permits issued. The harvest exceeded 20/year during 1971-1974. During the period 1981-1984, harvests have ranged from 5 to 14.

Since 1971, the number of moose hunters in the Berners Bay area has been limited to less than 50 by issuing a limited number of permits. Interest in participation in this hunt is high. For example, in 1973, 1,242 qualified applicants applied for permits to hunt moose in the Berners Bay area (ADF&G 1975).

Several moose are usually harvested each year in the Chilkat Range between Sullivan River and St. James Bay (ADF&G 1976a). Three moose were reported killed in the Endicott River drainage in both 1982 and 1983, and one and two moose were reported killed in St. James Bay area during those respective years (ADFG 1984a, 1985a). An estimated 12 and 21 people hunted moose in the Chilkat Range in GMS 1C during the years 1982 and 1983, respectively. In 1984, five and one moose were reported killed in the St. James Bay and Endicott River drainages, respectively (ADF&G 1985c). Thirty-eight people reported hunting moose a total of 139 days in the Chilkat Range in 1984 (ibid.).

e. <u>GMS 1D</u>. A major moose harvest area occurs near Haines in the Chilkat River drainage. Moose harvests in that area have exceeded 150 in at least one year and have averaged about 75-80/year (table 27). The harvest level peaked at about 100 to 150 moose/year during 1964-1973 and subsequently declined to an average of about 43 during the period 1974-1984 (table 27). The upper levels of the historic harvest for this population do not currently appear to be sustainable (Dinneford 1986).

Table 25. Annual Reported Moose Harvests and Number of Hunters for the Taku River Drainage, 1960-84[a]

Year	Harvest	No. of Hunters	Source
1960	Min. 27	---	ADF&G 1961a
1961	24	---	Atwell et al. 1963
1962	---	---	
1963	15	---	ADF&G 1970
1964	35	---	ADF&G 1970
1965	25	---	ADF&G 1970
1966	29	---	ADF&G 1970
1967	30	---	ADF&G 1970
1968	14	---	ADF&G 1970
1969	17	---	ADF&G 1974c
1970	24	---	ADF&G 1971
1971	21	---	ADF&G 1973
1972	26	---	ADF&G 1974c
1973	30	150	ADF&G 1975
1974	10	---	ADF&G 1976a
1975	5	---	ADF&G 1977a
1976	---	---	
1977	25	60-75	ADF&G 1979
1978	31	60-70	ADF&G 1980a
1979	---	---	
1980	---	---	
1981	23	65	ADF&G 1983a
1982	14	77	ADF&G 1984a
1983	11	85	ADF&G 1985a
1984	18	80	ADF&G 1985c

[a] The 1960, 1961, 1975, 1977, and 1978 statistics were based on field checks and hunter interviews. The 1980 statistics were based on registration permit returns. The statistics for the remaining years were based on harvest ticket returns.

--- means no data were available.

Table 26. Annual Reported Moose Harvests and Number of Hunters in the Berners Bay Area, 1963-84[a]

Year	Harvest		No. of Hunters	Source
1963	3		---	ADF&G 1976a
1964	6		---	ADF&G 1976a
1965	11		70	ADF&G 1976a
1966	10		61	ADF&G 1976a
1967	18		---	ADF&G 1976a
1968	21		---	ADF&G 1976a
1969	14		---	ADF&G 1976a
1970	10		---	ADF&G 1976a
1971	23		28	ADF&G 1973
1972	22		35	ADF&G 1974c
1973	33		42	ADF&G 1976a
1974	20		---	ADF&G 1976a
1975		Closed		
1976		Closed		
1977		Closed		
1978	12		19	ADF&G 1980a
1979	---		---	
1980	---		---	
1981	10		19	ADF&G 1983a
1982	5		21	ADF&G 1984a
1983	13		14	ADF&G 1985a
1984	14		15	ADF&G 1985c

a The statistics from 1971 through 1984 were based on permit returns. The basis of the harvest statistics for the remaining years are unknown.

--- means no data were available.

Table 27. Annual Reported Moose Harvests and Number of Hunters for the Chilkat River Area, 1960-84[a]

Year	Harvest	Number of Hunters	Source
1960	45	150	ADF&G 1961
1961	63	125	Atwell et al. 1963
1962	66	---	ADF&G 1974c
1963	81	---	ADF&G 1974c
1964	146	270	Dinneford 1986
1965	101	---	ADF&G 1974c
1966	152	260	Dinneford 1986
1967	137	---	ADF&G 1974c
1968	145	---	ADF&G 1974c
1969	103	---	ADF&G 1974c
1970	96	---	ADF&G 1971
1971	104	320	ADF&G 1973, 1974c
1972	92	325	ADF&G 1974c
1973	115	500	Dinneford 1983
1974	62	450	ADF&G 1976a
1975	28	300	ADF&G 1977a
1976	55	430	Dinneford 1983
1977	31	200	ADF&G 1979
1978	50-55	300	ADF&G 1980a
1979	39	200	Dinneford 1986
1980	48	350	Dinneford 1986
1981	35	315	Dinneford 1986
1982	25	270	Dinneford 1986
1983	61	350	Dinneford 1986
1984	35	350	Dinneford 1986

[a] The 1960-62, 1969-70, and 1975 statistics were based on hunter interviews and check stations. The 1971, 1974, and 1978 statistics were based on harvest-ticket reports. The 1984 statistics were based on registration permit returns. The basis of the harvest statistics for the remaining years are unknown.

--- means no data were available.

Since 1963, between 200 and 500 people have hunted moose in GMS 1D, with an average of about 325 (table 27). In 1983, 354 hunters spent a total of 1,854 days hunting moose for an average of about 5 days per hunter (Dinneford 1986). In 1984, 349 hunters hunted a total of 1,689 days for an average of 4.8 days/hunter (ADF&G 1985c). One moose was reported harvested in Warm Pass Valley near Skagway that year (ibid.).

f. GMS 5A. Two moose harvest areas are located in GMS 5A. One area is located north of Russell and Nunatak fiords and is referred to as the Nunatak Bench area. The other area comprises the forelands and adjoining habitat and is referred to as the Yakutat Forelands area.

The Yakutat Forelands is the major moose hunting area in GMU 5 and has produced the highest moose harvests of any area in the Southeast Region. Hunting began in the mid 1940's after moose migrated onto the Yakutat Forelands from Canada in the late 1930's (Mills and Firman 1986). Moose harvests within this area have fluctuated widely since 1960 (table 28) in response to dramatic changes in moose numbers. During 1962-1971, annual moose harvests ranged from 210 to 325, with a mean annual harvest of 270 moose. These figures include the harvest for all of GMU 5; the majority of this harvest, however, occurred on the Yakutat Forelands. During this same period, between 260 and 514 people hunted moose each year in GMU 5 (mean=410), with the majority of the hunting activity occurring on the Yakutat Forelands. Of interest is the relatively high hunter success during this time (table 28). In 1962, an estimated 95% of the hunters were successful (Atwell 1963).

Harvests declined during the period 1969-1973 and the season was closed during 1974-1977 in response to low moose numbers. Since 1977, annual harvest on the Yakutat Forelands has ranged from 20 to 49, by 123 to 235 hunters (table 28). During 1982-1984, an estimated yearly average of 994 hunter-days (range: 830 to 1,104) were spent on the Yakutat Forelands (ADF&G 1984a, 1985a, 1985c).

The Nunatak Bench area has had a limited moose population only in recent years. In the mid 1970's, the population was estimated at about 100 moose (ADF&G 1976a). Beginning in 1980, a specific season for this area permits late fall and winter harvest of moose (table 22). Reported harvest levels and hunter participation are summarized in table 29.

g. GMS 5B. The moose population in GMS 5B is located in an area referred to as the Malaspina Forelands. The first

Table 28. Annual Reported Moose Harvests and Numbers of Hunters in the Yakutat Forelands and Malaspina Forelands, 1960-84

	Yakutat Forelands		Malaspina Forelands		Total[a]	
Year	Harvest	No. of Hunters	Harvest	No. of Hunters	Harvest	No. of Hunters
1960	---	---	---	---	89	150
1961	---	---	---	---	---	---
1962	---	---	---	---	250	263
1963	---	---	---	---	302	---
1964	---	---	---	---	265	408
1965	---	---	---	---	282	---
1966	---	---	---	---	212	315
1967	---	---	---	---	263	426
1968	---	---	---	---	313	---
1969	---	---	---	---	324	514
1970	---	---	---	---	288	476
1971	---	---	---	---	230	472
1972	131	---	31	---	162	389
1973	51	---	96	---	147	387
1974	Closed		39	100	39	100
1975	Closed		18	61	18	61
1976	Closed		14	---	14	---
1977	Closed		14	35	14	35
1978	28	123	12	42	40	165
1979	20	167	22	50	42	217
1980	28	175	15	68	43	243
1981	27	180	27	85	54	265
1982	49	199	18	53	67	252
1983	47	235	11	55	58	290
1984	49	230	15	50	64	280

Source: ADF&G 1961, 1974c; Atwell 1963; Dinneford 1986.

[a] GMU 5 moose harvest data were not reported separately for the Yakutat and Malaspina forelands prior to 1972.

--- means no data were available.

Table 29. Annual Reported Moose Harvests and Hunter Effort in the Nunatak Bench area, 1979-84

Year	Harvest[a]	Hunters	Hunter-days
1979	2	10	45
1980	---	---	---
1981	4	12	105
1982	9	14	108
1983	2	9	41
1984	6	14	51

Sources: ADF&G 1980a, 1980b, 1983a, 1984a, 1985a; Dinneford 1986.

[a] Harvests in this area prior to 1979 were reported with the Yakutat or Malaspina forelands areas.

--- means no data were available.

occurrence of moose in the area was reported in the late 1950's (ADF&G 1976a). Prior to the early 1970's, reported harvests in this area were combined with the Yakutat Forelands harvest. Since 1971, harvests have been reported separately (table 28), and in most years since 1973 have been determined with registration permits and mandatory reporting requirements. During 1972-1984, reported harvests have ranged from 11 to 96, with an average yearly harvest of about 25. Since 1979, an average of 60 hunters have hunted moose each year on the Malaspina Forelands (table 28).

In 1979, 50 hunters reported spending a total of 170 days hunting moose in the Malaspina Forelands for an average of 3.4 days/hunters (ADF&G 1980b). In the four years from 1981 through 1984, the number of hunter-days ranged from 202 to 297 (average = 230), and the average days/hunter was 3.8.

h. <u>GMS 6A</u>. Moose populations in GMS 6A have increased and expanded their range since 1960. A significant and increasing harvest of moose has occurred in the Bering River-Controller Bay area since 1970 (ADF&G 1973, 1975, 1977a, 1980a, 1980b, 1983a, 1984a, 1985a). Only a small portion of this population's range is included within the Southeast Region. As a result, no further discussion of this moose harvest will be provided in this report and readers are referred to the Alaska Habitat Management Guide for the Southcentral Region, volume 2: Distribution, Abundance, and Human Use of Fish and Wildlife.

Moose harvests have occurred only recently east of the Suckling Hills and are steadily increasing in number, primarily in the area around the Tsiu River. The first reported harvest occurred in 1981, when three moose were killed (ADF&G 1983a). In 1982, 1983, and 1984, at least 13, 14, and 18 moose, respectively, were harvested (ADF&G 1984a, 1985a, Griese 1986). Only successful hunters were required to report hunting effort in this area, thereby preventing analysis of success rates, hunter effort, and number of active hunters (Griese 1986). In addition, not all the harvested moose may have been reported (ibid.). The local area game management biologist feels that success rates have apparently been high, however, perhaps around 80 percent in 1984 (ibid.).

3. <u>Significance of particular use areas</u>. In the previous section, harvest activity was described for specific populations. For 1:250,000-scale reference maps showing the location of known specific harvest areas within the range of these populations and the 1984 moose harvest activity by

unified code reporting area, see the Alaska Habitat Management Guide for the Southeast Region, volume 1. For information regarding moose hunting areas used by Yakutat residents during their lifetime and during three time periods (1945-1962, 1963-1974, and 1975-1984), see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2, and Mills and Firman (1986). See Mills and Firman (1986) for a discussion of changes in areas used by long-time Yakutat residents and changes in numbers of moose harvested in specific areas and by access methods.

4. Residency of hunters. In the Southeast Region, moose populations are generally most heavily hunted by residents of the nearest communities. Rausch and Bishop (1968) summarized the total 1966 moose harvest by residency of successful hunters (table 30). That year corresponded to a period of relatively high harvests in the Yakutat and Haines areas. In GMU 1, Haines residents had the highest community harvest of moose, reflecting the local importance of moose in that area. Juneau had the second highest community harvest due primarily to the proximity of the Taku River and Berners Bay populations, as well as the significant number of Juneau residents that hunted in the Chilkat River area that year. The community harvests of Wrangell and Petersburg were reflective of the use of the Stikine River drainage and Thomas Bay area for moose hunting by those communities.

   In 1966, the community with the highest reported take in GMU 5 was Juneau, followed by Yakutat and Sitka (table 30). About 20% of the harvest was from nonresidents and 7% from Alaskan residents outside southeast Alaska. These observations show that nonresidents will hunt moose in substantial numbers in the Southeast Region during periods of peak moose abundance and in areas with liberal seasons. Conversely, such hunters participate little where moose populations are relatively small and seasons more restrictive.

   The 1984 moose harvest is summarized by residency of hunters by hunt area (table 31). These data show that the highest moose harvest and the greatest hunting effort within a hunt area tends to be by residents of the nearest community. For example, residents of the Petersburg and the Wrangell areas comprised about 93% of the GMS 1B moose hunters, Juneau area residents comprised 91% of the GMS 1C moose hunters, residents of the Haines and the Skagway areas comprised 75% of the GMS 1D moose hunters, and residents of Yakutat comprised 56% of the GMU 5 moose hunters (table 31).

   The recent build-up of the remote Tsiu River moose population is resulting in this area becoming increasingly important for guided moose hunts (Griese 1986). During the 1984 hunting season, 33% of the reported moose harvest in the Tsiu River area was taken by guided nonresident hunters (ibid.). The

Table 30. Residency of Moose Hunters Successful in GMU 1 and 5 During the 1966 Season.

Area of Residency	No. Moose Harvested
GMU 1	
Haines	90
Juneau/Douglas	74
Wrangell	23
Petersburg	16
Ketchikan	7
Sitka	3
Skagway	3
Alaska communities outside Southeast Region	4
Oregon	1
GMU 5	
Juneau/Auke Bay/Douglas	61
Yakutat	47
Sitka/Mt. Edgecumbe	20
Ketchikan	10
Wrangell	4
Hoonah	3
Other southeast Alaska communities	6
Other Alaska communities	14
Other U.S.A. states	40
Italy	1

Source: Rausch and Bishop 1968. Results based on harvest tickets.

remaining harvest was by hunters from a number of Alaskan communities (table 31). In 1985, guided hunters comprised at least 50 percent of the moose harvest in this portion of GMS 6A (Griese 1986).

Nonresidents totalled 7% of the GMU 5 hunters in 1984 (table 31).

E. Regional Summary

In the Southeast Region, there are eight moose hunting areas that currently support harvests in excess of 10 moose/year (i.e., Yakutat Forelands, the Chilkat River, Stikine River, Berners Bay, Thomas Bay, Taku River, and Tsiu River drainages, and Malaspina Forelands). In addition, there are a number of other areas where usually 1 to 7 moose are taken yearly (e.g., the Unuk River, Endicott River, St. James Bay, Aarons Creek, and Farragut River drainages, and Nunatak Bench).

Approximately 210 moose were legally killed in both 1983 and 1984 by over 1,100 hunters. Historic harvests have been considerably higher, with harvests of 450 or more moose during many years in the 1960's. These high harvests were a result of large populations and high harvests on the Yakutat Forelands and the Chilkat River drainage during that time.

Moose hunting is extremely popular in many areas of the Southeast Region, and the demand for moose hunting greatly exceeds available opportunity. Restrictive hunting regulations and relatively low hunter success are common. Attention should be directed at identifying existing and potential hunting areas for moose and assuring that the moose habitat capability is preserved and the opportunities for hunting maintained. Attention should also focus on identifying opportunities for progressive management of browse for some populations.

V. HUMAN USE OF BLACK BEAR

A. Introduction

Black bears occur throughout the Southeast Region, except in GMU 4. This chapter summarizes human use of black bears, especially total harvest, harvests by nonresidents, and harvest by guided hunters.

B. Management Considerations

Black bears are harvested for both their meat and their hide. Populations in the Southeast Region are thought to be relatively high throughout most of their general distribution, and certain islands, such as Prince of Wales, are noted for the occurrence of relatively large bears. The area around Yakutat is known for the

Table 31. Residency of Moose Hunters in the Southeast Region by Hunt Area, 1984

Hunt Area/Residency	No. of Hunters	No. of Hunter-Days	Reported Harvest
GMS 1A			
Ketchikan	23	106	2
Klawock	9	29	2
Craig	4	25	0
Metlakatla	4	13	3
Thorne Bay	1	4	0
Outside Alaska	1	14	0
GMS 1B (North of LeConte Bay)[a]			
Petersburg	84	272	11
Ketchikan	4	14	1
Edna Bay	2	3	0
Other Alaskan communities	2	6	0
GMS 1B (South of LeConte Bay)[b]			
Wrangell	164	1,268	28
Petersburg	45	292	5
Sitka	5	23	2
Ketchikan	3	14	0
Juneau	2	15	0
Craig	2	14	0
Metlakatla	1	3	0
Other Alaskan communities	1	30	0
Outside Alaska	1	13	1
Berners Bay			
Juneau	15	37	14
Remainder of GMS 1C			
Juneau	118	512	24
Haines	3	6	0
Gustavus	1	7	0
Ketchikan	1	5	0
Sitka	1	4	0
Petersburg	1	2	0
Skagway	1	2	0
Outside Alaska	5	19	0
GMS 1D			
Haines	246	1,246	23
Juneau	70	328	7
Skagway	14	43	1
Sitka	6	51	2
Ketchikan	4	14	0
Wrangell	1	2	0
Other Alaskan communities	3	15	1
Outside Alaska	5	20	1

(continued)

Table 31 (continued).

Hunt Area/Residency	No. of Hunters	No. of Hunter-Days	Reported Harvest
Yakutat Forelands			
Yakutat	132	711	18
Juneau	57	252	16
Sitka	10	24	6
Ketchikan	4	12	2
Hoonah	3	5	2
Wrangell	3	4	1
Tenakee Springs	1	5	0
Petersburg	1	3	1
Other Alaskan communities	7	31	1
Outside Alaska	13	57	2
Malaspina Forelands			
Yakutat	24	112	5
Ketchikan	13	55	6
Juneau	3	13	1
Other Alaskan communities	3	16	0
Outside Alaska	7	17	3
GMS 6A, East of Suckling Hills[c]			
Outside Alaska	6	21	6
Ketchikan	3	15	3
Anchorage	2	8	2
Cordova	2	5	2
Yakutat	2	2	2
Haines	1	3	1
Juneau	1	3	1
Thorne Bay	1	5	1

Source: ADF&G 1985c; Griese 1986.

a Hunting primarily in the Thomas Bay area.

b Hunting primarily in the Stikine River drainage.

c Successful hunters only.

occurrence of a bluish color phase, referred to as a "glacier bear." For a discussion of habitat concerns relative to black bears in this region, see Sigman (1985).

The harvest of black bears has been closely monitored by the ADF&G by requiring that all bears taken be sealed. However, no data are available on the number of people who unsuccessfully hunt black bears which precludes an analysis of hunter effort.

Regulations prohibit the harvest of black bears during July and August, when some individuals are highly visible along fish streams and hides are in poor condition, and prohibit the taking of cubs or females with cubs.

C. Summary of Seasons and Bag Limits

Seasons for black bears have typically lasted 9.5 to 10 months and bag limits have varied from one to two bears/year (table 32). The sealing requirement for black bears became mandatory in GMU 5 in 1971 and in the remainder of the Southeast Region in 1973.

D. Data on Human Use

1. Qualifications and limitations of the data. This report evaluates the black bear harvest over two five-year periods, 1975-1979 and 1980-1984. Harvest figures were obtained from the ADF&G, Division of Game, statistical section, (ADF&G 1985d) and are divided into total harvest, guided harvest, and nonresident harvest. The data include all black bears that were sealed, including bears taken in defense of life and property. Black bears taken in defense of life and property comprise a minor part of the total reported harvest, however (ibid.). The data were lumped by five-year periods because harvests in individual years are relatively small and variable. Comparisons between the two five-year periods was done to display changes in harvest levels.

   Unlike brown bear hunting, guides are not required for black bear hunting by nonresidents. However, nonresidents generally comprise the majority of guided hunters who take black bears. The reader should note that sealing records only indicate the number of successful hunters, because unsuccessful hunters are not sampled. Therefore, success rates are not available.

2. Reported harvest levels. From 1975-1984, a total of 2,824 black bears were reported killed in the Southeast Region (table 33). Substantial harvests occurred in all GMUs and GMSs, except for GMS 5B, which had a harvest of only five bears and GMU 4, which is outside the general distribution of black bears. The highest harvest occurred in GMU 2 (803 bears), followed by GMU 3 (599), GMS 1C (541), GMS 1A (334) GMS 1D (231), and GMS 5A (195). Overall, the black bear

Table 32. General Seasons and Bag Limits for Harvest of Black Bears in Southeast Alaska, 1971-84

Year(s)	Area(s)[a]	Season	Limit[b]
1971-79	GMUs 1-5	Sept. 1 to June 30	2 bears
	GMS 6A	Sept. 1 to June 30	1 bears
1980-83	GMSs 1A, 1D, GMUs 2, 4, 5	Sept. 1 to June 30	2 bears
	GMU 3, GMSs 1B and 1C	Sept. 1 to June 15	1 bear
	GMS 6A	Sept. 1 to June 30	1 bear
1984	GMS 1A, 1B, 1D GMUs 2, 3, 5	Sept. 1 to June 30	2 bears
	GMSs 1C, 6A	Sept. 1 to June 30	1 bear

Source: Annual Alaska game regulation booklets printed each year by ADF&G, Div. Game, Juneau.

[a] Areas shown do not include special areas within the GMU/GMS that are traditionally closed to the taking of black bears.

[b] The taking of cubs or females accompanied by cubs is prohibited. In GMU 5, only one bear could be of the blue, or "glacier," color phase.

harvest increased by 44% between the period 1975-1979 and 1980-1984 (table 33). This increased use occurred throughout the region, with the highest increases occurring in GMU 3 (65%) and GMU 2 (57%). The rise in black bear harvests was most dramatic on Mitkof Island, where the take increased from 10 during 1975-1979 to 72 during 1980-1984.

3. Reported harvest by nonresidents and guided hunters. Nonresidents killed 908 bears during the period 1975-1984, thus accounting for 32% of the total harvest (table 34). Nonresidents harvested substantial numbers of black bears in most of the Southeast Region where black bears occur, except for GMSs 5B, 1D, and 6A. The highest harvests occurred in GMUs 2 and 3 (268 and 266 bears killed, respectively), followed by GMSs 1C (159) and 5A (113). Overall, the nonresident harvest increased by 33% between the two five-year periods, with the Ketchikan area having the highest increase and the GMSs 1B and 1C recording substantial declines (table 34).

   Guided black bear harvests totalled 416 during 1975-1984 or 15% of the Southeast harvest. The highest harvest of black bears by guided hunters occurred in GMU 3 (168 bears), followed by GMSs 1C (109) and 5A (98). The guided harvest of black bears in GMU 3 occurred almost exclusively on Kuiu Island and the northwestern portion of Kupreanof Island. The majority of the guided black bear harvest in GMS 1C was located in certain areas south of the Taku River (see 1:250,000-scale reference maps of black bear general harvest in the Alaska Habitat Management Guide for the Southeast Region, volume 1).

   Although most guided hunters are nonresidents, many successful nonresident hunters do not use guides. In fact, the number of bears killed by guided hunters increased by only 1% from 1974-1979 to 1980-1984 (table 35), indicating that the rise in nonresident harvest during that period was largely attributable to a rise in successful unguided hunters. The only GMU/GMS with a relatively large increase in numbers of black bears killed by guided hunters during the 10-year period occurred in GMS 5A (table 35). During 1975-1984 only three and 12 black bears were killed by guided hunters in GMS 1A and GMU 2, compared to a nonresident harvest of 58 and 268 in those respective areas. Apparently, few nonresident black bear hunters in the Ketchikan area were selecting to use guides.

   Substantial declines in guided bear harvests also occurred in GMS 1C and GMU 3 between the periods 1975-1979 and 1980-1984.

4. Significance of particular use areas. The harvest of black bears on Kuiu, Kupreanof, and Mitkof islands was noticeably greater than the remainder of GMU 3. Eighty-five percent of

Table 33. Total Black Bear Harvests in Southeast Alaska by GMU/GMS, 1975-79 and 1980-84

	Five-Year Period			Total
GMU/GMS	1975-79	1980-84	% Increase	1975-84
1A	141	193	37	334
1B	36	49	36	85
1C	245	296	21	541
1D	103	128	20	231
2	312	491	57	803
3	226	373	65	599
5A	79	116	47	195
5B	3	2	-33	5
6A[a]	14	17	21	31
Total	1,159	1,665	44	2,824

Sources: ADF&G 1985d, Dinneford 1986, Flynn 1986, Griese 1986.

[a] Includes only Minor Harvest Units 0100, 0200, and 0300.

Table 34. Harvest of Black Bears in Southeast Alaska by Nonresidents, GMU/GMS, 1975-79 and 1980-84

	Five-Year Period			Total
GMU/GMS	1975-79	1980-84	% Increase	1975-84
1A	12	46	283	58
1B	15	7	-53	22
1C	96	63	-34	159
1D	4	8	100	12
2	94	174	85	268
3	127	139	9	266
5A	37	76	105	113
5B	0	2	---[a]	2
6A[b]	4	4	0	8
Total	389	519	33	908

Sources: ADF&G 1985d, Griese 1986.

[a] Percentage of increase cannot be determined because division by zero is undefined.

[b] Includes only Minor Harvest Units 0100, 0200, and 0300.

Table 35. Harvests of Black Bears in Southeast Alaska by Guided Hunters, GMU/GMS, 1975-79 and 1980-84

	Five-Year Period			Total
GMU/GMS	1975-79	1980-84	% Increase	1975-84
1A	0	3	---[b]	3
1B	8	1	-88	9
1C	68	41	-40	109
1D	1	7	600	8
2	2	10	400	12
3	94	74	-22	168
5A	29	69	138	98
5B	0	2	---[a]	2
6A[b]	5	2	-60	7
Total	207	209	1	416

Source: ADF&G 1985d.

[a] Percentage of increase cannot be calculated because division by zero is undefined.

[b] Includes only Minor Harvest Areas 0100, 0200, and 0300.

the black bears taken in GMS 1D came from the Chilkat River drainage and other locations on the western side of the Chilkat Inlet. Harvests within the other GMUs and GMSs were more geographically dispersed throughout the unit.

For information concerning the numbers of black bear sealed from 1975-1984 by minor harvest units, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 1. For information concerning bear harvest areas for the communities of Klawock, Tenakee Springs, Angoon, and Yakutat, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2.

5. Harvest of glacier bears. A unique color phase of the black bear, referred to as a "blue or "glacier" phase, occurs in certain areas of Alaska. This phase, although relatively uncommon, is most abundant in parts of GMU 5. During the 15-year period 1971-1985, a total of 35 "glacier" bears were reported killed in GMU 5 (Dinneford 1986). The "glacier" bear is valued by some as a desired trophy, and some hunters travel specifically to the Yakutat area to hunt them (ADF&G 1974d, Dinneford 1986). The color phase is of scientific interest, and in 1972 one was captured live in GMU 5 for transport to the San Diego Zoo (ADF&G 1974d).

E. Regional Summary

During the period 1975-1984, 2,824 black bears were harvested in the Southeast Region, of which 32% were taken by nonresidents and 15% by guided hunters. Both total harvests and harvest by nonresidents rose dramatically during this 10-year period, increasing at an average rate of about 7-9%/year. The number of black bears killed by guided hunters increased only slightly. Total harvests increased regionwide; guided and nonresident harvests increased in some areas while declining in other areas.

VI. HUMAN USE OF BROWN/GRIZZLY BEAR

A. Introduction

Brown bears occur throughout the Southeast Region except for most islands south of Frederick Sound. This chapter summarizes information on the human use of brown bears in the Southeast Region since 1961.

B. Management Considerations

Brown bears are primarily hunted locally for sport and trophy, because the meat is not considered palatable by many hunters (Gmelch and Gmelch 1985). The brown bear is regarded by many outside hunters as an outstanding trophy, and brown bear hunting

Table 36. General Seasons for Harvest of Brown Bear in Southeast Alaska, 1961-84[a]

Year(s)	Area(s)[b]	Season
1961-64	GMUs 1-6	Sept. 1 to June 30
1965	GMUs 1-6	Sept. 1 to June 20
1966-68	GMUs 1-6	Sept. 1 to June 10
1969	GMUs 1-4	Sept. 1 to Nov. 30 April 1 to June 10
	GMUs 5, 6	Sept. 15 to Nov. 30 April 1 to May 31
1970	GMUs 1-4	Same as 1969
	GMUs 5, 6	Oct. 10 to Nov. 30 May 10 to May 25
1971-72	GMUs 1-4	Sept. 1 to June 10
	GMUs 5, 6	Same as 1970
1973-75	GMUs 1-4, 6	Same as 1971-72
	GMU 5	Sept. 1 to Nov. 30 May 10 to May 25
1976	GMUs 1-4, 6	Same as 1973-75
	GMU 5	Sept. 1 to May 31
1977-78	GMUs 1-3, 5, 6	Same as 1976
	GMU 4, except Admiralty Island	Sept. 1 to June 5
	GMU 4, Admiralty Island only	Sept. 1 to May 20
1979	GMU 1	Sept. 15 to May 31
	GMUs 2, 3	Sept. 1 to June 10

(continued)

Table 36. (continued).

Year(s)	Area(s)[b]	Season
	Unit 4, Chichagof Island south and west of a line that follows the crest of the island from Rock Point (58°00'N,136°21'W) to Rogers Point (57°35'N,135°33'W) including Yakobi and other adjacent islands. Baranof Island south and west of a line that follows the crest of the island from Nismeni Point (57°34'N, 135°25'W), to the entrance of Gut Bay (56°44'N,134°38'W), including the drainages into Gut Bay and including Kruzof and other adjacent islands	Sept. 15 to May 31
	Remainder of GMU 4	Sept. 15 to May 20
	GMU 5, GMS 6A	Same as 1977-78
1980	GMUs 1-3	Sept. 1 to May 31
	GMUs 4, 5	Same as 1979
	GMS 6A	Oct. 10 to May 25
1981-83	GMUs 1-3	Sept. 15 to May 31
	GMUs 4, 5, GMS 6A	Same as 1980
1984	GMUs 1-5	Same as 1981-83
	GMU 6A	Sept. 1 to May 25

Source: Annual Alaska game regulation bookets printed each year by ADF&G, Div. Game, Juneau.

[a] During 1961-67, the bag limit was one bear/year. During 1968-84, the bag limit was one bear every four regulatory years. The taking of cubs or females accompanied by cubs was prohibited.

[b] Areas shown do not include special areas within the GMU/GMS that are traditionally closed to the taking of brown bears.

is the mainstay of the hunter-guiding industry in the Southeast Region.

Guides have been required by nonresident brown bear hunters since 1960, except during the period 1964-1966. Beginning in 1967, guides were required by nonresidents hunting brown bear unless they were "accompanied by a relative over 19 years of age within the second degree of kindred." Prior to 1964, hunting guides were also required, under certain circumstances, by nonresidents who wished to photograph brown bears.

The management strategies for brown bear hunting in GMU 4 have been to promote a high-quality hunting experience by maintaining a harvest rate of about 60-80 bears/year, consisting primarily of adult males, and restricting the number of guides (Johnson 1980).

A mandatory sealing requirement of all harvested brown bears was established statewide in 1961. Beginning in 1977, residents were required to purchase a $25.00 tag if they wished to hunt brown bear.

For a discussion of habitat concerns relative to brown bears in this region, see Sigman (1985).

C. Summary of Seasons and Bag Limits

Seasons and bag limits for brown bears during 1961-1984 are summarized in table 36. Information on earlier harvest regulations, primarily in GMU 4, are presented in Johnson (1980).

D. Data on Human Use

1. Qualifications and limitations of the data. This report evaluates brown bear harvests over the period 1961-1984 using records of sealed bears (ADF&G 1985d). The limitations of these data are similar to those described in the previous chapter on human use of black bears. In particular, information on unsuccessful hunters is not recorded, and the statistics include sealing records of brown bears taken in defense of life and property. In some years, the harvest of brown bears taken in defense of life or property may approach 10% of the total number of brown bear that are sealed (Johnson 1980). Harvests are summarized by five-year intervals in order to examine for trends in the harvest over time and to reduce yearly variations in harvest levels. Readers should note that the brown bears harvested by nonresidents and by guided hunters are largely the same bears because most nonresidents are guided and most guided hunters are nonresidents.

2. Reported harvest levels. During the 24-year period 1961-1984, a total of 2,777 brown bears were reported harvested in the Southeast Region, for an average of about 115/year

(table 37). Of this harvest, 1,282 (46%) were taken by nonresidents. Guided hunters killed 1,176 bears (42%). Evaluation of the regional harvest by five-year intervals (table 38) shows a rapid increase in harvest levels during the early 1960's, followed by a slower, but steady increase from 1970 to 1985. The harvests by nonresident hunters and guided hunters increased from 1961 to the mid 1970's and has remained relatively constant since that time (table 38). Harvest patterns in individual GMUs are discussed below.

A substantial increase in yearly brown bear harvests occurred in GMU 5 during the period 1980-1984 (mean=31.6 bears killed/year) after a 15-year period of relatively constant harvests (mean=19.5 bears/year). The harvest by nonresidents more than doubled in GMU 5 between the periods 1975-1979 and 1980-1984 (from 47 to 105).

In GMU 4, harvests have fluctuated between years (table 37). Total and nonresident harvests rose from 425 and 201, respectively, during the period 1970-1974 to 445 and 255, respectively, during the period 1975-1979, but then declined to 409 and 198, respectively, during the recent period of 1980-1984. Historical harvests of brown bears in GMU 4 are discussed in detail by Johnson (1980).

In GMU 1, there was no substantial change in harvest levels of brown bears in GMU 1 over the 20-year period 1965-1984. GMU 2 and most of GMU 3 are outside the general distribution of brown bears. From 1961 to 1984, only three brown bears have been reported harvested in GMU 3: two on Wrangell Island and one on Etolin Island.

Random surveys of households in the communities of Yakutat and Sitka have indicated that about 6 and 2 %, respectively, of all households in these communities harvested brown bears in a given year (Mills and Firman 1986, Gmelch and Gmelch 1985).

3. Significance of particular use areas. In Southeast Alaska, 64% of the total brown bear harvest and 72% of the harvest by nonresidents came from GMU 4 during the period 1961-1984 (table 37). Johnson (1980) has noted that GMU 4 accounts for about 11% of the statewide brown bear harvest. Substantial brown bear harvests also came from GMSs 5A and 1D (414 and 190, respectively, during the period 1961-1984).

For information concerning the numbers of brown bears sealed during 1961-1984 by minor harvest units, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 1. For information concerning brown bear harvest areas for the communities of Angoon, Tenakee Springs, and Yakutat, see the

Table 37. Total Reported Brown Bear Harvests by GMU/GMS in Southeast Alaska, 1961-84[a]

	GMU/GMS						
Year	1A	1B	1C	1D	4	5A	5B
1961	2(0)[b]	3(0)	5(1)	3(0)	39(24)	5(5)	4(0)
1962	0	4(1)	2(0)	6(1)	47(31)	2(0)	4(0)
1963	0	0	1(0)	6(2)	27(16)	5(1)	0
1964	3(0)	1(1)	6(0)	14(1)	57(24)	13(5)	0
1965	0	1(0)	4(0)	3(0)	71(35)	15(5)	2(0)
1966	4(0)	0	4(1)	6(3)	76(51)	22(15)	1(1)
1967	6(0)	1(1)	7(2)	17(5)	70(33)	19(10)	1(1)
1968	5(0)	0	2(0)	10(4)	51(16)	16(6)	1(0)
1969	5(0)	6(0)	7(1)	11(1)	66(36)	17(7)	3(2)
1970	2(0)	2(0)	3(0)	9(4)	74(37)	11(4)	0
1971	2(0)	2(0)	1(0)	6(3)	79(40)	20(7)	3(1)
1972	1(0)	2(0)	1(0)	14(4)	81(41)	23(9)	5(0)
1973	2(0)	2(0)	3(1)	2(1)	105(40)	22(6)	2(0)
1974	3(0)	3(0)	8(1)	7(3)	86(43)	12(0)	1(0)
1975	2(0)	2(0)	2(0)	9(2)	109(60)	12(6)	4(0)
1976	3(0)	2(0)	10(3)	8(4)	148(86)	16(10)	1(0)
1977	4(0)	3(0)	4(1)	1(0)	68(37)	14(4)	2(1)
1978	3(0)	6(1)	2(1)	7(2)	69(36)	21(9)	5(1)
1979	7(0)	1(0)	6(1)	8(4)	51(36)	14(10)	8(6)
1980	1(0)	3(0)	4(0)	7(3)	74(37)	22(15)	4(4)
1981	1(0)	5(0)	1(1)	10(3)	73(40)	24(13)	8(7)
1982	2(1)	4(0)	6(2)	6(3)	53(25)	28(18)	3(3)
1983	7(1)	2(0)	5(0)	14(5)	88(43)	30(20)	3(3)
1984	3(1)	4(0)	5(1)	6(3)	121(53)	31(19)	5(3)
Total	68(3)	59(4)	99(17)	190(61)	1,783(920)	414(204)	70(33)

Source: ADF&G 1985d.

[a] In Minor Harvest Units 0100, 0200, and 0300 of GMS 6A, 12(3), 17(8), 26(14), 17(9), and 19(6) brown bears were sealed during the periods 1961-64, 1965-69, 1970-74, 1975-79, and 1980-84, respectively. (Number of bears sealed that were harvested by nonresidents is shown in parentheses.) Three brown bears were killed in GMU 3 by resident hunters during the period 1975-84.

[b] Number of bears sealed that were harvested by nonresidents is shown in parentheses.

Table 38. Reported Brown Bear Harvests in Southeast Alaska by Several-year Intervals, 1961-84[a]

		Harvest	
Period	Total	Nonresident	Guided
1961-64	271	116	112
1965-69	547	244	184
1970-74	625	259	230
1975-79	650	330	323
1980-84	684	333	327

Source: ADF&G 1985d

[a] Includes GMUs 1 through 5 and Minor Harvest Units 0100, 0200, and 0300 of GMS 6A.

1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2.

VII. HUMAN USE OF FURBEARERS

A. Introduction

This chapter briefly summarizes the human use of furbearers in the Southeast Region from regulatory years 1977-1978 through 1984-1985.

B. Management Considerations and Harvest Seasons

Harvesting furbearers in Alaska is permitted with either a hunting or a trapping license, depending upon the species sought. The Alaska game regulations (ADF&G 1985b) describe hunting seasons and bag limits for "fur animals", defined as wild stocks of coyote, arctic fox, red fox, lynx, raccoon, red squirrel, wolf, and wolverine (table 39). The Alaska trapping regulations (ADF&G 1985e) describe trapping seasons and bag limits for "fur bearers", defined as all fur animals plus beaver, marten, weasels, muskrat, land otter, flying squirrel, ground squirrel, and marmots (table 40). The generic term "furbearer" will be used here and will refer to those species harvested primarily for their fur. This usage will include all "fur bearers", except flying squirrel, ground squirrel, and marmots. Primary species of interest in Southeast Alaska are beaver, land otter, wolf, wolverine, marten, and mink. Lynx are occasionally harvested as well.

Sea otters are also classified as "fur bearers" under the Alaska trapping regulations; however, sea otters are federally protected under the Marine Mammal Protection Act of 1972. Harvest of sea otters by Alaskan natives is provided for by this act.

Hunting seasons (table 39) and trapping seasons (table 40) are different for most species. Trapping seasons are designed to allow harvest of furbearers only when most pelts are prime, whereas hunting seasons provide an opportunity to take an animal while hunting other game and provide for additional recreation. Hunting and trapping seasons also provide opportunities to harvest furbearers for food.

Within the designated trapping seasons in the Southeast Region, no limits are set on the number of animals that may be taken. In areas where populations are low (such as beaver in GMS 1D and part of GMU 4), the trapping season is closed. In Southeast Alaska, bag limits have been established during the hunting season for coyote, red fox, lynx, and wolverine (table 39).

Harvest levels are the product of animal abundance, trapper effort, winter weather conditions, and fur prices. For example,

Table 39. Hunting Seasons and Bag Limits for Fur Animals in GMUs 1-5, 1985-86

Species	Season Length	Bag Limit
Coyote	Sept. 1 - Apr. 30	2 coyotes
Red Fox	Nov. 1 - Feb. 15	2 foxes
Lynx	Nov. 1 - Mar. 31	2 lynx
Raccoon	No closed season	No limit
Red Squirrel	No closed season	No limit
Wolf	No closed season	No limit
Wolverine	Nov. 10 - Feb. 15	1 wolverine

Source: ADF&G 1985b.

Table 40. Trapping Seasons and Bag Limits for Furbearers in GMUs 1-5, 1985-86

Species/Area	Season Length	Bag Limit
Beaver		
GMUs 1 (except GMS 1D), 2, 3 (except Mitkof Island), and 4 (that portion east of Chatham Strait)	Dec. 1 - May 15	No limit
GMS 1D	No open season	
GMU 3, Mitkof Island	Dec. 1 - Apr. 15	No limit
GMU 4, that portion west of Chatham Strait	No open season	
GMU 5	Nov. 10 - May 15	No limit
Coyote, red fox, lynx		
GMUs 1-5	Dec. 1 - Feb. 15	No limit
Marten, mink, weasel		
GMUs 1-4	Dec. 1 - Feb. 15	No limit
GMU 5	Nov. 10 - Feb. 15	No limit
Muskrat		
GMUs 1-5	Dec. 1 - Feb. 15	No limit
Land Otter		
GMUs 1-4	Dec. 1 - Feb. 15	No limit
GMU 5	Nov. 10 - Feb. 15	No limit
Raccoon, squirrel, marmots		
GMUs 1-5	No closed season	No limit
Wolf, wolverine		
GMUs 1-5	Nov. 10 - Apr. 30	No limit

Source: ADF&G 1985e.

although lynx are never abundant in Southeast Alaska, occasionally the harvest of lynx will increase dramatically, most likely because of an influx of animals from Canada during a cyclic peak in lynx populations. Wolverine harvest also varies annually, but this may be due to the relative inaccessibility of wolverine habitat, particularly in mild winters, and to the fact that many wolverine are caught incidental to wolf trapping (ADF&G 1986). Currently, depressed beaver harvest has reflected the recent low pelt prices; however, harvest has increased lately, probably due to increased harvest opportunities in GMU 2, where beavers are inhabiting new clearcuts (Wood 1986). Harvest levels of other species, such as otter, mink, and marten, correspond more closely with fur prices (Wood 1986, Young 1986).

For a discussion of some habitat concerns regarding furbearers in the Southeast Region, see Sigman (1985). For a summary of the economic importance of furbearers in Southeast Alaska, see the Alaska Habitat Management Guide publication entitled Economic Overview of Fish and Wildlife, volume 2.

C. Data on Human Use

1. Qualifications and limitations of the data. Furbearer harvest information is derived from three different sources. The most accurate source is the statewide sealing program for beaver, lynx, land otter, wolf, and wolverine, and the Southeast (GMUs 1-5) sealing program for marten, which began in the regulatory year 1984-1985. All skins of these species must be presented to an ADF&G representative for sealing within specified deadlines. At the time of sealing, harvest data are collected. In Southeast Alaska, reliability of harvest data is considered good because of a high rate of compliance with sealing regulations (Johnson 1986, Wood 1986).

   Indirect methods of gathering harvest data include trapper and dealer export reports and reports of acquisition of furs. Export reports, listing the number of each species shipped and the GMU where taken, must be filed with ADF&G when raw skins are shipped out of state. Acquisition reports document purchases of raw skins by fur buyers within the state. Export and acquisition reports generally underestimate the harvest in any given year because trappers can store furs for several years before exporting or selling them, and some furs are dressed and utilized at home, thereby never appearing on such reports. Also, some trappers may combine catches when shipping and selling, thereby underestimating the number of trappers who sold furs. However, these reports are the primary indications of harvest intensity for species that are not sealed.

   For these unsealed species, statewide annual harvest is estimated by multiplying the sum of dealer purchases and trapper exports by a correction factor. The correction factor is derived from the relationship between dealer purchases, trapper exports, and the number of sealed beaver, lynx, and otter (ADF&G 1986). These correction factors are used only to estimate harvests at the regional level.

Furbearer harvest data were not compiled for the portion of GMU 6 that lies within the Southeast Region. Contact the ADF&G area game biologist in Cordova for information on furbearer harvest in that area. In addition, time limitations prevented us from analyzing more than one year of export/acquisition data.

2. Reported harvest levels. The numbers of furbearers, excluding marten, that have been sealed from 1977-1978 through 1984-1985 are given in table 41. During those eight years, an average of 556 otter, 246 beaver, 85 wolves, 26 wolverine, and 8 lynx were annually sealed in the Southeast Region. The sealing records are summarized by GMU/GMS for the years 1983-1984 and 1984-1985 (tables 42 and 43), and fur exports and dealer purchases are summarized by residency of trapper for 1983-84 (table 44).

   Although direct comparison of the harvest levels of the 1983-1984 sealing data (table 42) and fur export/acquisition data (table 44) are limited, the two sources illustrate that most trappers live in GMUs 1 and 4, while most furbearers are harvested in GMUs 2 and 4. In addition, the data indicate that mink and marten are the most commonly harvested furbearers in the Southeast Region.

3. Significance of particular use areas. For 1:250,000-scale reference maps showing the 1984-1985 furbearer sealing data by major harvest area, see the Alaska Habitat Management Guide for the Southeast Region, volume 1.

   Examination of these data indicate that most furbearers are harvested (and presumably most effort expended) in areas with maintained roads or within small-boat access of communities. Areas with the highest harvests correspond with the road systems of Ketchikan, Prince of Wales Island, Sitka, Juneau, Haines, and Yakutat. Other areas with high harvest are within boating distance from communities (i.e., Gravina Island, Peril Strait, Hoonah Sound, Shelter Island, and the islands near Wrangell and Petersburg). Exceptions to this pattern include areas, such as the Unuk River and southeastern Admiralty Island, which have higher harvests than would be expected based upon their distance to the nearest community. The harvest from these areas likely represents the efforts of one or more "serious" trappers who live and trap in remote areas and are capable of taking many animals.

Table 41. Number of Furbearers Sealed in GMUs 1-5 by Species, 1977-78 through 1984-85

Regulatory Year	Beaver	Land Otter	Lynx	Wolf	Wolverine
1977-78	157	695	1	75	28
1978-79	65	605	0	87	35
1979-80	259	654	1	72	25
1980-81	353	526	0	87	12
1981-82	107	467	0	68	21
1982-83	211	462	39	80	23
1983-84	435	443	18	105	30
1984-85	380	611	2	103	32
Mean	246	558	8	85	26

Source: ADF&G 1985f. The data reflects the furbearer harvest recorded in the statewide sealing files as of November 1985.

Table 42. Number of Furbearers Sealed in Southeast Alaska by Species by GMU/GMS, 1983-84

GMU/GMS	Beaver	Lynx	Land Otter	Wolf	Wolverine
1A	95	0	50	33	1
1B	0	0	15	4	3
1C	96	1	41	8	5
1D	0	14	10	6	18
2	215	0	153	27	0
3	25	0	42	17	1
4	0	0	117	0	0
5A	4	3	4	10	2
5B	0	0	0	0	0
Total	435	18	432	105	30

Source: ADF&G 1985f. The data reflect the furbearer harvest recorded in the statewide sealing files as of November 1985.

Table 43. Number of Furbearers Sealed in Southeast Alaska by Species by GMU/GMS, 1984-85

GMU/GMS	Beaver	Lynx	Land Otter	Wolf	Wolverine	Marten[a]
1A	39	0	65	15	1	203
1B	4	0	14	10	4	190
1C	36	1	31	9	9	245
1D	0	1	4	4	14	166
2	234	0	193	43	0	1,039
3	52	0	141	7	3	243
4	14	0	162	0	0	1,355
5A	1	0	1	15	1	63
5B	0	0	0	0	0	0
Total	380	2	611	103	32	3,504

Source: ADF&G 1985f. The data reflect the furbearer harvest recorded in the statewide sealing files as of November 1985.

[a] Marten were not sealed prior to 1984-85.

Table 44. Reported Trapper Exports and Dealer Purchases of Furs by GMU/GMS, by Residency of Trapper, 1983-84[a]

GMS/GMU	Community of Residence	No. Trappers	Number Exported/Sold[b] Bvr	Mnk	Msk	Mtn	Otr	Fox	Wsl	Lnx	Sql
1A	Ketchikan	21	59	126	0	428	46	0	5	0	0
1A	Meyers Chuck	7	0	74	0	131	12	0	4	0	4
1C	Juneau	18	17	58	0	183	30	4	10	3	0
1C	Gustavus	2	0	3	0	13	0	0	0	0	0
1D	Haines	10	0	21	11	40	0	8	7	7	0
1D	Skagway	2	0	11	0	23	1	3	3	2	0
1	Subtotal	60	76	293	11	818	89	15	29	12	4
2	Craig	9	0	69	0	181	19	0	0	0	0
2	Hydaburg	1	0	2	0	9	0	0	0	0	0
2	Klawock	2	75	1	0	18	4	0	2	0	0
2	Thorne Bay	5	40	5	0	27	12	0	0	0	0
2	Subtotal	17	115	77	0	235	35	0	2	0	0
3	Petersburg	14	0	176	0	197	9	1	11	0	3
3	Wrangell	9	0	115	12	59	14	0	0	0	0
3	Subtotal	23	0	291	12	256	23	1	11	0	3
4	Hoonah	11	0	42	0	239	0	0	0	2	1
4	Pelican	9	0	8	0	60	13	0	0	0	7
4	Port Alexander	1	0	0	0	16	0	0	0	0	0
4	Sitka	16[c]	1	151	0	292	7	0	0	0	0
4	Tenakee Springs	1	0	4	0	1	0	0	0	0	0
4	Subtotal	38	1	191	0	608	20	0	0	2	8
5	Yakutat	4[d]	0	12	0	11	0	0	2	0	0
Southeast Region		142	192	886	23	1,928	167	16	44	14	15

Source: ADF&G 1985f.

[a] This table shows only the numbers of furs reported sold or exported and the reported number of trappers who sold or exported furs, not the total harvest or the total number of trappers. See text for further discussion.

[b] Species codes: Bvr=beaver, Mnk=mink, Msk=muskrat, Mtn=marten, Otr=land otter, Fox=red fox, Wsl=weasel, Sql=red squirrel.

[c] A community survey of randomly-chosen households suggested that about 48 households (2% of all households) in Sitka trapped in the 1982-1983 season (Gmelch and Gmelch 1985).

[d] A community survey of randomly-chosen households indicated that about 18 households (10% of all households) in Yakutat trapped furbearers in 1984 and suggested a harvest of about 18 beavers, 58 mink, 76 marten, 11 land otters, 11 weasel, 7 lynx, and 18 red squirrels (Mills 1986, Mills and Firman 1986).

4. Division of Subsistence community use studies. The ADF&G Division of Subsistence is engaged in community-use research that includes gathering information on the harvest and use of furbearers. These studies indicate that trapping is an important element in the subsistence-based mixed economy of some communities in Southeast Alaska (Bosworth 1986). Furbearers may be an important food source and, in many cases, the income from the sale of furs is necessary to buy equipment used in the gathering of wild foods (ibid.).

In 1984, 10% of randomly surveyed households in Yakutat trapped furbearers (Mills and Firman 1986). The most common species trapped were mink, marten, land otter, and wolf (ibid.). Hare, beaver, lynx, wolverine, coyote, weasel, and red squirrel were also taken, with the former three species being used for both their fur and as a food source (ibid.).

Two percent of households surveyed in Sitka trapped during the 1982-1983 season (Gmelch and Gmelch 1985). The target species were marten, mink, and land otter (ibid.). Both the Yakutat and the Sitka study estimated harvest during a year of relatively low overall fur prices and lower than average trapper participation.

Reports are also in preparation that will include data on the harvest and use of furbearers by residents of Kake, Klawock, Hoonah, Angoon, and Tenakee Springs (Bosworth 1986).

For information concerning furbearer harvest areas for the communities of Klawock, Tenakee Springs, Angoon, and Yakutat, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2.

VIII. POTENTIAL CHANGES IN HUMAN USE OF WILDLIFE AS A RESULT OF SUBSISTENCE LAWS

During the time this report was prepared, it should be noted that considerable discussion was focused on interpretation of the State of Alaska subsistence law and whether or not the state law was in compliance with federal requirements for prioritization of subsistence needs for fish and wildlife on federal lands as specified in the Alaska National Interest Lands Conservation Act. Between the 1984 and 1985 hunting seasons, a number of changes in hunting regulations arose as a result of legal cases and recent court interpretations of the State of Alaska subsistence law. The outcome of these legal and legislative actions is presently far from clear and it is beyond the scope of this report to discuss the recent changes and potential ramifications in any detail. However, it is important to note here, that future harvest patterns could be different as a result of these actions. Presently it appears that the major changes might involve the number of people who harvest wildlife and where they hunt. The number of nonresidents and "non-local" residents who are permitted to hunt certain wildlife species may be curtailed in the future in certain areas or at certain times. Some similar changes in human use of the fisheries resource could occur as well.

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Part II. HUMAN USE OF PACIFIC HERRING AND SELECTED SHELLFISH IN THE SOUTHEAST REGION

I. MANAGERIAL AUTHORITY

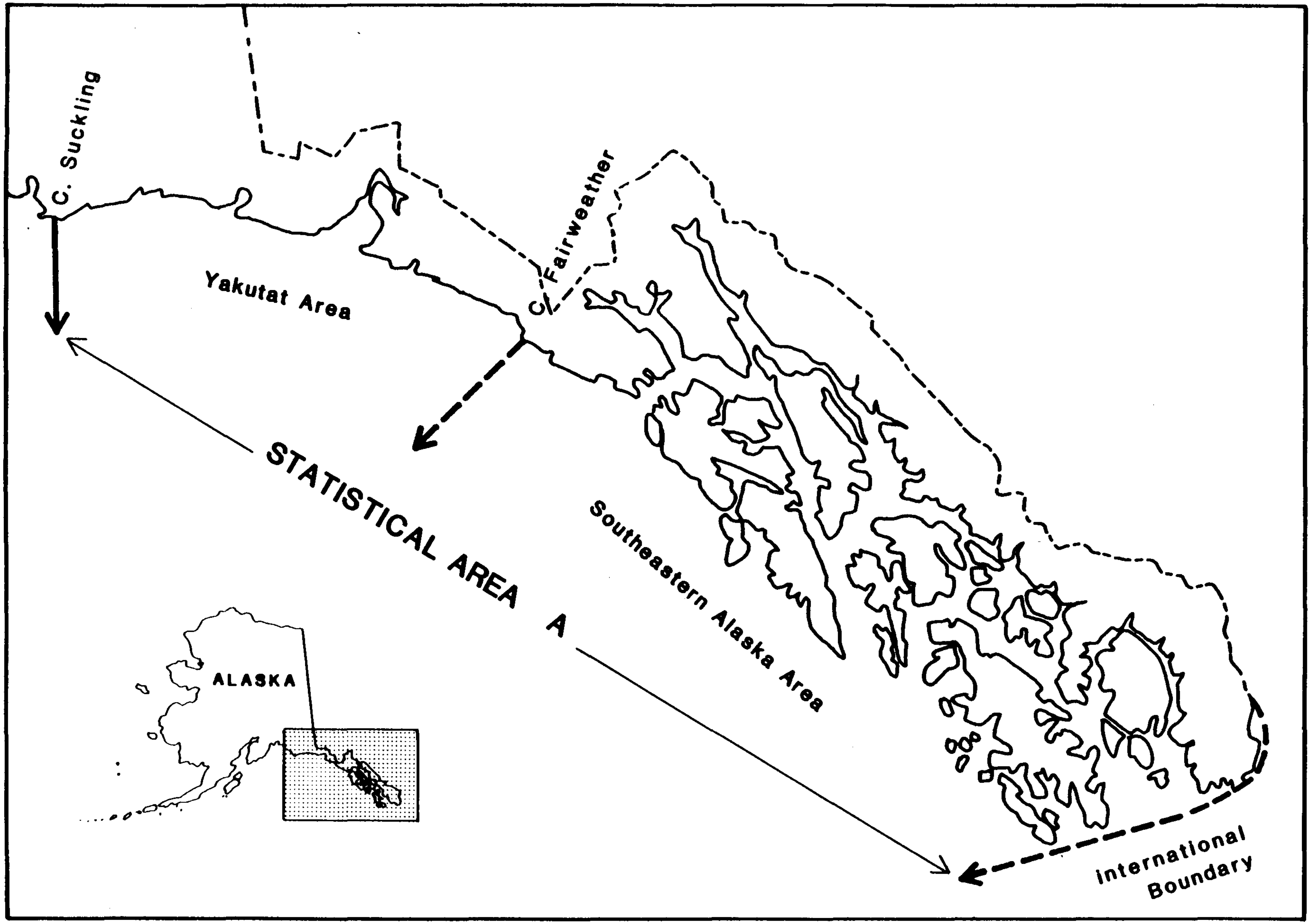
The nearshore fisheries are managed by the State of Alaska and the offshore fisheries are managed by the National Marine Fisheries Service. Nearshore is defined as within the 3-mi limit for Pacific herring, within the 800-fathom depth contour for king crabs, and within the 400-fathom depth contour for other shellfish species. The offshore fisheries extends from the seaward end of the nearshore fisheries to 200 mi off shore. Management is directed by joint policy developed by the Alaska Board of Fisheries and the North Pacific Fisheries Management Council. The regulations established are implemented by the ADF&G.

II. MANAGEMENT BOUNDARIES

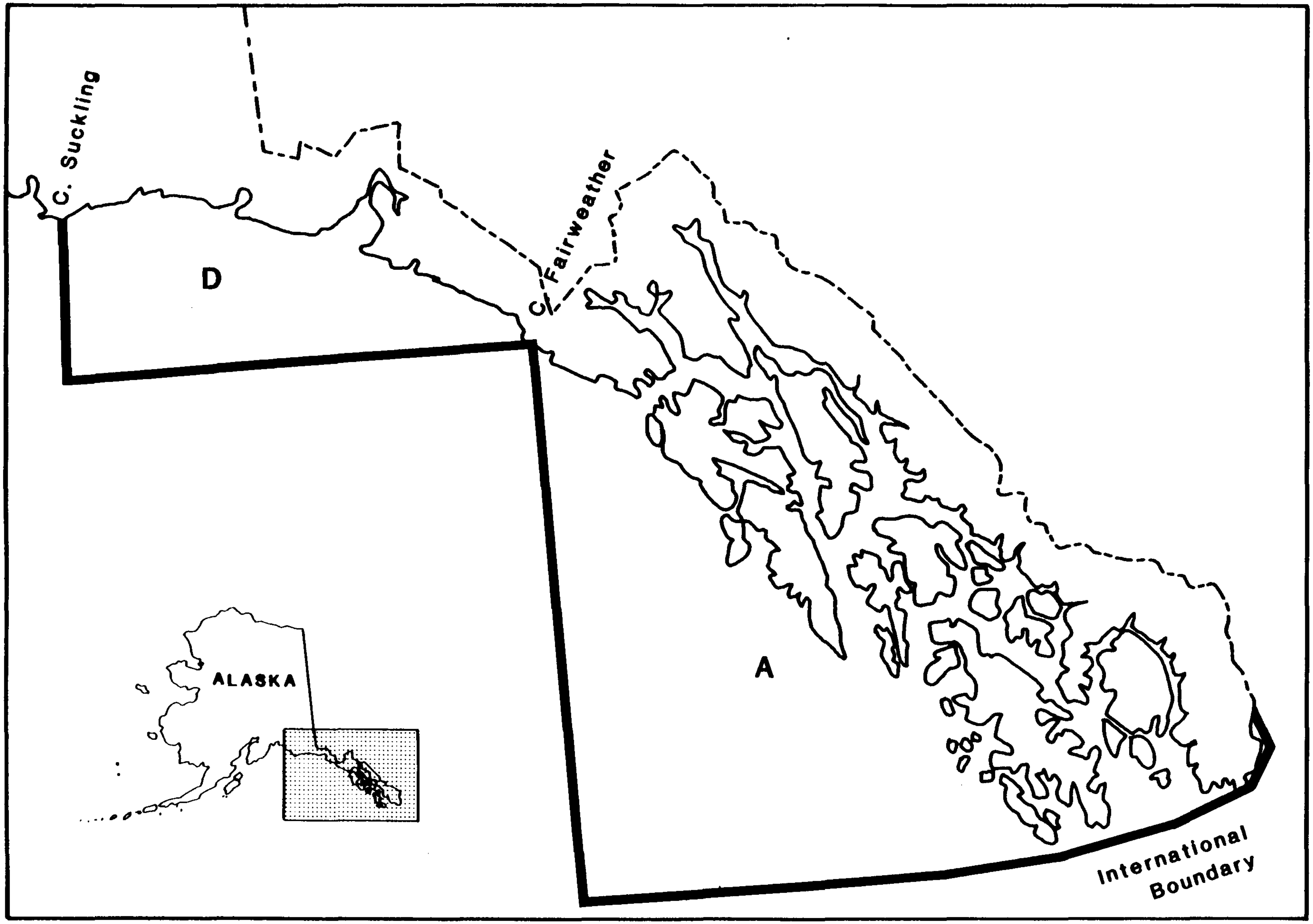
The largest management unit for the regulation of fisheries in the Southeast Region is the statistical area. For the shellfish fishery, one statistical area, Statistical Area A, comprises all the inshore and offshore waters of the Southeast Region (see map 1). Statistical Area A has as its western boundary the longitude of Cape Suckling (143° 53' W), as its southern boundary the International Boundary at Dixon Entrance, and as its seaward boundary the 400-fathom depth contour for all shellfish, except tanner and king crabs, which extends to the 800-fathom depth contour. Statistical Area A of the shellfish fishery is separated into two areas, referred to as the Southeastern Alaska Area and the Yakutat Area (see map 1). For practical purposes, these two areas are used to manage the fishery, and, at the winter 1986 Board of Fisheries meeting, regulations were adopted that divide Statistical Area A into two statistical areas.

For the Pacific herring fishery, the Southeast Region is divided into two statistical areas, the Southeast Alaska Statistical Area, and the Yakutat Statistical Area (see map 2). The Southeast Alaska Statistical Area is defined as the area that has as its western boundary a line extending south from Cape Fairweather and as its southern boundary a line extending west from the International Boundary at Dixon Entrance. The Yakutat Statistical Area is defined as the area that has as its western boundary a line extending south from Cape Suckling and as its southern boundary a line extending west from Cape Fairweather.

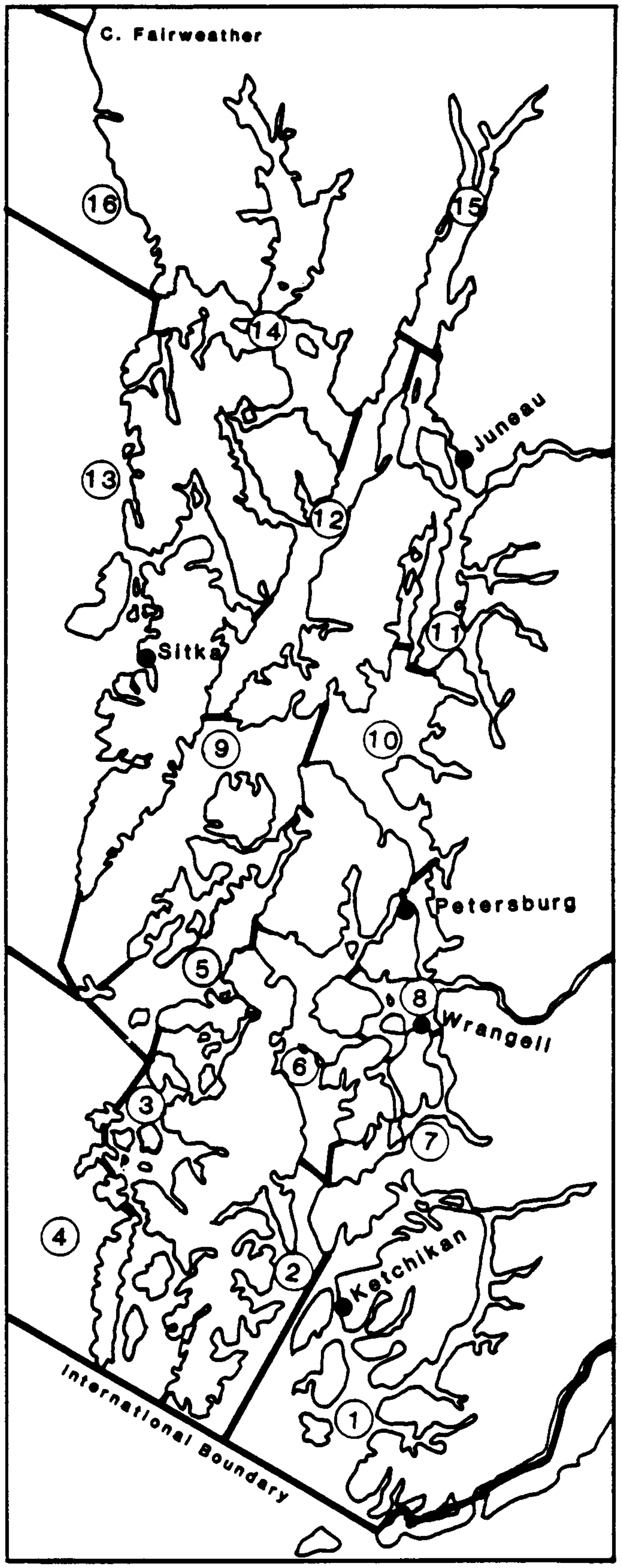
The Southeastern Alaska Area is divided into 16 fishing districts (see map 3) used for the management of herring and shellfish, numbered 1 to 16, and described as follows:



Map 1. ADF&G Commercial Shellfish Statistical Area A (Southeastern) and Yakutat Area and Southeastern Alaska Area subunits.



Map 2. ADF&G Commercial Pacific Herring Statistical Area A (Southeast Alaska) and D (Yakutat).



Map 3. Southeastern Alaska Area regulatory commercial fishing districts.

District 1: all waters east and north of a line from the southernmost tip of Caamano Point to 54°40'N, 131°45'W and north of a line from 54°40'N,131°45'W to 54°42'29"N,130°36'55"W

District 2: all waters south of a line from the easternmost tip of Narrow Point to the northernmost tip of Lemesurier Point, west of District 1 and east of a line from Point Marsh Light to 54°40'N,132°17'30"W

District 3: all waters north of a line from Point Marsh Light to 54°40"N,132°17'30"W to the southernmost tip of Cape Muzon and east of a line from the northernmost tip of Eagle Point on Dall Island and passing successively through the southernmost tip of Point Arboleda, the northernmost tip of Point San Rogue, the southernmost tip of Cape Ulitka, the northernmost tip of Cape Lynch to the southwest entrance point of Halibut Harbor on Kosciusko Island, and south of the latitude of Aneskett Point (56°08'50"N)

District 4: all waters north of Cape Muzon, west of District 3, and south of a line from Helm Point on Coronation Island to Cape Lynch

District 5: waters of Sumner Strait, north and east of a line from cape Decision to Helm Point to Cape Lynch to the southwest entrance point of Halibut Harbor, and north of the latitude of Aneskett Point, west of a line from Point Baker to Point Barrie, and south of a line from Point Camden to Salt Point Light on Keku Strait

District 6: all waters of Clarence Strait north of a line from Narrow Point to Lemesurier Point to Ernest Point to the most southerly point on Etolin Island, Stikine Strait south of the latitude of Round Point, Sumner Strait west of a line from Point Alexander to Low Point, and east of a line from Point Baker to Point Barrie, Wrangell Narrows south and west of a line from Prolewy Point to the northern tip of Mitkof Island, and all waters of Duncan Canal

District 7: all continguous waters of Ernest Sound and Bradfield Canal east of a line from Lemesurier Point to Ernest Point to the most southerly point of Etolin Island, Zimovia Strait south of the latitude of Nemo Point, and Eastern Passage and Blake Channel south of a line from Babbler Point to Hour Point

District 8: waters of Frederick Sound south of a line from Wood Point to Beacon Point (excluding Wrangell Narrows), Stikine Strait, Sumner Strait, Zimovia Strait, and Eastern Passage inside a line from Point Alexander to Low Point to Round Point to Nemo Point to Hour Point to Babbler Point

District 9: all waters of Frederick Sound and Chatham Strait south of the latitude of the southernmost tip of Point Gardner, south of the latitude of the southernmost tip of Elliot Island, and west of a line from the southernmost tip of Elliot Island to the westernmost tip of Point McCartney, north and west of a line from the northernmost tip of Point Camden to Salt Point Light, north and east of a line from the southernmost tip of Cape Decision to the southernmost tip of Helm Point to the westernmost tip of Hazy Islands to Cape Ommaney Light

District 10: Frederick Sound, Stephens Passage, and continguous waters north of a line from Beacon Point to Wood Point, east of a line from Point Macartney to the southern tip of Elliott Island, north of the latitude of the southern tip of Elliott Island, Seymour Canal south of 57°37'N, and south of a line from Point League to Point Hugh

District 11: Stephens Passage and contiguous waters north of a line from Point League to Point Hugh and Seymour Canal north of 57°37'N, south of the latitude of Little Island Light, and east of a line from Little Island Light to Point Retreat Light

District 12: all waters of Lynn Canal and Chatham Strait south of the latitude of Little Island Light to the latitude of Point Gardner, west of a line from Little Island Light to Point Retreat Light, east of a line from Point Couverden to Point Augusta, and east of a line from Point Hayes to Point Thatcher

District 13: all waters north of the latitude of the southernmost tip of Helm Point and west of a line from the southernmost tip of Helm Point to the westernmost tip of Hazy Island to Cape Ommaney Light, south of a line projecting west from the southernmost tip of Cape Spencer, west of a line from the southernmost tip of Cape Spencer through Yakobi Rock to Yakobi Island, south of a line from the northernmost tip of Soapstone Point to the westernmost tip of Column Point, and west of a line from the southernmost tip of Point Hayes to the northernmost tip of Point Thatcher

District 14: all waters of Icy Strait west of a line from the southernmost tip of Point Couverden to Point Augusta Light, east of a straight line from the southermost tip of Cape Spencer throughout Yakobi Rock to Yakobi Island, and north of a line from the northernmost point of Soapstone Point to the westernmost point of Column Point

District 15: all waters of Lynn Canal north of the latitude of Little Island Light

District 16: all waters north of a line projecting west from the southernmost tip of Cape Spencer and south of a line projecting southwest from the westernmost tip of Cape Fairweather

The fishing Districts 1 through 16 are also referred to as statistical areas, numbered 101 through 116, respectively, for the purposes of recording harvest-ticket data. Each statistical area is broken down further into subareas, which are designated by a hyphen followed by a two-number code following the statistical area number. For example, 110-12 refers to Statistical Area 110, Subarea 12, which is Thomas Bay in fishing District 10. The subarea code "00" is used to designate all subareas within the district. Hence, the code 110-00 refers to all of District 10.

For harvest-reporting purposes, the Yakutat Area is also divided into eight statistical areas designated with numbers between 181-192. These statistical areas are further divided into subareas which are coded as described above.

For information concerning the specific location of statistical area-subarea boundaries with regard to the commercial Pacific herring and the commercial shellfish harvest, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2.

III. HUMAN USE OF PACIFIC HERRING

A. Introduction

Pacific herring (Clupea harengus pallasi) is an important renewable resource for human use in the Southeast Region and is harvested both commercially and noncommercially.

B. Management Objectives and Considerations

In the Southeast Region, the commercial herring fishery is regulated by fishing districts using seasons and quotas as the principle management tools. Quotas are managed by emergency orders for separate stocks and are based on harvesting a percentage (10 to 20%) of each major stock using available data on total biomass, age and growth analysis, and spawning success (Blankenbeckler 1977, Blankenbeckler and Larson 1981). Harvest is allowed only on stocks that exceed certain threshold levels. Individual stocks are presently managed so that they are exposed to only one type of commercial fishery, either sac roe or food and bait (Blankenbeckler and Larson 1981).

Pacific herring may be taken for personal use in Southeast Alaska at any time, except that vessels licensed as commercial fishing vessels may not be used to take herring for personal use in any district that is open for commercial herring fishing for 72 hours before, during, and 72 hours after any open commercial herring fishing period for that district when the vessel has aboard it any person holding a Southeastern Alaska Area winter bait herring or herring sac roe interim-use or entry permit (ADF&G 1985a).

The take of subsistence roe-on-kelp in the Southeastern Alaska Statistical Area is regulated through the issuance of subsistence permits by local ADF&G offices. The permits specify times, areas, and amounts of roe-on-kelp allowed, with generally 10 lb of roe allowed per individual (ADF&G 1984a). Permits are not required to take herring roe on other substrates or to take roe directly from the fish for subsistence use. Permits are not required to harvest roe-on-kelp for subsistence in the Yakutat Statistical Area.

C. Commercial Harvest

1. Harvest summary. The first recorded statistics for Pacific herring harvest occurred in 1878 (Barry 1974). Most of the catch from the 1890's to the 1960's was used to supply herring for reduction to meal and oil (ADF&G 1982). Herring harvested for bait first appeared in the harvest statistics in 1906, with 831 tons marketed (Barry 1974). The average amount harvested for bait from 1910 to 1973 was 2,635 tons or about 11% of the total harvest (ibid.). The sac roe fishery has developed in recent years in response to Japanese demand for herring sac roe; it has accounted for 56% of the total harvest from 1971 to 1984, with an annual catch of 4,070 tons (ADF&G 1984b). The total commercial harvest of herring in Southeast Alaska from 1900 to 1984 is given in table 1.

   Since the start of commercial herring fishing, there have been three peaks in the industry (Barry 1974) (table 1). One occurred from 1925 to 1937, with average harvests exceeding 50,000 tons. Another occurred after World War II with average harvests of 34,500 tons from 1945 to 1947. The last peak occurred from 1956 to 1964, when harvests averaged over 28,000 tons/year.

2. Harvest methods and periods of use. The herring sac roe fishery in Southeast Alaska is presently segregated by area into one of two gear types: purse seiners or set gill-netters (Bergmann 1983). This fishery occurs in spring on the herring spawning grounds. Sitka Sound and Lynn Canal have been designated purse seine areas; Hoonah Sound, Seymour Canal, Three Mile Arm (Kuiu Island), Kaasan Bay, and Kah Shakes have been restricted to gillnetting (ibid.).

   The food/bait fishery is mainly a winter fishery that utilizes the entire fish for bait or food (as opposed to the sac roe fishery, where only the roe is consumed as food). Prior to the 1978-1979 season, this fishery was open from October through February and numerous stocks were harvested (Blankenbeckler 1975, Bergmann 1983). Since that time, the winter fishery has been restricted to certain areas where information indicates that harvestable amounts of overwintering mature herring are present (ADF&G 1980). Although this fishery is open to other gear types, the harvest is taken primarily by purse seiners.

   A second type of bait fishery is the fresh-bait pound. This fishery usually requires a purse seiner to capture the herring and move them to the pound, although sometimes leads are used to guide the fish into the pound as they move along the shore (Bergmann 1983). The pound is typically a rectangular log enclosure with net or wire mesh suspended from it, and the fish are held there and sold to individual fishermen (ibid.). Areas where fresh-bait pounds have been allowed in at least some years during the early 1980's include Tee Harbor and Indian Cove (111-50), Farragut Bay (110-14), Scow Bay (106-44), and Sitka Sound (113-41)

Table 1. Southeast Region Commercial Pacific Herring Harvests in Thousands of Pounds, 1900-84.

Year[a]	Total Harvest	Year[a]	Total Harvest
1900	2,388	1942	7,382
1901	2,500	1943	12,470
1902	1,624	1944	33,602
1903	2,988	1945	48,252
1904	3,042	1946	75,128
1905	2,618	1947	83,658
1906	2,010	1948	32,250
1907	2,764	1949	28,558
1908	3,422	1950	26,822
1909	2,150	1951	21,304
1910	13,734	1952	32,040
1911	24,114	1953	24,870
1912	32,134	1954	12,892
1913	26,992	1955	22,736
1914	16,636	1956	45,638
1915	13,928	1957	49,490
1916	22,388	1958	77,594
1917	24,890	1959	99,732
1918	35,650	1960	77,812
1919	21,924	1961	49,418
1920	32,904	1962	33,874
1921	12,024	1963	31,212
1922	33,900	1964	46,698
1923	42,480	1965	24,318
1924	58,790	1966	10,680
1925	115,564	1967	6,050
1926	147,686	1968	3,632
1927	90,620	1969	7,364
1928	106,014	1970	6,648
1929	157,498	1971	8,414
1930	141,710	1972	11,827
1931	89,714	1973	12,536
1932	99,572	1974	15,994
1933	123,176	1975	16,195
1934	133,684	1976	17,297
1935	116,310	1977	12,106
1936	73,426	1978	13,050
1937	100,668	1979	18,408
1938	44,712	1980	16,732
1939	40,056	1981	17,260
1940	6,274	1982	19,764
1941	12,460	1983	18,062

Source: ADF&G 1984b

[a] Harvest includes the fish harvested throughout the regulatory season although referenced as only one year. Example: 1976 year would include the 1976-77 season's harvest.

(Bergmann 1983, ADF&G 1984b) (subarea numbers given in parenthesis). From 1978 to 1984, the yearly fresh-bait pound harvest averaged around 50 tons (Bergmann 1983; ADF&G 1983, 1984b).

Two other types of commercial harvests connected with herring have occurred in recent years in Southeast Alaska. One fishery is a frozen-tray-pack pound that was created in 1979. This harvest has generated relatively little interest, however. Only 50 tons were harvested from 1979 to 1982 (Bergmann 1983), and no processors participated in the fishery in the 1982-1983 and 1983-1984 seasons (ADF&G 1983, 1984b).

There has been a limited harvest of Macrocystis kelp in Southeast Alaska. This kelp is harvested in the spring and transported mainly by boat to Prince William Sound where it is used as a substrate for the commercial herring roe-on-kelp fisheries (ADF&G 1984b). Prior to 1984, the demand for kelp was minimal with less than 15 tons harvested annually (ibid.). In 1984, the demand rose sharply, with 84 permits being issued for the taking of 232 tons, and an actual harvest of about 61 tons (ibid.).

3. Significance of particular use areas. Nearly all the commercial herring harvest has occurred in the Southeastern Alaska Statistical Area. The commercial harvest of herring in the Yakutat Statistical Area has been limited to an occasional winter food and bait fishery in the area of Yakutat Bay (ADF&G 1983, 1984b). Harvest has been reported during only four years in the Yakutat Statistical Area since 1969 (ADF&G 1985b).

   A summary of herring harvest by subarea from 1969 through 1984 is presented in tables 2-4. For maps showing the location of these subareas, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2.

D. Noncommercial Harvest: Personal Use Within the Commercial Fishery

Commercial fisherman frequently harvest herring for their own use as bait for crabbing, trolling, and longlining (Bergmann 1983). The desire for premium quality bait and the high cost of bait has led to this practice (ibid.).

This fishery is especially prevalent in the Wrangell Narrows near Petersburg using purse seiners (ibid.). An average of 80 tons/year was estimated to have been taken for personal use there from 1978 to 1982 (ibid.). This personal use fishery is largely unregulated, and the exact harvest of herring for personal use as commercial fishing bait is but little known (ADF&G 1984b).

Table 2. Southeast Region Total Commercial Pacific Herring Harvest by Subarea, 1969-84

Subarea	Total Tons	Years of Harvest
101-00[a]	*	1
101-11	*	1
101-13	*	1
101-21	*	1
101-22	12,967	10
101-24	286	4
101-25	92	2
101-27	*	2
101-28	49	2
101-30	39	1
101-40	1,290	6
101-43	*	4
101-44	*	1
101-45	9,341	8
101-46	*	1
101-47	2,423	9
101-75	*	1
101-77	543	1
101-80	938	4
101-90	713	4
102-00[a]	*	1
102-10	*	1
102-60	273	1
103-50	267	1
103-60	135	1
103-80	1,535	4
103-90	2,435	6
104-00[a]	*	1
104-20	*	2
104-30	248	2
105-10	*	1
105-31	*	1
105-32	*	1
105-41	*	1
106-20	*	1
106-22	286	4
106-41	*	2
106-42	59	2
106-43	*	1
106-44	1,655	12
107-20	5,043	8
107-30	4,137	9
107-40	*	1
108-20	*	1
108-40	*	5
108-50	*	1
109-42	815	4
109-43	2,321	5
109-51	*	1
109-62	805	3
110-14	*	11

(continued)

Table 2 (continued).

Subarea	Total Tons	Years of Harvest
110-22	22	1
110-23	*	1
110-34	478	3
111-11	1,857	5
111-14	2,884	8
111-50	4,081	10
112-00[a]	*	1
112-13	*	1
112-16	*	1
112-18	*	1
112-21	240	4
112-41	*	1
112-42	1,271	2
112-45	1,858	9
112-46	*	1
112-47	*	2
112-48	1,115	2
112-50	290	2
112-65	*	1
112-67	*	1
112-71	*	2
112-73	*	1
112-80	7	1
113-00[a]	4,753	3
113-21	*	1
113-22	*	2
113-31	3,996	1
113-32	*	3
113-33	*	1
113-34	481	4
113-41	24,603	13
113-43	*	1
113-44	*	3
113-55	*	3
113-59	*	1
113-72	*	1
113-73	*	2
113-81	*	2
113-95	4,092	9
113-96	*	1
113-97	*	2
114-21	*	1
114-23	*	1
114-27	*	1
114-32	*	2
114-33	*	1
114-34	*	2
114-40	243	2
114-50	417	3
115-10	3,805	6
115-20	754	1
154-00[a]	*	1
183-10	*	4

(continued)

Table 2 (continued).

Source: ADF&G 1985b

[a] Harvest reported only to statistical area.

* means that the reporting of tonnage to subarea was withheld because of nondisclosure regulations. A total of approximately 9,126 tons of herring was caught in these areas from 1969 through 1984.

Table 3. Southeast Region Commercial Pacific Herring Food and Bait Harvest by Subarea, 1978-84

Subareas	Total Tons	Years of Harvest
101-23	*	1
101-27	*	1
101-77	543	1
101-80	396	2
102-00[a]	*	1
103-50	267	1
103-80	523	1
103-90	676	3
104-20	*	1
104-30	248	2
105-10	*	1
105-31	*	1
105-32	*	1
105-41	*	1
106-20	*	1
106-22	*	1
106-44	81	5
107-30	1,316	3
108-40	*	1
109-42	*	1
109-43	150	1
110-14	*	4
111-11	*	1
111-50	*	2
112-16	*	1
112-41	*	1
112-42	1,271	2
112-45	1,172	4
112-48	1,115	2
112-71	*	1
113-00[a]	*	1
113-22	*	2
113-32	*	3
113-33	*	1
113-34	481	4
113-41	*	2
113-55	*	1
113-72	*	1
113-73	*	1
113-95	2,216	2
113-96	*	1
113-97	*	1
114-33	*	1
154-00[a]	*	1
183-10	*	2

Source: ADF&G 1985b.

[a] Harvest reported only to statistical area.

* means that the reporting of tonnage was withheld because of nondisclosure regulations. A total of approximately 2,630 tons of herring was caught by the food/bait fishery from 1978 through 1984.

Table 4. Southeast Region Commercial Pacific Herring Sac Roe Harvest by Subarea, 1978-84

Subareas	Total Tons	Years of Harvest
101-00[a]	*	1
101-11	*	1
101-23	12,032	7
101-24	286	4
101-28	49	2
111-11	1,810	4
111-14	302	3
113-00[a]	4,364	2
113-31	3,996	1
113-41	20,004	5
113-95	225	1
115-10	2,493	3
115-20	754	1

Source: ADF&G 1985b.

[a] Harvest reported only to statistical area.

* means the reporting of tonnage was withheld because of nondisclosure regulations.

E. Noncommercial Harvest: Personal Use Outside the Commercial Fishery

1. Harvest summary. Herring are widely used throughout the Southeast Region as a food source and as an important source of bait for sport and subsistence fishing and fur trapping. Use of the herring for food involves the harvest of both spawn and whole fish.

The harvest of roe-on-kelp under subsistence permits in the Southeastern Alaska Statistical Area is given in table 5. Subsistence permit harvests of roe-on-kelp may substantially underestimate the actual subsistence use of roe taken by all methods because permits are not needed to take roe on other substrates or to harvest the whole fish for eggs. A study in Sitka indicated that about 24% of all households harvested herring eggs, with an average take of about three gallons per household, suggesting a community harvest of about 6,000 gallons of roe (Gmelch and Gmelch 1985). A 1984 study in Yakutat showed that 30% of the households interviewed used herring roe taken on substrates, with an average use of 5 lb/household (including nonusers) (Mills and Firman 1986). Extrapolating the results of this survey provides an estimated noncommercial harvest of about 750 lb of roe by the residents of Yakutat (ibid.). This harvest has been reported to be much lower than previous harvests because of the limited size of the spawn that year (Mills 1986). In fact, in 1984 many Yakutat residents received herring spawn from the Sitka area to compensate for the limited Yakutat spawn (ibid.). Unpublished survey data from the ADF&G Division of Subsistence indicated a mean harvest of herring eggs taken on substrates other than kelp of 29.5 lb/household in Angoon (Bosworth 1986). The mean harvest of herring eggs on kelp was 25 lb/household in Klawock and 1 lb/household in Angoon (ibid.).

Estimates of the noncommercial use of herring (exclusive of roe-on-kelp) for food are limited to a few studies in select communities. In Sitka, about 16% of all households caught herring for food in 1983, with an average harvest of about one gallon per household, including nonusers (Gmelch and Gmelch 1985). In Yakutat, about 28% of all households used herring for food for an average of 19 lb/household including nonusers (Mills and Firman 1986). Households actively harvesting herring for food averaged 93 lb/year in the Yakutat study (ibid.). Unpublished survey data from the ADF&G Division of Subsistence suggested an average herring harvest of about 5 lb/household in Klawock, 12 lb/household in Angoon, and 14 lb/household in Tenakee Springs (Bosworth 1986).

2. Harvest methods. Live herring are generally harvested noncommercially by jigging or gathering them in nets. A rake device has traditionally been used to harvest herring by

impaling the fish on the teeth of the rake (ADF&G 1984a, Gmelch and Gmelch 1985). The herring are used fresh, pickled, frozen, or dried (ibid.).

3. Periods of use. The roe harvest occurs during spring in the intertidal and subtidal areas where herring spawn. The whole fish harvest occurs throughout the year, although in some communities there may be certain periods of the year when this harvest is most concentrated (Mills and Firman 1986).

4. Significance of particular use areas. Noncommercial use of herring occurs throughout the region, but is most concentrated near population centers. For information concerning herring harvest areas for the communities of Klawock, Tenakee Springs, Angoon, and Yakutat, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2. See Gmelch and Gmelch (1985) for a discussion of herring harvest areas for Sitka.

IV. HUMAN USE OF DUNGENESS CRAB

A. Introduction

The Dungeness crab (Cancer magister) is the most widespread crab species in the Southeast Region that is utilized extensively as both a commercial and a noncommercial food source.

B. Management Objectives and Considerations

The commercial Dungeness crab fishery in the Southeast Region is managed primarily on the basis of a minimum size limit and the taking of males only (Imamura 1986a). Minimum size limits are set above the size-of-maturity to allow males a chance to mate before they can be legally harvested (ibid.). Historically, the market demand for Alaskan Dungeness crab has been inversely related to the availability of crab in Washington, Oregon, and California (ibid.). Like Tanner crab, the Southeastern Alaska Shellfish Area and the Yakutat Shellfish Area are managed separately.

There is no closed season on the noncommercial take of Dungeness crab. Either sex may be taken, and in 1985-1986 the daily bag and possession limit was 20 for all of the Southeast Region, except for Thorne Bay, where the limit was 5 (ADF&G 1985c). The minimum size limit of the noncommercial take is the same as the commercial harvest. Closures of commercial Dungeness crab fishing at certain locations near Juneau, Tenakee, Port Protection, Point Baker, and Thorne Bay (ADF&G 1985d) have given a priority to the noncommercial fishery.

C. Commercial Harvest: Southeastern Alaska Shellfish Area

1. Harvest summary. Since 1960, commercial Dungeness crab harvests have averaged about 1.5 million pounds (table 6).

Table 5. Southeast Region Pacific Herring Roe-on-kelp Subsistence Harvests Under Permits by Area Fished, 1966-83

Year	Permits Issued	Permits Returned	Total Pounds Harvested[a]
Craig/Klawock/Hydaburg			
1966	145	86	5,200
1967	201	130	3,368
1968	130	95	2,260
1969	80	61	2,858
1970	103	70	3,213
1971	81	66	2,643
1972	102	44	4,250
1973	31	9	1,209
1974	159	39	3,087
1975	92	34	1,640
1976	54	12	1,728
1977	34	7	352
1978	109	83	3,521
1979	102	81	1,268
1980	309	189	3,721
1981	157	87	6,148
1982	187	81	5,485
1983	302	189	5,945
Kah Shakes			
1978	11	8	122
1979	16	6	0
1980	33	24	75
1981	6	5	12
1982	30	18	342
1983	33	24	103
Sitka			
1979	21	10	137
1980	19	13	145
1981	26	19	192
1982	36	25	886
1983	69	48	1,991

Source: ADF&G 1984b. Figures do not include the Yakutat area, which does not require permits for subsistence roe-on-kelp harvests.

[a] Total harvest was expanded to include estimate of the harvest under permits that were not returned.

Table 6. Southeast Region (Statistical Area A) Commercial Dungeness Crab Harvests in Pounds, 1961 to 1985-86

	Southeastern Alaska District		Yakutat Subdistrict		Total	
Year/Season	Harvest	No. of Vessels	Harvest	No. of Vessels	Harvest	No. of Vessels
1960	1,449,405	---	543,762	---	1,993,167	---
1961	671,455	---	1,023,545	---	1,695,000	---
1962	2,985,939	---	937,051	---	3,922,990	---
1963	3,296,362	---	1,383,298	---	4,679,660	---
1964	3,996,100	---	637,140	---	4,633,240	---
1965	2,392,395	---	910,278	---	3,302,673	---
1966	1,968,117	---	528,060	---	2,496,177	---
1967	2,033,156	---	2,031,460	---	4,064,616	---
1968	1,900,690	---	2,096,119	---	3,996,809	---
1969-70	1,149,111	20	1,207,397	11	2,356,508	31
1970-71	700,168	21	1,589,945	10	2,290,113	31
1971-72	413,361	23	1,250,118	8	1,663,479	31
1972-73	383,100	30	2,207,061	12	2,590,161	42
1973-74	563,148	41	2,532,778	22	3,095,926	63
1974-75	647,733	43	1,097,508	19	1,745,241	62
1975-76	562,768	32	628,879	16	1,191,647	48
1976-77	476,650	15	542,726	8	1,019,376	23
1977-78	124,276	11	131,052	2	255,328	13
1978-79	679,175	22	1,875,088	13	2,554,263	35
1979-80	719,277	32	1,474,149	19	2,193,426	51
1980-81	516,245	17	881,681	7	1,397,926	24
1981-82	2,685,627	55	3,300,158	16	5,985,785	71
1982-83	2,929,916	103	5,880,409	33	8,810,325	136
1983-84	1,492,815	139	3,133,531	54	4,626,346	193
1984-85	1,820,215	141	765,850	41	2,586,065	182
1985-86[a]	2,166,082	191	370,620	28	2,536,702	219

Source: Imamura 1986a.

[a] Most recent year's data should be considered preliminary.

--- means data not available.

Since 1980-1981 the average has been 2.2 million pounds. The number of vessels fishing during the period 1969-1970 to 1980-1981 ranged from 11 to 43. By 1985-1986 the number had risen to 191.

2. Harvest methods. Dungeness crab may be taken only by pots, ring nets, or diving gear (ADF&G 1985d). No more than 300 pots may be used by a vessel to take Dungeness crab (ibid.). The minimum shoulder (carapace) width is 6.5 inches.

3. Periods of use. From the early 1930's through 1955, regulations closed the season for two to four months during the summer in an effort to prohibit fishing during the molting season. (Imamura 1986a). From the late 1950's to 1968, the commercial season was opened all year (ibid.). Since then, various closures were implemented in certain areas during certain periods from March to September. In 1985, the season was closed in the latter half of August and all of September (ibid.). A summary of harvests by month from 1969-1970 to 1985-1986 is given in table 7. Most of the Dungeness crab harvest generally occurs from June to October, although some fishing occurs during the rest of the year.

4. Significance of particular use areas. The summer fishery of Dungeness crab is concentrated in bay areas with mud or sand bottoms at depths of about 4 to 15 fathoms (ibid.). The fall and winter fishery tends to use deeper waters, fishing at depths of about 15 to 60 fathoms (Koeneman 1986a). Imamura (1986a) believes that currently all available Dungeness crab fishing grounds in the Southeast Alaska area are fully utilized. A summary of the district harvest during the 1985-1986 season (a year with above-average catches) is shown in table 8.

   For information concerning subarea commercial harvests of Dungeness crab from 1969-1984 and known specific commercial harvest areas, see the I:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2.

D. Commercial Harvest: Yakutat Shellfish Area

1. Harvest summary. Since 1960, commercial harvests have averaged 1.5 million pounds (Imamura 1986a) (table 6). Record catches of 3.1 to 5.9 million pounds were recorded from 1981-1982 to 1983-1984. Harvests subsequently declined to 765,850 and less than 400,000 lb in 1984-1985 and 1985-1986, respectively (ibid.). The number of vessels in the fishery since 1969 has ranged from 2 to 54 (table 6).

   There is concern that the Yakutat Dungeness crab stocks are declining and that low harvests will continue over the next few seasons (ibid.).

Table 7. Southeastern Alaska Area Commercial Dungeness Crab Harvests in Thousands of Pounds by Month and Season, 1969-70 to 1985-86

Season	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	Total
1969-70	21.3	84.9	201.0	217.5	225.5	210.9	116.6	37.0	14.2	5.0	7.1	8.1	1,149.1
1970-71	11.1	37.0	92.0	150.4	157.1	122.9	68.6	35.9	9.3	5.6	4.6	5.9	700.1
1971-72	7.4	18.5	43.6	68.8	79.1	88.9	63.6	23.3	9.5	6.9	1.8	2.2	413.5
1972-73	4.2	10.8	38.6	57.6	82.4	83.6	49.5	31.5	16.7	3.5	1.4	3.2	383.0
1973-74	13.8	32.2	82.6	112.1	112.7	83.7	71.6	27.5	8.8	3.5	4.7	9.9	563.1
1974-75	24.8	21.5	106.5	138.4	126.9	85.0	53.9	27.6	26.5	6.3	13.7	16.8	646.9
1975-76	18.1	35.9	89.3	127.7	115.1	69.5	49.7	25.9	11.7	6.8	2.9	10.1	562.7
1976-77	0.4	---	105.9	178.9	83.9	42.6	30.1	13.4	11.6	3.9	6.1	---	476.7
1977-78	---	---	2.3	8.5	29.6	31.1	16.2	25.0	6.3	0.5	4.9	---	124.3
1978-79	---	---	123.5	127.7	145.6	117.6	73.5	42.9	21.7	17.8	8.9	---	679.2
1979-80	---	---	125.6	133.2	145.5	137.4	75.5	53.5	28.9	12.8	6.9	---	719.3
1980-81	---	---	63.0	169.4	121.4	68.5	36.3	30.2	13.0	5.3	9.1	---	516.2
1981-82	---	---	421.6	819.3	482.0	418.5	265.9	110.1	26.0	24.4	17.8	---	2,685.6
1982-83	---	---	830.9	885.0	604.8	308.9	198.2	75.7	12.8	8.8	4.6	---	2,929.9
1983-84	---	---	410.5	376.4	237.1	219.5	123.0	75.1	10.3	30.1	10.7	---	1,492.8
1984-85	---	---	---	676.8	496.9	266.8	142.5	122.5	57.7	38.9	18.0	---	1,820.0
1985-86[a]	---	---	329.4	852.9	444.9	Clsd.	362.6	117.2	59.0	---	---	Clsd.	2,166.1

Source: Imamura 1986a.

[a] Most recent years data should be considered preliminary

Clsd. means no open season.

--- means no reported harvest.

Table 8. Southeastern Alaska Area Commercial Dungeness Crab Harvest in Pounds by District, May to December 1985

District	Harvest	(% Total)
1	53,997	(2)
2	5,450	(tr)[a]
3	5,175	(tr)[a]
4	13,142	(1)
5	134,415	(6)
6	470,919	(22)
7	153,233	(7)
8	352,359	(16)
9	222,077	(10)
10	73,743	(3)
11	12,916	(1)
12	182,236	(8)
13	119,058	(5)
14	225,940	(10)
15	11,849	(1)
16	129,573	(6)

Source: Imamura 1986a.

tr means less than 0.5% of the total harvest.

2. Harvest methods. Commercial harvest methods in 1985-1986 were similar to those of the Southeastern Alaska Shellfish Area, except that the maximum number of pots used by a vessel was 600 (ADF&G 1985d).

3. Periods of use. In 1985-1986, the summer season extended from May 1 to July 15, and the winter season ran from November 2 to February 28 (Imamura 1986a). Historically, the majority of the catch occurs in June and July (Table 9).

4. Significance of particular use areas. The Dungeness crab fishery occurs primarily in the surf zone along the exposed sand and gravel beaches of the outer coastline (Imamura 1986a). Fishing primarily occurs at depths between 4 and 15 fathoms (Imamura 1986a, Koeneman 1986a). Spits and channels that form at the mouths of rivers bisecting these beaches are also good habitat for Dungeness crab (Imamura 1986a) and receive some fishing pressure (ADF&G 1985b).

   For information concerning subarea commercial harvests of Dungeness crab from 1969 through 1984 and known specific harvest areas, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2.

E. Noncommercial Harvest

1. Harvest summary. Dungeness crab is the major crab species harvested noncommerically for food in the Southeast Region. In Yakutat, an estimated 40% of all households harvested an average of 203 lb of Dungeness crab in 1984, making it the most commonly consumed shellfish species in that community (Mills and Firman 1986). In Sitka in 1983, an estimated 24% of all households noncommercially crabbed and harvested an average of 35 crabs, of which Dungeness crab was the primary species caught (Gmelch and Gmelch 1985). Unpublished survey data from the ADF&G Division of Subsistence indicated a Dungeness crab harvest of 12.5 crabs/household in Klawock, 32.4 crabs/household in Yakutat, 3.4 crabs/household in Angoon, and 19.5 crabs/household in Tenakee Springs in 1984 (Bosworth 1986).

2. Harvest methods. Dungeness crabs are primarily caught with crab pots and secondarily with rings, by diving or snorkeling, or by picking, netting, and raking at low tides (ibid.). Historically, they were often gathered by spearing at low tides (ADF&G 1984a). Currently no more than 5 pots/person or 10 pots/vessel may be used when fishing noncommercially for crab in the Southeast Region (ADF&G 1985c).

3. Periods of use. Noncommercial Dungeness crab harvesting occurs throughout the year; however, the primary period of

Table 9. Yakutat Area Commercial Dungeness Crab Harvest in Thousands of Pounds by Month and Season, 1969-70 to 1985-86

Season	April	May	June	July	Aug.	Sept.	Nov.	Dec.	Jan.	Feb.	Total
1969-70	---	87.7	254.7	529.0	336.0	---	---	---	---	---	1,120.4
1970-71	---	40.3	468.0	426.1	511.9	143.6	---	---	---	---	1,589.9
1971-72	---	17.5	407.8	601.4	223.4	---	---	---	---	---	1,250.1
1972-73	---	120.4	653.7	951.6	478.0	3.4	---	---	---	---	2,207.1
1973-74	21.6	214.0	739.4	1,173.2	211.8	91.9	80.9	---	---	---	2,532.8
1974-75	16.3	141.0	505.0	242.0	121.5	37.4	34.3	---	---	---	1,097.5
1975-76	4.1	80.2	260.3	260.5	10.5	13.3	---	---	---	---	628.9
1976-77	---	---	133.0	246.7	163.0	---	---	---	---	---	542.7
1977-78	---	---	---	---	33.7	87.9	---	1.6	0.6	7.2	131.0
1978-79	---	---	720.6	897.9	256.6	Clsd.	---	---	---	---	1,875.1
1979-80	---	---	831.8	609.4	32.9	Clsd.	---	---	---	---	1,474.1
1980-81	---	---	404.4	328.3	129.6	18.7	0.5	---	0.1	---	881.7
1981-82	---	---	2,404.8	751.2	127.6	16.5	Clsd.	---	---	---	3,300.2
1982-83	---	---	3,135.6	2,028.6	565.8	133.2	13.6	3.6	---	---	5,880.5
1983-84	---	1,005.2	1,497.9	245.5	114.7	223.6	3.0	---	2.5	1.8	3,133.5
1984-85	---	402.8	306.7	54.1	Clsd.	2.3	---	---	---	---	765.9
1985-86[a]	Clsd.	159.0	142.4	65.9	Clsd.	Clsd.	1.3	1.0	---	---	370.6

Source: Imamura 1986a.

[a] Recent year's data should be considered preliminary.

Clsd. means no open season.

--- means no reported harvest.

harvest is from mid April through October (George et al. 1985, Mills and Firman 1986).

4. Significance of particular use areas. For information concerning shellfish harvest areas for the communities of Klawock, Tenakee Springs, Angoon, and Yakutat, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2. See Gmelch and Gmelch (1985) for a discussion of shellfish harvesting areas for Sitka. Additional information on noncommercial Dungeness crab harvesting areas around a number of communities can be found in George et al. (1985).

V. HUMAN USE OF TANNER CRAB

A. Introduction

The chief species of Tanner crab utilized by humans in the Southeast Region is *Chionoecetes bairdi*.

B. Management Objectives and Considerations

The management of the commercial Tanner crab fisheries is based on the establishment of guideline harvest levels, retention of only male crabs with carapace widths exceeding 5.5 inches, and timing the seasons to avoid sensitive molting and mating periods (Imamura 1986b). Guideline harvest levels are based on past historical catches (ibid.). The Tanner crab fisheries in the Southeastern Alaska and the Yakutat Shellfish Areas are managed separately (ibid.).

The noncommercial season for Tanner crab is open throughout the year (ADF&G 1985c). There is no minimum size limit and either sex may be taken. The daily limit and possession limit is 30.

C. Commercial Harvest: Southeastern Alaska Shellfish Area

1. Harvest summary. The Tanner crab fishery in the Southeastern Alaska Shellfish Area began in the early 1960's and intensified in the 1970's (table 10). This fishery produced an annual harvest of 1.7 million pounds since the 1972-1973 season and involved an average of 50 vessels. The number of vessels rose to between 75 and 99 during the period 1982-1985. Currently the fishery is largely dependent on recruitment-sized males (Imamura 1986b).

2. Harvest methods. Tanner crab may be harvested commercially only by pots and ring nets (ADF&G 1985d). The minimum carapace width is 5.5 inches, and only males may be taken. The number of pots per vessel is restricted to a maximum of 100 king and Tanner crab pots on most of the fishing grounds.

3. Periods of use. Historically, the commercial harvest has occurred primarily during January through April (Imamura

Table 10. Southeast Region (Statistical Area A) Commercial Tanner Crab Harvests in Pounds, 1961 to 1984-85

	Southeastern Alaska Area		Yakutat Area		Total	
Year/Season	Harvest	No. of Vessels	Harvest	No. of Vessels	Harvest	No. of Vessels
1961	6,800	---	---	---	6,800	---
1962	7,820	---	---	---	7,820	---
1963	---	---	---	---	---	---
1964	13,940	---	---	---	13,940	---
1965	---	---	---	---	---	---
1966	---	---	---	---	---	---
1967	2,733	---	---	---	2,733	---
1968	109,220	---	---	---	109,220	---
1968-69	223,045	33	---	---	223,045	33
1969-70	660,037	31	---	---	660,037	31
1970-71	166,618	12	---	---	166,618	12
1971-72	656,661	25	---	---	656,661	25
1972-73	1,282,309	38	540,880	6	1,823,189	44
1973-74	1,309,673	44	1,872,357	11	3,182,030	55
1974-75	849,304	41	1,997,199	13	2,846,503	54
1975-76	2,157,752	28	1,724,649	3	3,882,401	31
1976-77	2,540,181	32	996,650	5	3,506,831	37
1977-78	2,085,151	32	998,646	6	3,083,797	38
1978-79	1,547,887	33	1,606,848	15	3,154,735	48
1979-80	1,736,247	42	2,474,089	14	4,210,336	56
1980-81	1,788,800	44	700,200	16	2,489,000	60
1981-82	2,845,983	46	71,944	4	2,917,927	50
1982-83	1,004,200	85	151,587	17	1,155,787	102
1983-84	1,581,192	99	11,142	4	1,592,334	103
1984-85[a]	1,150,774	75	8,925	4	1,159,699	79

Source: Imamura 1986b.

[a] Most recent year's data should be considered preliminary.

--- means no data were available.

1986b) (table 11). However, since 1981-1982, the Tanner crab season has been restricted to one or two months during the winter (table 11).

4. Significance of particular use areas. Historically, the major Tanner crab fishery has occurred in Frederick Sound, Stephens Passage, and Icy Strait (Imamura 1986b). Recently, fishermen have begun to utilize areas other than those normally fished (ibid.). A summary of catches by district is given in table 12. Although it is believed that no new, major Tanner crab populations will be discovered, it is likely that fishing effort will continue to expand in some less-traditional fishing areas (ibid.). Harvest primarily occurs at depths of 15 to 100 fathoms on suitable bottom substrates (Koeneman 1986a).

   For information concerning subarea commercial harvests of Tanner crab from 1969 through 1984 and known specific commercial harvest areas, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2.

D. Commercial Harvest: Yakutat Shellfish Area

1. Harvest summary. The Tanner crab fishery in the Yakutat Shellfish Area developed during the 1970's (Imamura 1986b) (table 10). Tanner crab harvests averaged 1.5 million pounds from 1972-1973 through 1979-1980 (ibid.). Following a record harvest of 2.4 million pounds in 1979-1980, the harvest declined dramatically to 11,000 and 9,000 lb in the 1983-1984 and 1984-1985 seasons, respectively.

   Initially, the Yakutat fishery attracted larger, long-range vessels with the capability of storing tons of crab for extended periods of time (ibid.). Up to 17 vessels participated in this fishery, and many of the operators also were engaged in shellfish fisheries in other areas of the state (ibid.).

   As a result of the recent decline in the Tanner crab fishery and regulations prohibiting side-loading pots, the number of vessels declined to four during the seasons 1983-1984 and 1984-1985 (table 10). Currently the species is harvested by smaller vessels, with limited range and holding capabilities, operating out of Yakutat (ibid.).

2. Harvest methods. Harvest methods are similar to those of the Southeastern Alaska Shellfish Area, except that side-loading pots are prohibited and there are no restrictions on the number of pots that may be fished (ibid.).

3. Periods of use. Most of the harvest has historically occurred during the months of February through April (ibid.).

Table 11. Southeastern Alaska Area Commercial Tanner Crab Harvest in Thousands of Pounds by Month and Season, 1968-69 to 1984-85

Season	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Total
1968-69	5.6	11.0	17.0	13.2	10.0	6.7	13.1	60.4	35.0	34.2	8.2	8.6	233.0
1969-70	24.4	30.3	17.5	18.7	19.7	97.2	214.4	149.6	21.1	27.1	32.5	7.5	660.0
1970-71	0.1	1.5	6.7	6.3	21.3	41.4	56.2	32.2	---	---	---	---	165.7
1971-72	---	29.9	30.9	39.0	29.4	17.9	91.6	203.5	148.5	58.5	6.3	1.0	656.5
1972-73	5.4	42.0	83.3	58.2	50.7	114.4	320.5	450.1	131.8	20.6	4.1	0.8	1,282.4
1973-74	29.4	91.8	94.8	87.3	69.5	126.3	314.7	406.2	89.8	---	---	---	1,309.8
1974-75	4.4	78.9	70.0	65.5	50.7	74.4	177.0	225.8	102.6	---	---	---	849.3
1975-76	13.3	110.3	125.4	107.1	159.7	367.4	634.6	460.0	168.8	11.1	---	---	2,157.8
1976-77	3.9	52.4	277.0	209.6	338.1	393.8	695.3	458.0	112.1	---	---	---	2,540.2
1977-78	29.4	162.7	139.5	176.0	116.4	275.2	595.0	507.0	84.0	---	---	---	2,085.2
1978-79	6.8	47.6	77.1	52.7	205.9	182.6	466.6	448.2	60.3	---	---	---	1,547.8
1979-80	57.5	72.7	74.5	61.0	146.3	403.4	604.8	278.5	37.5	---	---	---	1,736.2
1980-81	37.0	47.0	34.6	57.2	249.1	443.7	527.0	320.1	28.1	---	---	---	1,788.8
1981-82	---	---	---	883.8	492.8	575.5	679.8	214.0	---	---	---	---	2,846.0
1982-83	---	---	---	1,004.2	---	---	---	---	---	---	---	---	1,004.2
1983-84	---	---	---	---	---	857.2	723.5	---	---	---	---	---	1,581.2
1984-85[a]	---	---	---	---	---	551.9	598.8	---	---	---	---	---	1,150.7

Source: Imamura 1986b.

[a] Most recent year's data should be considered preliminary.

--- means no harvest reported.

Table 12. Southeastern Alaska Area Commercial Tanner Crab Harvest in Thousands of Pounds by District and Season, 1968-69 to 1984-85

	District															
Season	1	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
1968-69	---	---	---	---	1.0	0.6	85.7	2.1	81.7	20.1	0.8	9.8	15.4	5.8	---	233.0
1969-70	---	---	---	---	0.7	---	78.4	---	179.0	227.4	4.8	28.6	96.6	44.4	---	660.2
1970-71	---	---	---	---	0.8	---	41.7	31.7	0.6	75.7	2.9	10.6	---	2.6	---	166.6
1971-72	---	---	---	---	0.6	---	71.6	30.9	69.6	71.0	0.4	99.7	310.8	2.0	---	656.6
1972-73	---	---	---	---	37.5	---	69.2	37.3	55.0	436.9	23.3	58.3	505.2	59.6	---	1,282.3
1973-74	---	---	---	0.3	18.8	4.2	23.1	46.1	132.8	616.2	1.7	60.8	404.3	1.5	---	1,309.8
1974-75	3.5	---	---	---	0.9	10.6	22.0	40.0	67.3	211.2	3.6	100.7	381.0	8.4	---	849.2
1975-76	---	---	---	10.2	2.8	11.3	117.0	98.9	138.0	832.8	92.5	176.3	500.9	177.1	---	2,157.8
1976-77	---	---	---	71.8	115.3	---	104.0	62.6	222.0	712.8	52.7	92.8	992.5	113.6	---	2,540.1
1977-78	3.6	13.8	---	0.3	127.9	---	64.9	6.7	210.7	579.0	43.3	86.6	757.4	191.1	---	2,085.3
1978-79	2.0	---	---	1.5	21.8	---	19.7	---	331.5	425.6	2.9	54.9	617.8	70.2	---	1,547.9
1979-80	---	---	---	---	5.9	15.6	118.2	24.8	251.0	749.4	22.0	33.3	390.4	125.6	---	1,736.2
1980-81	3.7	12.5	---	8.2	20.3	37.5	223.8	40.9	266.5	348.7	83.5	48.2	623.3	71.7	---	1,788.8
1981-82	---	---	---	---	121.4	41.7	201.2	---	167.4	386.3	78.5	60.9	1,654.7	89.1	---	2,846.0
1982-83	0.5	---	---	3.1	45.2	---	---	6.4	68.4	100.0	25.7	0.4	744.6	10.0	---	1,004.2
1983-84	---	---	0.1	6.9	38.8	29.0	46.4	28.9	205.4	375.0	16.4	32.8	644.8	154.2	2.2	1,581.2
1984-85[a]	0.3	---	---	0.9	7.8	14.3	41.4	38.0	141.2	368.3	67.3	32.5	143.6	243.7	52.0	1,150.7

Source: Imamura 1986b.

[a] Most recent year's data should be considered preliminary.

--- means no reported harvest.

Table 13 summarizes the monthly harvests from 1972-1973 to 1984-1985.

4. Significance of particular use areas. The harvest by district from 1972-1973 to 1984-1985 is given in table 14. For information concerning subarea commercial harvests of Tanner crab from 1969 through 1984 and known specific commercial harvest areas, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2.

E. Noncommercial Harvest

1. Harvest summary. Tanner crabs are harvested noncommercially for food wherever they are generally abundant in the Southeast Region. In a Yakutat study, 10% of the households sampled harvested an average of 91 lb of Tanner crab noncommercially in 1984 (Mills and Firman 1986). Tanner crab was ranked third behind Dungeness and king crabs in the noncommercial crab harvest by Sitka residents (Gmelch and Gmelch 1985). Unpublished survey data from the ADF&G Division of Subsistence indicated a mean Tanner crab harvest of 0.3 crabs/household in Klawock, 4 crabs/household in Yakutat, 1.6 crabs/household in Angoon, and 0.04 crabs/household in Tenakee Springs in 1984 (Bosworth 1986).

2. Harvest methods and periods of use. Tanner crab are generally taken in pots and, occasionally, by divers (Gmelch and Gmelch 1985). Rings are also used. In Yakutat, they are primarily harvested from November to mid April and secondarily during the remaining months of the year (Mills and Firman 1986). No more than 5 pots/person or 10/vessel may be used to take crab (ADF&G 1985c).

3. Significance of particular use areas. For information concerning shellfish harvest areas for the communities of Klawock, Tenakee Springs, Angoon, and Yakutat, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2. See Gmelch and Gmelch (1985) for a discussion of shellfish harvesting areas for Sitka.

VI. HUMAN USE OF KING CRAB

A. Introduction

Within the Southeast Region, three species of king crab are found that are utilized both commercially and noncommercially by humans: red king (*Paralithodes camtschatica*), blue king (*P. platypus*), and brown king crab (*Lithodes aequispina*).

Table 13. Yakutat Area Commercial Tanner Crab Harvest in Thousands of Pounds by Month and Season, 1972-73 to 1984-85

Season	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Total
1972-73	---	13.1	2.4	28.5	---	26.4	56.2	165.4	219.8	11.9	---	17.2	540.9
1973-74	---	---	---	---	2.6	7.7	131.8	990.2	558.0	---	---	---	1,872.3
1974-75	---	---	---	---	48.0	32.3	595.7	839.4	481.9	---	---	---	1,997.3
1975-76	---	---	---	48.4	184.6	276.7	661.8	418.8	134.3	---	---	---	1,724.6
1976-77	---	---	---	---	2.1	343.2	486.1	135.3	---	---	---	---	966.7
1977-78	---	3.0	14.5	40.5	169.7	184.6	254.1	279.0	53.1	---	---	---	998.5
1978-79	2.1	0.2	---	---	63.7	123.7	412.8	766.3	238.1	---	---	---	1,606.9
1979-80	---	10.2	16.4	27.9	64.6	566.9	1,220.9	560.8	6.5	---	---	---	2,474.1
1980-81	---	---	---	0.3	19.8	181.9	437.8	60.7	---	---	---	---	700.2
1981-82	---	---	---	---	---	---	16.1	47.7	8.8	---	---	---	77.9
1982-83	---	---	---	---	---	50.2	73.9	27.5	---	---	---	---	151.6
1983-84	---	---	---	---	---	1.7	5.8	3.6	---	---	---	---	11.1
1984-85[a]	---	---	---	---	---	---	---	5.3	3.7	---	---	---	9.0

Source: Imamura 1986b.

[a] Most recent year's data should be considered preliminary. No harvest reported from 1968-69 to 1971-72.

--- means no harvest reported.

Table 14. Yakutat Area Commercial Tanner Crab Harvest in Thousands of Pounds by District and Season, 1972-73 to 1984-85

	District						
Season	16	181	183	184	186	191	Total
1972-73	318.4	2.9	102.2	12.8	104.6	---	540.9
1973-74	---	619.4	518.6	215.6	518.3	---	1,872.4
1974-75	24.4	1,135.1	193.7	118.7	97.2	428.0	1,997.1
1975-76	---	159.8	245.0	464.6	715.2	140.0	1,724.6
1976-77	---	---	452.7	167.8	346.2	---	966.7
1977-78	---	---	998.6	---	---	---	998.6
1978-79	---	---	352.4	589.2	182.6	482.7	1,606.9
1979-80	50.4	720.8	216.2	187.0	461.4	838.2	2,474.1
1980-81	58.4	20.3	158.4	122.5	78.3	262.3	700.2
1981-82	---	---	51.8	---	---	20.1	71.9
1982-83	---	61.2	83.8	1.6	0.5	4.5	151.6
1983-84	---	---	11.1	---	---	---	11.1
1984-85[a]	---	---	3.7	---	5.2	---	9.0

Source: Imamura 1986b.

[a] Most recent year's data should be considered preliminary.

--- means no harvest reported.

B. Management Objectives and Considerations

The management objectives of the commercial king crab fisheries, as established by the Board of Fisheries through public meetings, are to establish a stable harvest to the degree practical, to maintain stocks comprised of various age classes of legal-size crabs, to monitor stocks annually, to provide closures during sensitive life stages, and to manage stocks conservatively where information is lacking (Koeneman 1986b). Since the 1979-80 season, guideline harvest levels for red king crab have been based upon the results of an annual index project (ibid.).

East of the longitude of Cape Spencer, the king crab season was closed to noncommercial harvest from April 1 to June 30 in 1985 (ADF&G 1985c). The minimum shell width in that area is the same as the commercial harvest: 7 inches for red and brown king crabs and 6.5 inches for blue king crab. In the remainder of the Southeast Region, there is no closed season or size limit on the noncommercial harvest. The daily and possession limit for the noncommercial harvest is six in the Southeastern Alaska Shellfish Area and 2 in the Yakutat Shellfish Area (ibid.). Only males may be taken.

The Gastineau Channel, Auke Bay, and Fritz Cove have been closed to commercial king crab fishing (ADF&G 1985d) to protect stocks and favor noncommercial harvest.

C. Commercial Harvest: Statistical Area A (Southeast Region)

1. Harvest summary. Commercial king crab fishing in the Southeast Region was first documented when a small harvest occurred in the Petersburg-Wrangell area in 1960 (Koeneman 1986b). From 1961 through 1967, regulations allowed a male-only harvest, with a minimum legal carapace width of 6.5 inches and no closed season (ibid.). During this time, yearly harvests averaged 1.1 million pounds from less than 10 vessels (ibid.).

   By 1970, the minimum legal carapace width was raised to seven inches and an overall quota of 1.5 million pounds was provided (ibid.). In 1971, separate red, blue, and brown king crab fisheries were established with the adoption of distinct seasons and quotas (ibid.).

   Since the 1970-1971 season, the harvest of red and blue king crabs in the Southeast Region has averaged 436,000 lb taken by an average of 35 vessels (table 15). Red king crab is the target species, and small quantities of blue crab are taken incidentally. Exploratory blue king crab fisheries have been allowed in certain locations beginning with the 1983-1984 season (Koeneman 1986b). Red king crab fishing was closed during the 1985-86 season due to declining stocks (ibid.).

Brown king crab harvests have averaged approximately 340,000 lb since the 1970-1971 season (table 15). Five to 10 vessels participated in the fishery during the 1970's, and the number of vessels rose to 64 in 1984-1985. Harvests of brown king crab have increased dramatically since the 1979-1980 season (table 15).

2. Harvest methods. King crab in the Southeast Region may be harvested commercially only by pots and ring nets (ADF&G 1985d). The minimum carapace width is 7 inches for red and brown crabs and 6.5 inches for blue king crab. Only males may be commercially harvested. A maximum of 100 pots are allowed per vessel when fishing king crab in Yakutat Bay, Lituya Bay, and the inside waters (ibid.).

3. Periods of use. Since 1972, the fishing of red and blue king crabs has been largely restricted to the months of September to January, with limited blue king crab fishing in February (Koeneman 1986b) (table 16). This season provides protection during the congregation period, the molting and mating season, and the growth season and allows harvesting during maximum shell fullness (ibid.). Increasing fishing pressure has resulted in increasingly restrictive seasons on red king crab, culminating with a complete closure in the 1985-1986 season. The exact timing of the king crab fisheries is regulated by opening dates and emergency closures of specific areas keyed to meeting guideline harvest levels.

   The brown king crab seasons, on the major fishing grounds, have also become more restrictive in response to greater fishing pressure (ibid.). However, the original 1971-1972 season, from August 1 to March 31, has gradually been expanded to the entire year, with special permits issued for the period May 1 through September (ibid.). This has permitted an exploratory brown king crab fishery off the traditional fishing grounds. Table 17 summarizes catches of brown king crab by month from 1972-1973 to 1984-1985.

4. Significance of particular use areas. Red and blue king crabs are primarily harvested at depths of 15 to 125 fathoms (Koeneman 1986a). The major red king crab commercial harvest areas in the Southeast Region occur in Frederick Sound, Stephens Passage, Seymour Canal, Icy Straits, and Peril Straits (Koeneman 1986b). Blue king crab fisheries have been primarily limited to certain portions of Glacier Bay, Chilkoot Inlet, Lynn Canal, Port Frederick, Icy Strait, Endicott Arm, and Stephens Passage (ADF&G 1985b). Harvests of blue and red king crab by district and fishing season are given in table 18.

   Currently, it appears that the development of significant new red king crab fisheries outside the traditional grounds is unlikely (Koeneman 1986b). Similarily, exploratory blue king

Table 15. Southeast Region (Statistical Area A) Commercial King Crab Harvest in Pounds by Species and Year, 1960 to 1985-86

Year	Red and Blue King Crabs	Brown King Crab	Total King Crab
1960	---	---	3,424
1961	---	---	429,600
1962	---	---	1,289,550
1963	---	---	1,112,200
1964	---	---	820,530
1965	---	---	579,300
1966	---	---	105,899
1968	---	---	2,199,772
1969	---	---	1,899,930
1969-70	1,438,226	359,567	1,797,833
1970-71	221,369	181,142	402,538
1971-72	391,623	372,933	764,556
1972-73	476,761	265,310	742,071
1973-74	640,369	179,520	819,889
1974-75	537,189	34,451	571,640
1975-76	346,341	68,429	414,770
1976-77	335,714	71,475	407,189
1977-78	241,220	81,746	322,966
1978-79	443,794	37,324	481,118
1979-80	672,734	46,551	719,285
1980-81	520,134	660,172	1,186,206
1981-82	530,461	622,666	1,153,127
1982-83	451,999	806,637	1,258,636
1983-84	303,916	996,887	1,300,803
1984-85	249,046	805,332	1,099,378

Source: Koeneman 1986b.

--- means no data were available.

Table 16. Southeast Region (Statistical Area A) Commercial Red and Blue King Crab Harvests in Thousands of Pounds by Month and Season, 1972-73 through 1984-85

Season	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
1972-73	83.9	117.4	136.2	116.7	22.4	0
1973-74	171.8	228.1	184.0	50.1	6.2	0.1
1974-75	68.9	117.0	125.4	132.9	92.6	0.3
1975-76	45.4	111.7	68.6	57.0	59.5	4.1
1976-77	32.9	94.1	59.0	76.0	66.8	6.9
1977-78	34.1	43.8	45.3	50.9	59.3	7.8
1978-79	82.0	109.7	99.2	97.2	55.7	0
1979-80	211.9	179.7	175.8	105.3	Clsd.	Clsd.
1980-81	207.4	140.5	72.3	70.4	Clsd.	Clsd.
1981-82	Clsd.	327.4	173.0	30.1	Clsd.	Clsd.
1982-83	Clsd.	420.3	18.7	8.9	Clsd.	Clsd.
1983-84	Clsd.	Clsd.	287.3	12.0	3.0	Clsd.
1984-85	Clsd.	248.5	0.6	Clsd.	Clsd.	Clsd.

Source: Koeneman 1986b. In 1985-86, the red king crab season was closed, and the blue king crab season was open February 10-24.

Clsd. means no open season.

Table 17. Southeast Region (Statistical Area A) Commercial Brown King Crab Harvests in Thousands of Pounds by Month and Season, 1972-73 to 1984-85

Season	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Total
1972-73	18.1	43.7	18.6	22.0	26.3	19.5	35.6	11.0	6.0	11.1	9.6	43.8	265.3
1973-74	25.6	21.4	15.6	16.5	12.2	24.6	30.9	15.5	Clsd.	Clsd.	3.2	13.9	179.5
1974-75	8.9	4.9	3.2	4.5	1.4	2.8	3.8	Clsd.	Clsd.	Clsd.	Clsd.	5.0	34.5
1975-76	16.1	4.8	7.9	13.1	1.4	13.2	1.7	0.3	Clsd.	Clsd.	2.6	7.2	68.4
1976-77	12.0	9.1	8.5	11.1	7.2	9.1	7.5	0.1	Clsd.	Clsd.	Clsd.	7.0	71.4
1977-78	9.6	7.2	15.1	10.8	9.1	11.5	12.3	Clsd.	Clsd.	Clsd.	Clsd.	6.2	81.7
1978-79	5.6	4.4	10.7	14.4	1.0	5.9	3.7	0.1	Clsd.	Clsd.	2.2	1.3	49.2
1979-80	4.7	8.2	4.9	9.0	16.5	34.8	44.9	10.4	6.8	6.2	Clsd.	3.3	147.8
1980-81	18.9	27.6	12.1	79.3	187.5	171.0	87.7	19.1	32.1	14.0	10.4	6.4	666.1
1981-82	35.4	41.7	44.0	17.9	93.8	85.8	70.7	16.6	81.8	70.0	48.2	19.1	625.2
1982-83	173.5	77.3	65.4	0	115.9	166.2	15.1	46.8	27.5	35.2	59.8	24.0	816.3
1983-84	24.3	53.6	11.3	31.7	168.9	303.5	287.1	53.4	32.2	11.0	6.9	13.5	963.5
1984-85	158.8	250.8	19.9	14.9	117.8	177.6	22.3	19.6	24.9	8.1	19.1	16.5	850.3

Source: Koeneman 1986b.

Clsd. means no open season.

Table 18. Southeast Region (Statistical Area A) Commercial Red and Blue King Crab Harvest in Thousands of Pounds by District and Season, 1970-71 to 1984-85

	District															
Season	1	3	5	6	7	8	9	10	11	12	13	14	15	16	Yakutat	Totals
1970-71	---	---	---	---	---	3.2	45.2	118.3	130.8	48.6	1.1	0.8	53.8	---	---	401.9
1971-72	---	---	---	---	---	7.0	21.7	231.4	164.4	57.8	95.4	46.2	17.5	---	---	641.3
1972-73	---	---	---	2.1	---	16.8	11.2	183.0	109.1	19.0	34.5	95.4	---	1.3	4.5	476.8
1973-74	---	---	0.1	0.8	0.3	4.3	21.2	273.4	114.3	25.1	78.4	87.9	34.6	---	---	640.4
1974-75	0.3	---	---	1.5	0.1	7.6	30.2	124.5	74.1	64.6	102.2	117.0	8.5	---	6.6	537.2
1975-76	---	---	0.5	0.1	---	15.8	3.2	30.4	35.1	53.4	97.5	103.7	6.7	---	---	346.3
1976-77	---	1.8	4.3	11.6	---	11.6	16.6	49.3	81.9	11.0	52.8	70.2	24.7	---	---	335.7
1977-78	1.1	---	4.6	3.7	---	5.3	48.2	57.6	4.8	69.1	26.2	16.7	---	---	3.9	241.2
1978-79	---	---	---	---	---	6.6	---	121.6	123.6	13.5	112.5	31.2	29.7	---	5.1	443.8
1979-80	0.6	---	3.6	14.3	0.2	0.5	30.2	175.0	216.4	37.3	79.4	89.1	12.2	---	13.9	672.7
1980-81	1.1	---	---	2.8	4.3	27.4	10.5	167.8	155.4	7.9	67.9	5.2	39.6	---	18.6	508.6
1981-82	---	---	13.2	4.5	15.0	6.6	0.1	116.4	140.4	32.7	117.0	31.0	53.5	---	---	530.4
1982-83	---	---	7.2	---	1.4	1.5	2.5	77.5	61.6	98.0	70.2	94.6	28.0	---	4.1	452.0
1983-84	0.1	0.6	1.8	0.9	0.1	---	32.7	79.5	35.5	31.4	37.2	72.0	10.5	---	1.3	303.9
1984-85	0.7	0.2	---	---	---	---	0.7	59.1	76.2	9.2	51.9	44.0	6.8	---	---	249.1

Source: Koeneman 1986a.

--- means no harvest reported.

crab fisheries have not found stocks of sufficient size to warrant a directed fishery on this species (ibid.).

Brown king crabs are usually harvested at depths of 40 to 350 fathoms (Koeneman 1986a). The major brown king crab fishery has traditionally occurred at the confluences of Icy Straits-Lynn Canal-Chatham Strait and in Chatham Straits, Stephens Passage, and Frederick Sound (ibid.). Harvests by districts and fishing seasons are given in table 19. The recent exploratory seasons have resulted in increasing harvests primarily in District 9, and, to a lesser extent, Districts 6 and 7. Fishing effort is expected to increase in certain locations as catches decline on the traditional fishing grounds (Koeneman 1986b).

For more information concerning subarea commercial harvests of king crab from 1969 through 1984 and known specific commercial harvest areas, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2.

D. Noncommercial Harvest

The noncommercial harvest of king crab is similar to that described for Tanner crab, except that king crab appear to be more preferred for food than Tanner crab (Gmelch and Gmelch 1985). Harvest methods are similar (ibid.). In a Yakutat study, 8% of the households surveyed harvested a mean of 112 lb of king crab (Mills and Firman 1986). Unpublished survey data from the ADF&G Division of Subsistence suggested an average king crab harvest of 1.3 crabs/household in Yakutat, 1.3 crabs/household in Angoon, and 9 crabs/household in Tenakee Springs in 1984 (Bosworth 1986). No king crabs were reported harvested noncommercially by residents interviewed in Klawock in 1984 (ibid.), although king crab is listed as a species utilized noncommercially in southwestern Prince of Wales (ADF&G 1984a). For information on particular use areas around select communities, consult the references listed for noncommercial Tanner crab harvesting areas in the preceeding section. Additional information on noncommercial king crab harvesting areas around a number of Southeast Alaska communities can be found in George et al. (1985).

VII. HUMAN USE OF SHRIMP

A. Introduction

Four species of shrimp are commonly utilized in the Southeast Region: northern pink (Pandalus borealis), sidestripe (Pandalopsis dispar), coonstripe (Pandalus hypsinotus), and spot (Pandalus platyceros). A very limited commercial catch of humpy shrimp (Pandalus goniurus) has also occurred during some years (ADF&G 1985b). The commercial shrimp harvest is separated into three distinct fisheries: beam trawl, pot, and otter trawl (Koeneman 1986c). Commercial ex-vessel values, however, are only available

Table 19. Southeast Region (Statistical Area A) Commercial Brown King Crab Harvests in Thousands of Pounds by District and Seasons, 1972-73 to 1984-85

	District												
Season	2	6	7	8	9	10	11	12	13	14	15	16	Total
1972-73	---	---	---	0.4	10.5	186.5	36.2	5.8	---	2.6	23.4	---	265.3
1973-74	---	---	---	0.1	0.5	149.2	24.6	---	0.6	4.1	0.4	---	179.5
1974-75	---	---	---	0.1	14.9	12.3	0.7	5.2	---	1.4	0.1	---	34.5
1975-76	---	---	---	0.6	---	58.8	---	1.3	3.5	0.8	3.5	---	68.4
1976-77	---	---	---	---	8.6	61.4	1.1	0.1	---	---	0.2	---	71.4
1977-78	---	---	---	0.1	0.1	73.8	7.4	---	---	---	0.5	---	81.7
1978-79	---	---	---	---	---	35.1	6.8	0.9	---	2.5	3.7	---	49.0
1979-80	---	---	---	0.4	---	36.5	7.6	1.2	---	0.3	0.5	---	46.6
1980-81	---	---	---	1.2	6.4	195.1	23.9	166.1	0.1	245.3	28.1	---	666.1
1981-82	---	---	---	6.1	23.6	218.5	50.9	88.9	4.3	183.5	48.8	---	625.5
1982-83	---	13.9	28.1	7.3	109.2	185.7	52.6	225.8	12.9	151.1	37.9	---	816.6
1983-84	---	3.2	5.4	5.3	142.3	222.7	40.2	436.2	0.1	46.5	94.4	---	966.4
1984-85	5.1	4.5	14.1	0.1	168.3	375.6	34.5	157.3	1.9	52.8	18.2	0.6	829.0

Source: Koeneman 1986b.

--- means no harvest reported.

for the shrimp fishery as a whole and are presented as such in the Alaska Habitat Management Guide report entitled Economic Overview of Fish and Wildlife, volume 1.

B. Management Objectives and Considerations

The policies and goals of the shrimp fisheries in Southeast Alaska have not been well defined; however, Board of Fisheries deliberation has identified a preferred system of management (ibid.).

Management of the beam trawl fisheries is based on a series of guideline harvest ranges (GHRs) based on previous harvests (ibid.). In 1985-1986, the GHRs were as follows:

- District 6 (Duncan Canal): 250,000 to 900,000 lb
- District 7 (Eastern Passage): 50,000 to 100,000 lb
- District 8 (Stikine Flats): 80,000 to 300,000 lb
- District 10 (Thomas Bay): 5,000 to 50,000 lb (ADF&G 1985d)

In 1985-1986, the season was closed during a certain portion of the spring when the eggs are near hatching (Koeneman 1986c). Mesh-size restrictions were implemented to provide some escapement for smaller shrimp (ibid.).

Management of the pot shrimp fishery has concentrated on monitoring the harvest through fish ticket information (ibid.). In 1985-1986, the GHRs for pot fishing were established in the following areas:

- portion of District 1, District 2, and District 7: 125,000 lb
- Districts 6 and 8: 75,000 to 100,000 lb (ADF&G 1985d)

As in the beam trawl fishery, an egg-hatch closure was used over a portion of the fishing grounds in 1985-1986 (Koeneman 1986c), and a mesh size will go into effect on October 1, 1986, to allow smaller shrimp to escape. On most of the fishing grounds, limits have been placed on the maximum number of pots that may be fished from a registered shrimp vessel (ADF&G 1985d).

The otter trawl fishery is managed largely by monitoring harvest information (ibid.). A maximum monthly harvest of 30,000 lb during the open season has been established for the trawl area of Yakutat Bay as a result of shrimp assessment surveys (ibid.). The otter trawl fishery is prohibited on the traditional beam trawl fishing areas of Districts 6, 8, and 10 (ADF&G 1985d).

There is no closed season or limit on the noncommercial harvest of shrimp (ADF&G 1985c). Several fishing areas have been closed to commercial trawling to give priority to the noncommercial harvest. These areas include prohibitions against shrimp trawling in Lituya Bay to protect the subsistence use of the coonstripe resource and in a portion of Yakutat Bay to protect subsistence use and the commercial shrimp pot fishery (Koeneman 1986c). In addition, Glacier Bay is closed by the National Park Service to trawling due to the use of shrimp as a food source by humpback whales (ibid.).

C. Commercial Harvest: Shrimp Beam Trawl Fishery

1. Harvest summary. The beam trawl shrimp fishery began in Southeast Alaska about 1915, when fishing was initiated in Thomas Bay (District 10). The primary species taken are northern pink and sidestripe shrimp with incidental catches of coonstripe, spot, and humpy shrimp (Koeneman 1986a).

   Until its decline in the 1960's, the annual beam trawl harvest averaged 3.5 million pounds, with a range of 1.7 to 7.6 million pounds (Koeneman 1986c). From 1969-1970 to 1984-1985, harvests averaged 1.1 million pounds (table 20). The 1985-1986 harvest through January 1986 totaled just over 390,000 lb. This extremely low harvest level was mainly attributed to the loss of production facilities when the Alaska Glacier Seafood plant in Petersburg burned down in February 1985, and a Wrangell processor subsequently closed production (ibid.).

   In the past, when shrimp were hand-picked, over 20 processors operated in Thomas Bay (Koeneman 1986a). More recently, there have been three seafood plants with shrimp production facilities utilizing mechanical picking machines together with some handpicking of the larger shrimp (Koeneman 1986c). During the 30-year period from 1955 to 1984-1985, an average of 15 vessels/year participated in the beam trawl fishery in Southeast Alaska, with a range of 8 to 23 (table 20).

2. Periods of use. The shrimp beam trawl fishery tends to be a year-round fishery except for recent closures during the spring egg-hatch (table 21). The highest catches traditionally occur from May through August.

3. Significance of particular use areas. During its development, Thomas Bay (District 10) supported the entire industry (Koeneman 1986c). In 1960, 53% of the Southeast Region total beam trawl harvest came from that area (ibid.). This fishery has subsequently collapsed to where in 1984-1985 and 1985-1986, it accounted for only about 3.2 and 0.3%, respectively, of the harvest (Koeneman 1985a, 1986c). By contrast, District 6 (Duncan Canal) accounted for 23% of the total harvest in 1960 and about 42 and 58% in 1984-1985 and 1985-1986 (ibid.). Districts 7 and 8 have also become significant producers in this fishery, accounting for 7 and 47%, respectively, of the total Southeast Region harvest from May through December 1984 (Koeneman 1985a) and 7 and 35%, respectively, of the harvest from May 1985 through January 1986 (Koeneman 1986c).

Table 20. Southeast Region (Statistical Area A) Commercial Shrimp Beam Trawl Harvests in Pounds, 1955 to 1985-86

Year/Season	Harvest	No. of Vessels
1955	1,777,122	15
1956	3,301,598	15
1957	2,350,449	10
1958	7,605,871	14
1959	5,518,843	22
1960	3,343,373	21
1961	4,212,300	20
1962	3,884,050	22
1963	3,110,340	20
1964	2,793,101	13
1965	2,941,429	13
1966	3,784,597	14
1967	2,203,717	13
1968	2,003,753	12
1969-70	1,840,727	10
1970-71	824,800	8
1971-72	1,045,300	8
1972-73	955,900	9
1973-74	763,000	8
1974-75	1,205,600	10
1975-76	983,700	10
1976-77	770,600	14
1977-78	947,626	11
1978-79	1,021,030	10
1979-80	952,906	17
1980-81	843,737	18
1981-82	918,975	19
1982-83	1,397,026	18
1983-84	1,766,148	17
1984-85	1,213,456	23
1985-86[a]	386,666	14

Source: Koeneman 1986c.

[a] The data for the most recent regulatory year are preliminary and consist only of the harvest reported through December 1985.

Table 21. Southeast Region (Statistical Area A) Commercial Shrimp Beam Trawl Harvest in Thousands of Pounds by Month and Season, 1969-70 to 1984-85

Season	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	Total
1969-70	326.7	280.2	78.8	129.1	184.7	241.2	119.6	165.2	160.0	100.6	32.4	22.4	1,840.9
1970-71	131.3	105.1	65.4	79.8	49.7	65.5	54.8	91.6	64.0	59.7	14.9	73.0	824.8
1971-72	139.0	96.2	144.5	106.6	69.7	79.3	59.9	71.0	46.3	64.8	90.8	77.8	1,045.3
1972-73	168.5	125.4	77.2	66.1	65.8	44.7	59.9	66.0	81.6	60.3	104.2	36.2	955.9
1973-74	96.3	124.1	75.6	73.7	45.0	32.0	56.8	121.1	42.2	29.2	21.6	45.4	763.0
1974-75	160.9	199.2	202.4	168.0	120.1	61.4	73.9	90.8	104.2	21.6	0.7	2.4	1,205.6
1975-76	180.7	130.3	67.2	92.6	112.3	154.5	73.0	77.8	38.9	46.1	3.6	6.7	983.7
1976-77	78.9	171.6	120.0	118.8	61.7	37.4	55.0	33.1	65.0	24.8	0.7	3.6	770.6
1977-78	73.3	229.8	152.9	166.2	126.2	47.8	29.6	19.4	81.7	20.7	---	---	947.6
1978-79	107.9	130.9	137.6	240.2	112.0	93.1	67.1	36.8	72.3	23.1	---	---	1,021.0
1979-80	99.8	154.9	146.5	165.7	104.7	55.1	58.6	39.6	66.3	48.2	3.4	4.5	947.3
1980-81	153.8	168.6	164.9	153.7	54.2	30.2	35.5	12.2	33.6	31.6	1.8	3.7	843.8
1981-82	165.1	183.4	124.0	168.6	81.1	52.7	36.2	48.3	33.0	22.3	0.1	3.1	918.1
1982-83	181.1	171.7	168.8	159.4	134.0	50.1	60.7	82.0	152.6	119.8	64.4	52.5	1,397.1
1983-84	436.3	249.0	287.0	218.2	138.5	132.0	83.3	86.9	100.3	16.2	9.0	9.6	1,766.3
1984-85	156.2	252.5	269.8	232.8	130.9	59.5	61.8	49.7	57.4	22.5	3.0	1.1	1,297.2

Source: Koeneman 1986c.

--- means no harvest reported.

For information concerning subarea harvests of shrimp from 1969 through 1984 and known specific commercial trawl shrimp harvest areas, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2.

D. Commercial Harvest: Shrimp Pot Fishery

1. Harvest summary. The pot shrimp fishery targets on the larger spot shrimp (ibid.) with harvests of coonstripe shrimp in certain locals like Lituya Bay (Koeneman 1986a). Other species are taken incidentally. Until recently, effort and harvests from year to year have been inconsistent with the fishery, serving mainly as a source of supplementary income for most vessel owners (Koeneman 1986c). Annual harvests since 1966 have averaged 73,850 lb of whole shrimp and, since 1978, have increased steadily to over 200,000 lb (table 22). The number of permits fished have similarly increased from less than 10 prior to 1979 to 118 and 106 in 1984 and 1985, respectively.

2. Periods of use. Like the beam trawl fishery, the shrimp pot fishery tends to be a year-round fishery, with monthly effort varying from year to year (table 23).

3. Significance of particular use areas. Table 24 summarizes district harvests of pot shrimp from 1969 through 1985. The largest catches have occurred in Districts 1, 2, 3, 7, and 10. For information concerning subarea harvests of shrimp from 1969 through 1984 and known specific commercial pot shrimp harvest areas, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2.

E. Commercial Harvest: Otter Trawl Fishery

1. Harvest summary. The first significant otter trawl landings for shrimp were reported in 1975-1976 (Koeneman 1986c). The effort peaked in 1980-1981 with catches of 2.1 million pounds by 22 vessels (table 25). Harvests and the number of vessels fishing have been inconsistent. In 1977-1978, 1978-1979, and in the 1985-1986 season, through January 1986, no harvests were reported (table 25).

2. Periods of use. This recent fishery, with its inconsistent yearly harvests, has not developed well-defined harvest periods. In the Yakutat Bay area, the otter trawl season has been restricted to the period June 21-February 14 (ADF&G 1985d). Present regulations restrict the harvest in Yakutat Bay to a maximum of 30,000 lb/month during the open season (ibid.).

3. Significance of particular use areas. Substantial harvests of shrimp in the otter trawl fishery have occurred in

Table 22. Southeast Region (Statistical Area A) Commercial Shrimp Pot Fishery Harvests in Pounds, 1962-85

Year	Harvest	No. of Permits Fished
1962	488	---
1963	686	---
1964	3,669	---
1965	0	---
1966	400	---
1967	38,900	---
1968	38,209	---
1969	40,196	5
1970	32,833	5
1971	12,071	4
1972	27,317	7
1973	5,028	1
1974	15,954	5
1975	5,841	5
1976	12,451	6
1977	19,185	7
1978	28,202	9
1979	23,505	10
1980	63,095	26
1981	87,282	34
1982	174,593	52
1983	289,964	87
1984	255,884	118
1985[a]	232,649	106

Source: Koeneman 1986c.

[a] Most recent year's data should be considered preliminary.

--- means no data where available.

Table 23. Southeast Region (Statistical Area A) Commercial Shrimp Pot Fishery Harvest in Thousands of Pounds by Year and Month, 1969-85

1985	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1969	4.2	5.7	3.5	5.5	6.5	3.4	---	---	---	---	---	1.5	40.2
1970	4.6	4.6	5.1	2.5	4.3	6.5	1.0	---	---	0.3	0.8	3.2	32.8
1971	1.6	3.5	1.3	---	---	---	1.9	---	2.0	0.2	0.9	0.5	12.1
1972	1.8	1.6	4.7	10.9	3.8	1.7	---	2.1	---	0.6	---	---	27.3
1973	---	---	0.9	1.1	---	2.5	---	---	---	---	---	0.5	5.0
1974	---	1.3	4.5	7.3	---	1.7	---	---	---	0.4	0.3	0.6	16.0
1975	0.1	0.6	1.3	0.7	---	---	1.0	---	---	---	0.4	1.9	5.8
1976	0.6	1.1	1.6	1.5	1.5	1.3	1.6	1.2	---	---	0.5	1.6	12.5
1977	10.4	---	1.5	6.5	---	---	0.3	---	0.1	0.4	0.1	---	19.2
1978	9.9	1.4	1.6	5.3	3.9	0.3	0.7	0.1	---	0.6	---	4.5	28.2
1979	---	---	---	3.2	5.1	3.2	3.9	1.6	3.6	1.8	0.8	---	23.3
1980	0.8	1.5	3.7	2.5	12.4	8.4	7.8	1.5	11.1	9.4	3.1	0.7	63.1
1981	1.7	1.4	4.0	7.4	8.3	7.2	23.0	10.0	5.7	11.4	2.9	4.3	87.3
1982	2.6	5.1	9.9	10.0	3.3	5.0	32.6	47.3	15.0	20.1	7.0	16.2	174.6
1983	9.2	25.8	7.5	1.0	4.5	3.3	50.7	42.9	58.2	38.2	34.2	14.4	290.0
1984	12.2	20.3	22.3	24.4	30.6	29.4	8.8	8.0	4.3	32.4	36.6	26.5	255.9
1985[a]	29.8	38.3	9.1	8.7	27.2	18.6	18.4	19.6	18.6	14.1	27.4	2.8	232.6

Source: Koeneman 1986c.

a Most recent year's data should be considered preliminary.

--- means no harvest reported.

Table 24. Southeast Region (Statistical Area A) Commercial Shrimp Pot Fishery Harvest in Thousands of Pounds by Year and District, 1969-85

District	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985[a]
1	32.9	11.0	3.8	8.4	---	3.0	1.6	4.4	3.6	5.7	4.2	21.4	14.5	18.9	39.5	47.9	45.9
2	4.5	1.5	3.4	14.8	5.0	12.8	4.0	6.7	10.8	13.1	7.3	13.2	16.5	18.1	32.5	19.0	48.4
3	---	8.1	---	---	---	---	0.2	1.4	---	---	4.2	7.6	23.1	60.5	61.0	35.5	20.8
4	---	---	---	---	---	---	---	---	---	---	1.3	0.4	---	---	1.0	---	0.1
5	---	---	---	---	---	---	---	---	---	0.7	---	---	---	---	0.9	---	0.2
6	---	---	---	---	---	---	---	---	---	---	---	---	4.5	4.5	13.6	4.7	4.3
7	2.8	---	---	1.7	---	---	---	---	4.8	3.8	5.0	15.4	19.2	28.2	73.1	82.7	58.5
8	---	1.1	1.0	---	---	---	---	---	---	4.5	---	0.8	---	2.2	4.9	15.0	5.5
9	---	---	---	0.3	---	---	---	---	---	---	---	2.7	2.1	4.1	6.0	0.1	1.4
10	---	0.2	2.1	1.9	---	---	---	---	---	---	---	---	2.1	---	5.5	13.3	26.4
11	---	---	---	---	---	---	---	---	---	---	---	---	0.1	0.5	---	0.2	1.0
12	---	---	---	---	---	---	---	---	---	---	1.3	---	2.0	1.1	0.5	3.7	1.5
13	---	---	---	---	---	---	---	---	---	0.4	0.1	0.5	0.5	15.8	15.2	21.1	7.9
14	---	---	---	---	---	---	---	---	---	---	---	1.0	1.4	0.2	0.1	0.1	0.4
15	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
16	---	---	---	---	---	---	---	---	---	---	---	---	---	20.5	---	4.0	7.4
183	---	10.1	---	---	---	0.1	---	---	---	---	---	0.1	0.6	---	36.2	6.6	1.8
186	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1.6	---
Unk.	---	---	1.9	0.4	---	---	---	---	---	---	---	---	0.5	---	0.1	---	1.3

Source: Koeneman 1986c.

[a] Most recent year's data should be considered preliminary.

--- means no harvest reported.

Table 25. Southeast Region (Statistical Area A) Commercial Shrimp Otter Trawl Fishery Harvest in Pounds, 1976-77 to 1985-86

Season	Catch in Pounds	No. of Landings	Pounds per Landing	No. of Vessels
1976-77	185,755	6	30,959	2
1977-78	0	0	0	0
1978-79	0	0	0	0
1979-80	56,500	2	28,250	2
1980-81[a]	2,136,966	38	56,236	22
1981-82	36,365	4	9,091	3
1982-83	127,912	6	21,318	6
1983-84	416,190	10	41,619	4
1984-85	97,774	2	48,887	1
1985-86[b]	0	0	0	0

Source: Koeneman 1986c.

[a] Catch includes 450,000 lb reported out of Yakutat Bay in August and September but not reported via fish tickets.

[b] Includes reported harvest through January 1986.

Yakutat, Lituya, Glacier, and Icy bays (Koeneman 1986c). Yakutat Bay has been the major otter trawl fishing area, with a harvest of 1.8 million pounds in the 1980-1981 season (ibid.). Current restrictions now prohibit shrimp trawling in Lituya Bay, Glacier Bay, and portions of Yakutat Bay (ibid.). For information concerning subarea harvests of shrimp from 1969 through 1984 and known specific commercial trawl shrimp harvest areas, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2.

F. Noncommercial Harvest

1. Harvest summary. Shrimp are harvested noncommercially for food throughout the Southeast Region. At Yakutat, 18% of all households harvested an average of 86 lb of shrimp for noncommercial use in 1984 (Mills and Firman 1986). By weight it was second only to Dungeness crab in terms of the average number of pounds of shellfish harvested by all households (16 pounds lb/household). At Sitka, where shrimp are less abundant, 6% of the households sampled in 1983 harvested an average of 30 lb of shrimp (Gmelch and Gmelch 1985). Unpublished survey data from the ADF&G Division of Subsistence indicated a mean household shrimp harvest of 1.0 lb in Klawock and 0.02 lb in Angoon in 1984 (Bosworth 1986). No shrimp were reported harvested noncommercially by residents interviewed in Tenakee Springs (ibid.).

2. Significance of particular use areas. For information concerning shellfish harvest areas for the communities of Klawock, Tenakee Springs, Angoon, and Yakutat, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2. See Gmelch and Gmelch (1985) for a discussion of shellfish harvesting areas for Sitka.

VIII. HUMAN USE OF SCALLOPS

A. Introduction

A commercial fishery of the weathervane scallop (Pactinopectin caurinus) exists in offshore waters in the northern portion of the Southeast Region, and a limited noncommercial harvest occurs throughout the range of scallops in the Southeast Region.

B. Management Objectives and Considerations

The management goal of the commercial weathervane scallop fishery in the Southeast Region is to provide for a reproductively viable population through ensuring escapement of a proportion of the mature animals by regulating ring size (Koeneman 1986d). The fishery is monitored through vessel registration and collection of harvest data (ibid.).

There is no closed season or bag limits on the noncommercial harvest of scallops (ADF&G 1985c).

C. Commercial Harvest

1. Harvest summary. Harvest levels have fluctuated from highs of over 800,000 lb in 1968 and 1969 to lows of less than 25,000 lb, with an average of about 220,000 lb (table 26). The number of vessels fishing have ranged from 0 to 14, with an average of 4.4. Koeneman (1986d) felt that the recent low harvests may be indicative of currently depressed stocks following periods of significant harvest.

2. Harvest methods. Scallops may be taken only with scallop dredges having rings with inside diameters of four inches or more (ADF&G 1985d).

3. Periods of use. In the Southeast Region, there is no closed season on commercial harvest of scallops (ibid.).

4. Significance of particular use areas. The major scallop fishery in the Southeast Region occurs in offshore waters from Cape Fairweather to Cape Suckling (ADF&G 1985b). Harvests primarily occur on select grounds at depths of approximately 30 to 70 fathoms, with some harvest up to depths of about 100 fathoms (Koeneman 1986a). For information concerning subarea commercial harvests of scallops from 1969 through 1984, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2.

D. Noncommercial Harvest

1. Harvest summary. At least four species of scallops are harvested noncommercially for food within the Southeast Region, including the weathervane scallop and the rock scallop (*Hinnites multirugosus*) (ADF&G 1984a, Gmelch and Gmelch 1985). Data on this harvest is limited primarily to select community-use studies conducted by the ADF&G, Division of Subsistence.

   A survey of households in Sitka indicated that about 6% of all households harvested an average of 1.5 gallons of scallops in 1983 for an estimated community harvest of 180 gallons (Gmelch and Gmelch 1985).

   In Yakutat, 4% of all households harvested weathervane scallops noncommercially, taking an average of 28 lb (Mills and Firman 1986). A portion of the commercial catch is also shared among certain members of the community at Yakutat (ibid.). In general, scallops comprise a relatively minor percentage of the total shellfish resources utilized by the typical household.

Table 26. Southeast Region (Statistical Area A) Weathervane Scallop Harvest in Pounds, 1968-85

Year	Harvest	No. of Vessels
1968	927,795	11
1969	837,087	14
1970	22,726	2
1971	84,948	3
1972	128,241	4
1973	173,700	4
1974	356,493	2
1975	139,022	4
1976	189,543	2
1977	22,121	2
1978	0	0
1979	20,146	2
1980	261,517	6
1981	445,934	11
1982	210,554	7
1983	800	1
1984	74,010	2
1985[a]	21,496	3

Source: Koeneman 1986d.

[a] Recent year's data should be considered preliminary.

2. Harvest methods. Because of their subtidal harvest, scallops are primarily taken by divers and, therefore, are not widely harvested (Gmelch and Gmelch 1985). Rock scallops can be gathered at extremely low tides, often in assocation with abalone (ADF&G 1984a). A strong pry bar is generally used to break the shell off the rock (ibid.).

3. Periods of use. There is no closed season on the noncommercial harvest of scallops (ADF&G 1985c). In Yakutat, they are primarily harvested from January through March during the commercial fisheries (Mills and Firman 1986).

4. Significance of particular use areas. For information concerning shellfish harvest areas for the communities of Klawock, Tenakee Springs, Angoon and Yakutat, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2. See Gmelch and Gmelch (1985) for a discussion of shellfish harvest areas for Sitka.

IX. HUMAN USE OF ABALONE

A. Introduction

The pinto or northern abalone (Haliotis Kamtschatkana) which inhabits coastal areas influenced by ocean swells, is utilized both commercially and noncommercially in the Southeast Region (Koeneman 1986d).

B. Management Objectives and Considerations

The long-term goal of the abalone fishery is to ensure the availability of sufficient abalone stocks during future seasons to allow for commercial and noncommercial utilization, including subsistence (ibid.). Management regulations developed by the Alaska Board of Fisheries to meet this goal include a closed season on the commercial fishery during the sensitive spawning and settling stages in summer and early fall, a minimum legal size to ensure some amount of reproduction prior to recruitment into the fishery, closed areas to prevent commercial harvest of some stocks, guideline harvest levels for the commercial fishery, and a bag limit of 50 abalone/person/day on the noncommercial take (ibid.). The minimum size limit is smaller for the noncommercial fishery, noncommercial harvest is allowed in areas closed to commercial harvest, and there is no closed season on noncommercial abalone harvest (ADF&G 1985c, Koeneman 1986d). These measures are designed to give a greater preference to the noncommercial harvest. As of the 1985-1986 season, commercial abalone harvests were closed around certain areas near the communities of Sitka, Craig, Klawock, Ketchikan, Hydaburg, and Metlakatla (ADF&G 1985d).

The guideline harvest levels of the commercial abalone harvest in the 1985-1986 season were 8,000 lb for District 13 and 25,000 to 50,000 lb in all other districts combined (Koeneman 1986d).

C. Commercial Harvest

1. Harvest summary. Abalone harvests from 1964-1985 are shown in table 27. These data show a relatively low harvest, averaging under 10,000 lb from 1964 through 1976, with a dramatic increase to an average harvest of about 190,000 lb during the period 1978-1985. There was concern that this level of commercial harvest was not sustainable; hence, current guidelines call for a maximum harvest of 58,000 lb (Koeneman 1986d, ADF&G 1985d).

   The estimated number of operators since 1976 ranged from 26 to 49, with an average of 38 (table 27).

2. Harvest methods. Abalone may be taken commercially by diving gear and abalone iron (ADF&G 1985d). During extremely low tides, they may be picked by hand; however, most commercial harvest is in subtidal areas (Koeneman 1986d). In the 1985-1986 season, the minimum size limit was 3 3/4 inches at the greatest diameter of the shell (ADF&G 1985d).

3. Periods of use. In the early years of the fishery commercial abalone fishing occurred throughout the year. In 1979-1980 and 1980-1981, the season lasted between 9 and 10 months (Koeneman 1986d). Since then, fishing has been restricted to about one to five months, beginning in the fall (ibid.). In 1985-1986, the season in District 13 began on November 1 and closed on December 18 by emergency order (ibid.). In the remainder of the region, the 1985-1986 season began October 1 and closed October 31 by emergency order (ibid.). The maximum guideline harvest levels were slightly exceeded during these time periods.

4. Significance of particular use areas. Commercial abalone harvest generally occurs at depths of less than 50 ft along rocky areas influenced by ocean swells (ibid.).

   Table 28 summarizes harvests by district from 1977-1978 to 1985-1986. Districts 3, 4, and 13 are the major producers of abalone, with the highest harvests occuring in District 4. For information concerning subarea commercial harvests of abalone from 1971 through 1984 see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2.

D. Noncommercial Harvest

1. Harvest summary. Noncommercial harvest of abalone is an important food source in some areas of Southeast Alaska (Mills 1982, Gmelch and Gmelch 1985). In Sitka, an estimated 32% of all households harvested an average of 5.2 gallons of abalone in 1983, for an estimated community harvest of 3,000 gallons (Gmelch and Gmelch 1985) In Craig, Klawock, and Hydaburg, about 80 to 95% of all households use abalone and

Table 27. Southeast Region (Statistical Area A) Commercial Abalone Harvests in Pounds,[a] 1964-85

Year	Harvest[b]	No. of Operators
1964	3,000	---
1965	1,000	---
1966	3,000	---
1967	6,511	---
1968	0	---
1969	0	---
1970	1,100	---
1971	923	---
1972	2,610	---
1973	2,813	---
1974	16,339	---
1975	8,497	---
1976	601	---
1977	13,894	43
1978	181,295	37
1979	357,369	39
1980	247,188	43
1981	369,224	42
1982	113,284	49
1983	46,804	40
1984	117,243	26
1985[d]	74,254	27

[a] Pounds are expressed as the weight of the entire abalone, including the shell (i.e., "round pound").

[b] The harvest data are from Koeneman 1986d.

[c] The data for the years 1977-84 are from Koeneman 1985b. The datum for the year 1985 is from Botelho 1986. The number of operators for the years 1980-82 is based on the total number of ADF&G permits issued during the 1980-81 to 1982-83 abalone fishing seasons (Koeneman 1985b).

[d] Most recent year's data should be considered preliminary.

--- Means no data were available.

Table 28. Southeast Region (Statistical Area A) Commercial Abalone Harvests in Pounds[a] by District, 1977-78 to 1985-86

	Districts									
Season	1	2	3	4	5	9	13	14	16	Total
1977-78	133	---	26,911	94,504	---	---	41,482	148	---	163,178
1978-79	35	160	51,151	152,823	3,134	---	61,045	148	171	268,667
1979-80	---	3,807	102,946	129,743	---	4,590	32,684	---	---	273,770
1980-81	15	1,355	111,058	147,242	824	---	18,619	---	---	279,113
1981-82	---	---	68,049	87,159	---	---	16,821	---	---	172,029
1982-83	98	---	29,693	67,177	3,490	---	12,826	---	---	113,284
1983-84	2,565	---	67,336	39,506	7,601	---	9,922	---	---	126,950
1984-85	2,745	55	23,553	23,511	7,548	---	10,864	---	---	68,276
1985-86[b]	---	---	10,151	14,598	4,836	1,448	8,145	---	---	39,178

Source: Koeneman 1986d.

[a] Pounds are expressed as the weight of the entire abalone, including the shell (i.e., "round pound").

[b] Most recent year's data should be considered preliminary.

--- means no harvest reported.

approximately 70% actively harvest them noncommercially (Mills 1982). Typically, people from those communities who actively harvest abalone may take an average of 200 to 300 abalone/year (ibid.). Substantial noncommercial abalone harvesting also occurs around the community of Ketchikan (ibid.), and a few abalone are harvested by residents of Yakutat (Mills and Firman 1986).

2. Harvest methods. Abalone are chiefly harvested by hand-picking them at low tides (ibid.). Abalone irons and poles with a gaff hook attached are commonly used for more efficient gathering (ibid.). Snorkling and SCUBA diving is also used by some to harvest abalone (Mills 1982, Gmelch and Gmelch 1985).

3. Periods of use. Abalone are harvested noncommercially throughout the year. In Sitka, the best times are during minus tides in the fall and winter, when the water is clear of algae (Gmelch and Gmelch 1985). In southwestern Prince of Wales, the major harvest period is from April to August during daylight hours at minus tides (Mills 1982).

4. Significance of particular use areas. Mills (1982) has indicated that most harvesting occurs within 30 mi of each community. For information concerning shellfish harvest areas for the communities of Klawock, Tenakee Springs, Angoon, and Yakutat, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2. See Mills (1982) for a discussion of abalone harvest areas of the communities of Craig, Hydaburg, Sitka, and Ketchikan and for additional information concerning Klawock. See Gmelch and Gmelch (1985) for further information regarding abalone harvest areas of the community of Sitka.

X. HUMAN USE OF SEA URCHIN

A. Introduction

A number of sea urchin species are found in the tidal and subtidal areas of the Southeast Region and utilized as a food resource by some people. Recently, two species have received commercial harvest, the green sea urchin (Strongylocentrotus drobachiensis) and the red sea urchin (S. franciscanus) (Koeneman 1986d).

B. Management Objectives and Considerations

The commercial harvest of sea urchin began in 1981, with the first significant harvests occurring in 1984 and 1985 (ibid.). Limited information suggests that the red sea urchin is the most abundant and widely distributed. The smaller green sea urchin is most preferred by the Japanese market, where most of the catch is sold (ibid.).

Lack of knowledge concerning stock abundance and recruitment makes intensive management difficult (ibid.). Current management consists of monitoring the harvest by the collection of the fish ticket (harvest) information and requiring a miscellaneous shellfish harvest permit. Permit stipulations have restricted commercial harvest to low levels in specific areas and forced industry to explore other areas, thus preventing local depletions of the resource (ibid.).

There is no closed season or bag limit on the noncommercial harvest of sea urchins (ADF&G 1985c).

C. Commercial Harvest

1. Harvest summary. Commercial catches have risen from 1,580 lb in 1981 to 111,810 lb in 1985 (table 29), with the red sea urchin comprising most of the harvest (Koeneman 1986d). Given the increased interest in the fishery, it is anticipated that the harvest will rise in 1986.

2. Harvest methods and periods of use. Sea urchin are harvested by divers utilizing rakes or hand-picking (Koeneman 1985b). Most of the harvest occurs during the winter months (Koeneman 1985b, 1986d).

3. Significance of particular use areas. Most of the harvest has occurred in the Ketchikan area. For information concerning subarea commercial harvest of sea urchins from 1981 through 1984, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2.

D. Noncommercial Harvest

1. Harvest summary. Historically, sea urchins were commonly used for food by many people in Southeast Alaska (ADF&G 1984a). Today, relatively fewer people utilize them as food. Six percent of the households in Sitka reported harvesting them in 1983 (Gmelch and Gmelch 1985). Twelve percent of the Yakutat households reported harvesting an average of 10 lb of sea urchins in 1984 (Mills and Firman 1986). Unpublished survey data from the ADF&G Division of Subsistence indicated an average sea urchin harvest of 1.6 lb/household in Angoon (Bosworth 1986).

2. Harvest methods. Sea urchins are generally harvested noncommercially by spearing or prying with a digging stick at low tide (ADF&G 1984a). The shell is broken, the mouth and intestines are discarded, and the gonads are scooped out and eaten raw (ibid.).

3. Periods of use. The prime season for harvesting occurs when the gonads are ripe (Gmelch and Gmelch 1985). For the green sea urchin, this occurs during the summer (ibid.).

Table 29. Southeast Region (Statistical Area A) Commercial Sea Urchin Harvest in Pounds, 1981-85

Year	Harvest
1981	1,584
1982	550
1983	1,870
1984	61,650
1985	111,812

Source: Koeneman 1986d.

4. Significance of particular use areas. For information concerning shellfish harvest areas for the communities of Klawock, Tenakee Springs, Angoon, and Yakutat, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2. See Gmelch and Gmelch (1985) for a discussion of shellfish harvesting areas for Sitka.

XI. HUMAN USE OF GEODUCKS

A. Introduction

Geoduck clam (*Panope generosa*) beds occur sporadically in portions of the Alexander Archipelago, primarily near the outer coast (Koeneman 1986d). In recent years attempts have been made by the State of Alaska to develop a commercial harvest on this species.

B. Management Objectives and Considerations

The objective of the commercial geoduck fishery is to provide for low exploitation rates in response to known life history parameters and to provide for an orderly development of the fishery by limiting harvests to beds with biomass estimates (ibid.). The fishery is monitored through the use of the miscellaneous species registration/permit form (ibid.).

Two factors are especially relevant to this fishery. First, studies suggest that the species is long-lived, often in excess of 100 years, with a low recruitment rate (ibid.). Consequently, overharvesting is a special concern.

The second factor concerns the fact that paralytic shellfish poisoning (PSP) has been associated with this clam (ibid.). Department of Environmental Conservation (DEC) regulations prohibit the sale of unprocessed clams and regulate the disposal of the waste portions of the clam.

Each individual lot of clams must be tested and certified free of PSP prior to marketing (ibid.). These conditions necessitate a close working relationship between the DEC and the ADF&G.

Prior to 1985, a few geoducks were test marketed or sold for bait (ibid.). Three state grants administered by the Alaska Department of Commerce and Economic Development were used to explore for potential commercial geoduck beds from 1979 to 1984 over much of the Alexander Archipelago. A number of potential commercial beds were located. Biomass estimates were made and PSP levels were tested in three beds near Noyes Island and the beds were certified for harvesting (ibid.). Two processors were also certified for processing. Permits for harvest on these beds were issued late in 1985 (ibid.).

There is no closed season or limit on the noncommercial harvest of geoducks (ADF&G 1985c).

C. Commercial Harvest

1. Harvest summary. A summary of the commercial harvest of geoducks from 1980 through 1985 is given in table 30. Six different divers received permits for the 1985-1986 season, and it is predicted that the 300,000 lb guideline for the three Noyes Island beds will be reached in 1986 (ibid.). As of January 1986, no problems with PSP had been reported (ibid.). Interest in the fishery is expected to continue, and the ADF&G objective is to find and survey at least three additional beds for PSP levels in anticipation of future harvesting (ibid.).

2. Periods of use. The 1985-1986 geoduck fishery occurred during the winter months following the abalone season closure (ibid.).

3. Significance of particular use areas. The 1985-1986 harvest occurred on the three surveyed beds on Noyes Island (ibid.). For information concerning subarea commercial harvests of geoducks from 1980 through 1984 and known potential commercial harvest areas, see the 1:250,000-scale reference maps in the Alaska Habitat Management Guide for the Southeast Region, volume 2.

D. Noncommercial Harvest

Data on noncommercial use of geoduck is very limited. No harvest of geoducks was apparently reported in a survey of 139 household in Sitka (Gmelch and Gmelch 1985). Geoducks were listed as an intertidal resource for the communities of Craig, Klawack, and Hydaburg (Sumida 1983). In southwestern Prince of Wales, ADF&G (1984a) reports they are occasionally taken at low tides on sandy beaches. Unpublished survey data from the ADF&G Division of Subsistence found no noncommercial geoduck harvest by residents interviewed in the communities of Klawock, Angoon, Yakutat, and Tenakee Springs in 1984 (Bosworth 1986).

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Table 30. Southeast Region (Statistical Area A) Commercial Geoduck Harvest in Pounds, 1980-85

Year	Harvest
1980	300
1981	0
1982	0
1983	266
1984	1,066
1985	18,917[a]

Source: Koeneman 1986d.

[a] The 1985 harvest was part of a 300,000 lb harvest-guideline for three certified Noyes Island geoduck beds. Koeneman (1986d) expected the remaining 280,000 lb of the guideline to be harvested in 1986.

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Part III. OVERVIEW OF ACCESS FOR NONCOMMERCIAL HARVESTS OF FISH AND WILDLIFE IN THE SOUTHEAST REGION

I. INTRODUCTION

Southeast Alaska is unique compared to other regions of Alaska because of the predominance of travel by air and water and the resultant limiting roles exerted by the weather and marine conditions. The combination of a mainland area characterized by large river valleys and characteristically steep topography and an extensive archipelago with numerous small islands precludes an extensive highway system to connect the widely scattered communities of the region. Rather, the major transportation systems link the largest communities by air and the mainland highways via a state ferry system while smaller communities are linked by charter planes or, in some cases, limited road systems. The Alexander Archipelago includes a myriad of bays, channels, straits, and passageways that serve to protect the waters offshore of the mainland. This topography provides a large expanse of protected, interconnected waterways (the Inside Passage) accessible to boats and vessels of various sizes. Road systems are limited in the region. Prince of Wales Island and the northern half of Chichagof Island have extensive logging road networks that connect communities. Also, logging road networks extend from individual communities or remote logging camps. Most communities are not connected to other communities by road, and local road systems are small or nonexistent. Off-road travel is also limited, either by regulation on public lands or by the relative infrequency of conditions that permit snowmachine or dogsled travel as in other regions of Alaska. The region has less extensive freeze-ups, broken topography, and dense vegetation all of which combine to preclude extensive cross-country travel via these means. However, "three-wheeler" all-terrain vehicles are used for travel in the vicinity of remote logging camps.

II. LIMITATIONS OF INFORMATION

The general description of access patterns that follows in this section includes an overview of the current variety of modes of transportation available to, and used by, residents of various communities to harvest fish and wildlife. However, as human population shifts occur or economic conditions change, the provision and frequency of commercial transportation can be expected to change accordingly (ADOT 1986). The number of communities or population centers is also subject to change. State land settlement policies, for example, can result in the creation of new communities, and the development of logging camps or support facilities for mining can result in temporary or permanent new settlements. Also, if current plans for logging in the region are implemented, many unroaded areas will be intensively roaded, which will greatly change the nature of available access to fish and wildlife populations in the near future. For example, a recent Forest Service five-year sale planning document references 1,143 miles of road needed to access all operable commercial forest lands in the Alaska Pulp

Company sale area. The document (USDA 1986) also references an areawide transportation analysis. However, the effects of the proposed transportation system have not been analyzed.

The effects of changing transportation systems and of technology in general on traditional patterns of access to fish and wildlife are the subject of active research in the region. This section primarily describes current access patterns; however, sources of historical information are included and summarized wherever possible.

The discussion of access patterns is not intended to imply that access across private or restricted lands should occur without permission of the landowner. Although the Southeast Region has a relatively small percentage of its land in private ownership compared to other regions of the state, private land holdings do exist in large or small scattered blocks, and landowner policies vary. Ownership patterns may change in the future as the state selects and receives more of its state land entitlement and Native corporations are able to sell their lands after 1991. The tide and submerged lands are in state ownership, with a few exceptions; thus beach access below the mean high water tide level is generally public. State land disposal areas (currently in private ownership) may include easements for access along the shorelines of beaches or lakes and along river corridors. With the exception of restrictions established by the Coast Guard for safety reasons, boat access via waterways is unrestricted.

The discussion focuses on access modes used for noncommercial harvests of fish and wildlife. Commercial fishermen use their boats to reach dispersed remote hunting and sportfishing areas as well, and this is acknowledged in the discussion.

Finally, the discussion focuses on quantitive data on the modes of transportation used for access. Qualitative information is available from numerous informed sources such as the ADF&G area management staff and a common sense review of the topography between communities and areas where harvests have been recorded.

III. TYPES OF TRANSPORTATION AVAILABLE

A. Water-based Transportation

Each community in the region has a relatively unique combination of types of access available to hunting and fishing areas. All communities are along the coast, and most are located in close proximity to a good anchorage or port. Many individuals own and operate boats, either primarily for the purpose of transportation or for recreation or commercial operation (fishing boat or charter boat). Commercial fishing boats are based in the communities, which have small boat harbors or other suitable docking facilities; traffic is especially heavy during summer months in communities with canneries or cold storage facilities (currently

Juneau, Petersburg, Wrangell, Kake, Pelican, Sitka, Ketchikan, Craig, and Klawock). The size and seaworthiness of the vessel determine how far the individual can range, taking into account the degree of protection afforded by the coastline and the navigability of the waterway. Commercial fishing boats range the widest and are used for access to hunting, sportfishing, and gathering areas as well.

The Alaska Marine Highway System provides frequent (weekly or several times per week) major ferry service between nine communities in the region: Haines, Skagway, Juneau, Petersburg, Wrangell, Ketchikan, Sitka, Kake, and Tenakee Springs. Smaller ferries link Hyder, Hoonah, Tenakee Springs, Angoon, Pelican, Kake, Hollis, and Metlakatla to the mainline ports of the Marine Highway System.

The ferries provide both passenger and vehicle service. In addition, catamarans and hovercrafts have been operated between communities on an experimental basis. In 1983, a hydrofoil began trial runs between several Southeast communities. In 1985, regular summer catamaran service began between Juneau and Gustavus.

Depending on weather and sea conditions, other types of vessels, including fishing boats, landing craft, and skiffs, are used to travel between communities. However, in addition to providing transportation between communities, these boats provide access to a great variety of areas remote from settlements. The shorelines and bottom characteristics of each area or existence of docking facilities determine whether the boat can be beached or anchored to gain access to the beach or forest.

B. Air Transportation

Jet service is available on a daily basis year-round in Juneau, Sitka, Petersburg, Wrangell, Ketchikan, and Yakutat, and during the summer months in Gustavus. These communities, along with Skagway and Haines have charter services available locally for travel to remote lakes and seaplane float facilities with floatplanes or to landing strips with wheelplanes. Charter service is available in other communities from these bases, although limited to floatplane access in most, because of the scarcity of suitable flat lands for landing sites or strips. Access to remote areas is similarly limited to suitable sites for wheel or floatplane landings. The Yakutat area and coastline to the west is a notable exception; many areas of the beach between Pt. Manby and Bancos Point and between Sitkagi Bluffs and Pt. Riou are suitable for wheel plane landings. Local knowledge of tideflat and beach condition provides numerous private pilots in the region with additional access, if their aircraft are suitably equipped for beach landings. Similarly, floatplanes make use of hundreds of small lakes or sheltered saltwater landing sites, which provide access to upland areas.

C. Land-based Transportation

Roads are limited in extent in and around many communities because of the steep topography and relatively narrow zone of flat land suitable for settlement along the coast. At least eight communities, Kupreanof, Tenakee, Port Alexander, Elfin Cove, Edna Bay, Port Protection, Point Baker, and Meyers Chuck have no roads; boardwalks, trails, or skiffs are used locally. Pelican has two miles of surfaced road, which, however, connect to the ferry terminal and boat harbor via boardwalks. Even large communities have limited road mileage; Juneau has approximately 30 mi of highway along the mainland and 20 mi on Douglas Island. On the other hand, Haines, Klukwan, and Skagway are connected to the major Alaska highway system, and Hyder is connected to the Canadian highway system. The opening of areas to timber harvesting has resulted in construction of often extensive logging road networks which are used by residents of remote logging camps and sometimes connect to permanent communities. Communities such as Petersburg, Kake, and Wrangell currently have access to formerly unroaded watersheds via recently constructed logging roads. In some areas, on Prince of Wales Island and Yakutat, for example, logging roads on public lands have been upgraded for year-round access and maintained as a public road system; in other more remote areas, roads have been put-to-bed or have become impassible, and use by vehicles (including off-road vehicles) may be restricted by the landowners.

Many trails exist on public lands around communities and popular recreational areas. Some have been developed and maintained by the U.S. Forest Service, including trails with marked portages. In one area, a tramway for transporting small boats between waterways has been constructed and maintained by a variety of agencies and a local sportsmen's group. Other trails remain in areas developed in the past for mining and are often maintained, to the dismay of hikers, by bears. Large, flat tideflats can be found in many bays, and these flats provide access to the forest, depending on the tidal cycle, in many areas. Bushwacking is also common between the often short, but usually rugged, distance between the intertidal and alpine zones.

IV. PATTERNS OF SETTLEMENT

The Southeast Region has historically had a dynamic settlement pattern. The original Native inhabitants, Tlingit and Haida tribes, expanded into the region from the south and east and moved and established settlements or camps in response to seasonally abundant resources such as salmon, marine mammals, and shellfish. In Tlingit societies, small groups typically shared winter villages in a geographic area occupied by one of several tribes. Clans and houses within each tribe owned property and controlled various resource locations. Haida villages, on the other hand, were occupied by single clans (Langdon 1977). The

Haida occupied southern Prince of Wales Island, with clans claiming streams and handing ownerships down through the recognized heads of clan. In addition, households, or clans, held property at temporary villages occupied seasonally by several family groups for halibut fishing, gathering of seaweed or seabird eggs, gathering of herring spawn, gardening, berry-picking, hunting, and trapping (Vaughn in CH2M-Hill 1983a). A third group of Natives, a Tsimpshean tribe, occupied Annette Island in 1887, under the leadership of an Anglican missionary (Pacific Rim Planners 1979).

Tribes sometimes moved permanent settlements to avoid unfavorable weather or climatic events. For example, the legends of one tribe, the Chookaneidi tell the story of the abandonment of the Glacier Bay area when the glacier ice advanced and crushed the village. Family groups or clans also moved when food shortages occurred at permanent camp locations.

The areas that historically became year-round Native settlements were usually located in the vicinity of 1) a salmon stream with runs of various salmon species and often runs with staggered timing so that salmon were available for a major portion of the year and 2) protected access to the marine waters and resources (Langdon 1977). Communities such as Klukwan, Angoon, Hoonah, Hydaburg, and Klawock possess these characteristics and remain as permanent settlements today with good access to fish and wildlife resources. Many of the seasonal camp areas remain as favored recreational or subsistence areas to harvest fish and wildlife. The industries that resulted in the settlement of the region by non-Natives also contributed to a variety of dynamic seasonal or temporary settlements around fur-trading locations, canneries, mining areas, and logging camps. The coming of schools and other aspects of government, particularly the establishment of the territorial capital in Sitka and the state capitol in Juneau, helped create the permanent communities that exist today. However, temporary camps are still frequently established for the purpose of supporting logging or mining operations throughout the region. In some cases, the state has disposed of land selected from the Tongass National Forest to residents of logging camps, creating more permanent communities. Other state land disposals have also occurred. With the exception of some subdivision disposals immediately adjacent to existing communities (e.g., Sitka), the disposals are sold as remote parcels or homesites, with no roads or other facilities provided. Thus the development and occupancy of the land disposal areas into communities depends on the abilities of the residents to pursue a subsistence-type lifestyle or their dependence on wage-employment. For many, their use is limited to occasional recreational purposes while they are employed elsewhere. Seasonal use of areas to harvest fish and wildlife is dispersed throughout the region; many individuals own cabins constructed on federal homesites, and special use permits can be obtained to maintain permanent tent sites or seasonal camps on federal lands. Finally, some people live year-round in remote locations, as the sole residents of a bay or bight, in cabins or floathomes.

V. TYPES OF SETTLEMENTS

A. Major Communities

A number of relatively permanent communities currently exist in the region. For the most part, they are separate from each other and many are unique communities as a result. However, residents in all communities participate in hunting and fishing.

Table 1 summarizes the transportation options available within the community and for travel to hunting and fishing areas. The communities for which there is more detailed information on the mode of transportation used for hunting and fishing are described in subsequent sections on each community.

B. Logging Camps

With the exception of logging that occurs around established communities, initiation of timber harvest in a specific watershed or re-entry into a watershed that has been partially logged generally requires the housing of a work force at the point where a facility is constructed to transfer logs from the logging road system to water for transport. Logging camp communities include workers and their families. Camps may be on land or floating camps. The duration of residence and population of each logging camp area is extremely variable, depending on the scope and duration of the logging operations.

Logging camp residents may have access to the logging road system, although few personal vehicles are available at some camps, and off-road vehicle use is restricted on public lands. Many camps have float facilities and seaplane bases that can be used for docking personal boats or planes used for hunting and fishing access.

No specific harvest data are readily available for logging camp communities because the origin of the hunter is recorded in the form of the zip code of residence, which many logging camp communities share with the larger communities that provide mail service. Also, many workers reside in camps only seasonally and live in other Southeast communities or outside Alaska the rest of the year. The Alaska Public Survey (Alves 1981) provides some information on general hunting patterns of logging camp residents, however. Participation in fishing, clamming, and crabbing, in particular, is heavy. As a group they spent more days on average each year, participating more in these activities than other types of communities sampled. A percentage of household meat and fish is provided through deer hunting (14%) and salmon fishing (16%) (ibid.).

Some logging camps become more permanent communities when private land is made available through state land disposals, as described below.

Table ummary of Transportation Facilities and Services Available ommunity in Southeast Alaska, 1986

	Air					Water				Road		
				Charter Service Available								
Community	Daily Jet Service	Charter Service Based in Community	Scheduled Mail Plane or Flights	Float (Seaplane, Dock)	Wheel (Airstrip)	Main Ferry Route	Local Ferry	Floats, Moorage, or Small Boat Harbor	Skiffs	Local Road System	Road Access to Other Communities	Logging Road Network or Connection
Yakutat	X	X	---	X	X	---	---	X	X	X	---	X
Haines	---	X	---	X	X	X	---	X	X	X	X	X
Klukwan	---	---	---	---	---	---	---	---	X	X	X	
Skagway	---	---	---	X	X	X	---	X	X	X	X	X
Juneau-Douglas	X	X	---	X	X	X	---	X	X	X	---	---
Gustavus	X[a]	X	X	X	X	---	---	X	X	X	---	---
Tenakee Springs	X	---	X	X	---	X	---	X	X	---	---	---
Hoonah	---	---	X	X	X	X	---	X	X	X	---	X
Petersburg	X	X	---	X	X	X	---	X	X	X	---	X
Wrangell	X	X	---	X	X	X	---	X	X	X	---	X
Kake	---	---	X	X	X[b]	X	---	X	X	X	---	X
Angoon	---	---	X	X	---	X	---	X	X	X	---	---
Pelican	---	---	X	X	---	X[c]	---	X	X	X	---	---
Sitka	X	X	---	X	X	X	---	X	X	X	---	---
Port Alexander	---	---	X	X	---	---	---	X	X	X	---	---
Meyers Chuck	---	---	X	X	---	---	---	X	X	X	---	---

(continued)

Table 1. (continued).

Community	Air					Water				Road		
	Daily Jet Service	Charter Service Based in Community	Scheduled Mail Plane or Flights	Charter Service Available: Float (Seaplane, Dock)	Charter Service Available: Wheel (Airstrip)	Main Ferry Route	Local Ferry	Floats, Moorage, or Small Boat Harbor	Skiffs	Local Road System	Road Access to Other Communities	Logging Road Network or Connection
Ketchikan	X	X	---	X	X	X	X	X	X	X	---	---
Hyder	---	---	X	X	---	X[d]	---	X	X	X	X	---
Point Baker	---	---	---	X	---	---	---	X	X	---	---	---
Port Protection	---	---	---	X	---	---	---	X	X	---	---	---
Thorne Bay	---	---	X	X	---	X	---	X	X	X	X	X
Hollis	---	---	---	X	---	X	X	X	X	X	X	X
Kasaan	---	---	X	X	---	---	---	X	X	X	---	---
Klawock	---	---	X	X	X	---	---	X	X	X	X	X
Craig	---	---	X	X	---	---	---	X	X	X	X	X
Hydaburg	---	---	X	X	---	---	---	X	X	X	X	X

[a] Jet service to Gustavus is daily only during the summer.

[b] An airstrip was under construction, but useable, at Kake in summer, 1986.

[c] Ferry service to Pelican is approximately monthly.

[d] Infrequent ferry service to Hyder was initiated in summer, 1985, but was cancelled in 1986 due to lack of funding.

--- s facility or service is not present.

C. Settlements Resulting from Land Disposals

Private land holdings exist throughout the region as a result of the federal homesteading laws and the Alaska Native Claims Settlement Act, the latter providing for individual allotments of land to natives who had traditionally used the area for hunting, fishing, and gathering. Many of these areas are the sites of recreational cabins or year-round residences, and are used as a base for hunting and fishing.

State selection of lands resulted from a portion of the Statehood Act which provided for selection of National Forest Service lands. While not all the original entitlement lands have been selected, a number of disposals of state-selected or patented land into private ownership have occurred. Disposals have occurred adjacent to the established communities of Petersburg, Kupreanof, Wrangell, Haines, Klukwan, Ketchikan, Gustavus, Skagway, Juneau, Sitka, Tenakee Springs, Pelican and Port Protection. In addition, disposals have occurred at Hollis, Thorne Bay, Whale Pass, Funter Bay, and Edna Bay, areas that were previously used for logging camps. Land disposals have also resulted in new settlement areas in south Wrangell Narrows, Excursion Inlet, Thoms Place/Olive Cove, the upper Taku River, Shelter Island, near Juneau, and George Inlet near Ketchikan. The more remote disposals were in areas that included existing cabins or private lands and were disposed of primarily for the purpose of seasonal or recreational settlement. The logging camp areas were also originally intended as similar types of disposals, however, a number of people in each disposal area have settled in as permanent residents with a desire to pioneer new communities. Because of this pattern of settlement, a major land use issue is emerging with respect to whether land disposals should be made in areas such as Prince of Wales Island, where the economy is, at best, seasonal or cyclical (ADNR 1986). Alaska Statutes 38.04.010 requires that disposals intended for year-round settlement areas be in areas where public services are economically available or where an economic base is probable. Land disposals result in either seasonal or year-round use of areas and increased hunting and fishing effort in those areas. Approximately 2,000 state-owned lots have been offered for sale during the period 1979-1985. In addition to state land disposals, some village Native corporations have also made land available to share holders for residential or recreational settlement (e.g., shoreline of Klawock Lake and Port St. Nicholas by Klawock-Heenya Corporation), and others have plans for similar disposals.

Few data are available on the specific hunting and fishing patterns of people residing in remote disposal areas or using the areas for seasonal hunting or fishing camps.

D. Construction Camps and Mining Support Communities

Two major mining developments are in the planning stages in the region. Development of the Greens Creek Mine on Admiralty Island is currently planned to result in construction of a road between Young Bay and Hawk Inlet. However, employees will be housed in Juneau and transported to the mine site on company transportation. Employees will not be allowed to transport guns, traps, or fishing equipment to Admiralty Island on company transportation. Also, under the terms of the FS Special Use Permit, use of the road other than for transfer of employees on company business will not be permitted (USDA 1983). Construction of the road and the mine site has required a work force stationed in old cannery housing at Hawk Inlet.

Exploration and development of the Quartz Hill Mine in the Misty Fjords area resulted in road construction in the Blossom River drainage. Options for development of the mine include housing workers in Ketchikan who would commute to the mine site or phased development of a permanent townsite community in Bakewell Arm (eventual projected population of 2,000). The commute option, however, was preferred by the U.S. Borax Company in its 1983 environmental report (U.S. Borax and Chemical Corporation 1983). Temporary floating camps in Boca de Quadra and Wilson Arm may be used to house construction workers initially, and temporary land-based camps may be located at the mine site, plant site, and townsite during the construction phase. Increased access, hunting, and recreational activities around a permanent townsite are described as potential adverse impacts on wildlife in the Draft Environmental Impact Statement. The document projects that sportfishing would likely be a primary recreational activity for townsite residents and that if sportfishing patterns are similar to those in the region as a whole, 2,000 salmon could be harvested annually, equalling 28% of the chinook and 11% of the coho available for harvest from the Wilson and Blossom rivers. Recreational fishing in Wilson Arm is also expected to have moderate to high impacts on halibut and rockfish populations in Wilson Arm/Smeaton Bay and past Behm Canal and to deplete the number of legally harvestable Dungeness crabs in Wilson and Bakewell arms (ibid.).

VI. SUMMARY OF AVAILABLE INFORMATION ON TYPES OF TRANSPORTATION USED FOR HUNTING PARTICULAR SPECIES

Locations of game management units (GMU) and game management subunits (GMS) are shown on map 1, in part I.

A. Deer Hunting

Hunting patterns and historical harvests are described in the Human Use section of this report. Deer hunting is an important hunting activity in all Southeast communities, with the exception of Haines, Skagway, and Yakutat, where deer populations are low in numbers and hunting is currently closely. The only information on the type of transportation used by deer hunters was gathered in an economic survey of deer hunters in 1986 (Fay, in prep. a). Preliminary results of the survey for the harvest areas where the majority of deer hunting occurred by residence of individual communities are summarized in Fay (ibid.).

B. Moose Hunting

As described in the Human Use of Moose section, moose populations are generally most heavily hunted by residents of the nearest communities. Thus, residents of Yakutat, Haines, Juneau, Petersburg, Wrangell, and Ketchikan hunt the Yakutat/Malaspina Forelands, Chilkat drainage, Taku River/Berners Bay, Thomas Bay, Stikine River, and Unuk River moose populations, respectively. The Yakutat forelands have been used, however, by hunters from many areas, including Juneau, Hoonah, Sitka, Ketchikan, and nonresidents. Haines area residents also concentrate on the nearest moose population that is accessible by a variety of means of transportation, although some residents travel to the Taku River area as well.

Information on the type of transportation used by moose hunters is available from responses to moose hunter permits and harvest tickets, which have always included a question concerning the last type of transportation used before starting to walk on the moose hunt (ADF&G 1985a). Table 2 displays the percentage of moose hunters using specific transportation types in 1984 to access specific moose harvest areas and to hunt specific moose populations. Based on permit responses by all hunters on the Yakutat Forelands, the type of transportation used was a highway vehicle (34%), airplane (32%), boat (25%), or off-road vehicle (10%). Airplanes were used by 85% of all hunters in the Malaspina Forelands, and 12% used boats. The transportation type reported by all hunters in GMS 1D was highway vehicles (36%), boat (33%), airplane (27%), and off-road vehicle (1%). Access to GMS 1C was primarily by boat (78%) and airplane (20%). In Unit 1C (Taku River), access was predominantly by boat (78%), with 20% of hunters using airplanes. Access to the Berner's Bay area was primarily by boat (93%).

Based on permit and harvest ticket responses, the transportation type used to Thomas Bay was predominantly boat, with 81% of Thomas Bay hunters using boats compared to 12% using airplanes and 7% using highway vehicles (transported to Thomas Bay by boat or barge). Similarly, 96% of Stikine River hunters used boats compared to 4% using airplanes. The majority of the hunters (71%) on the Unuk River used boats for transportation, as compared to 14% who used airplanes and 14% for whom the transportation type is unknown (ADF&G 1985a).

A more detailed economic survey of hunters in 1985 requested information on all types of transportation used by hunters on each

Table 2. Percentage of Moose Hunters by Mode of Transportation Used by Harvest Area in Southeast Alaska, 1984

Harvest Area[a]	Boat	Airplane	Highway Vehicle	Off-Road Vehicle[b]	Other Unknown[c]
Unit 1A (42) Unuk River population	71	14	0	0	14
GMS 1B north of (59)[d] LeConte Glacier Thomas Bay population	81	12	7[e]	0[e]	0
GMS 1B soutb of (193)[f] LeConte Glacier Stikine River population	96	4	0[e]	0[e]	0
Berners Bay (14) Berners Bay population	93	7	0	0	0
Remainder GMS 1C (107) Taku River population Chilkat Range population	78	20	1	0	2
GMS 1D (224) Chilkat River population	33	27	36	3	1
Yakutat Forelands (136) Yakutat Forelands population	25	32	34	10	0
Malaspina Forelands (41) Malaspina Forelands population	12	85	0	2	0
Tsiu River (18)[g] Tsiu River population	17	72	0	6	6

Source: ADF&G 1985a; Griese 1986.

[a] Sample size in parenthesis.
[b] Includes "three-wheelers."
[c] Includes several hunters who reported walking from their residency to their hunting area.
[d] Includes Thomas Bay.
[e] In 1984, except for the Stikine River drainage (which is roadless), the use of motorized land vehicles to hunt moose or to aid in transportation during hunting, except to retrieve moose from the field after 12:00 noon was prohibited in GMS 1B.
[f] Includes the Stikine River.
[g] Successful hunters only; however, because success rates were around 80% in GMS 6A, these percentages are reflective of transportation means used by all moose hunters in this harvest area (Griese 1986).

moose hunt. Preliminary data from this survey are summarized by community in Fay (in prep. b).

C. Goat Hunting

Goat hunting is an important activity in several Southeast communities, particularly Juneau, Haines, Skagway, Sitka, Petersburg, Wrangell, and Ketchikan. Participation by nonresidents of the region and the state is also high. As with moose hunting, hunters tend to hunt the areas closest to their community. Thus, Haines and Skagway area residents primarily hunt goats, in the Haines/Skagway area (Permit Hunt #5), Sitka hunters hunt Baranof Island (Permit Hunt #15), Petersburg, Wrangell, and Ketchikan area hunters hunt GMSs 1A and 1B on the southern mainland (Permit Hunt #1). Juneau hunters hunt several areas, but most hunting effort occurs in GMS 1C (Permit Hunts #2 and #3). Nonresidents also hunt in several areas, but the greatest number of hunters in recent years occurred in GMSs 1A and 1B (Permit Hunt #1) (ADF&G 1985b).

Information on the type of transportation used by goat hunters is available from responses to goat hunter permit reports, which have always asked a question concerning the last type of transportation used before starting to walk on the goat hunt. Table 3 displays the responses in 1984 for specific goat hunting areas. Access to goat hunting in the Yakutat area was by plane (38%) or by boat (62%), with moderate success using either means (62% and 40% success, respectively). However, the only goat hunting area accessible by road, Harlequin Lake area, was closed to hunting during 1984. Boats, highway vehicles, and walking were the primary means of transportation in the Haines portion of GMS 1D, accounting for 45, 26, and 20% of hunter responses, respectively. Boats and highway vehicles were primary modes in the remainder of the subunit, with each mode reported by 43% of hunters. In both areas of the subunit, hunters using boats were more successful than those using highway vehicles (62% vs. 50% in the Haines area, 37% vs. 25% in the remainder of GMS 1D). Planes and walking were unsuccessful modes of access in both areas. Approximately one-third of the hunters in the portion of GMS 1C between Antler River and Eagle River and Glacier reported airplanes as the mode of access, compared to 38% reporting boats and 24% reporting highway vehicles. However, only those using planes were successful (57% success rate). The majority of hunters (81%) used boats to travel to the remainder of GMS 1C, 18% used planes, and 2% walked. Plane access resulted in more successful hunts than boats (63% vs. 35%). Access to goat hunting areas on Baranof Island (GMU 4) was by boat (62%), by airplane (36%), and by highway vehicle (5%). Hunters using planes to fly in to remote areas on the island were more successful than those using boats (59% vs. 23% success), and hunters using highway vehicles in GMU 4 were all unsuccessful. The majority of hunters hunting in GMSs 1A and 1B reported airplanes as the mode of access (61%); 38% reported using boats; and 1% reported using highway vehicles. Hunter success was moderate using either boats (53% successful) or planes

Table 3. Percentage of Goat Hunters by Mode of Transportation by Harvest Area in Southeast Alaska, 1984

Harvest Area[a]	Boat	Airplane	Highway Vehicle	Foot	Horse
Unit 1A and 1B (239) Hunt Number 801	38	61	1	0	0
Unit 1(C) Antler River to Eagle Glacier and River (21) Hunt Number 802	40	34	25	1	0
Unit 1(C)-Remainder (63) Hunt Number 803	81	18	0	1	0
Unit 1(D)-Haines Portion (47) Hunt Number 805	45	2	5	20	8
Unit 1(D)-Remainder (19) Hunt Number 806	43	11	43	3	0
Unit 4-Baranof Island (139) Hunt Number 815	61	35	4	0	0
Unit 5(A) and 5(B)(13) Hunt Number 817	38	62	0	0	0

Source: ADF&G 1985b.

[a] Sample size in parenthesis.

(47% success) for access in these subunits (ibid.). Information on the mode of access used in GMU 6A is incomplete, but can be obtained from the Area Management Biologist, Division of Game, in Cordova.

A more detailed economic survey of hunters in 1985 requested information on all types of transportation used by hunters on each goat hunt. Preliminary data available are summarized by community in Fay (in prep. c).

D. Black and Brown Bear Hunting

No information is available on the mode of access used to hunt bears by residents of specific communities. Limited information is available on the mode of access used by successful bear hunters in each GMU, however, from information recorded on sealing records. The information is incomplete for two reasons: 1) the categories of access for which information was requested did not include road or highway vehicles as a category, and, 2) no information is available on means of transportation used by unsuccessful hunters.

1. Black bear. Black bears are present in the vicinity of all communities, with the exception of those on Admiralty, Baranof, and Chichagof islands. The mode of access used in obtaining black bears was recorded as part of the sealing record. Table 4 is based on the results of 2,819 sealing records during 1975-1984 (ADF&G 1985c).

   Boats, the major overall method of transportation in the Southeast Region, were used on over 47% of the successful hunts. Between 59 and 79% of the successful hunters in GMU 3 and GMSs 1A, 1B, and 1C reported using boats for transportation.

   Aircraft was another major method of transportation in some areas and was reported to have been used by 19% of the successful hunters. The highest percentage of hunters using aircraft occurred in GMSs 6A and GMU 5, where it was reported used on nearly half the hunts. Significant numbers of successful black bear hunters used aircraft for transportation in GMU 2 (190 successful hunters), GMU 3 (103), and GMS 1A (80).

   As noted above, use of road vehicles was not sampled. This transportation method is important for hunting in some parts of the region. The high percentage (35 and 68%, respectively) of "unknown or other" methods of transportation reported in GMU 2 and GMS 1D (table 3) probably reflects the use of road vehicles for black bear hunting in those areas. Off-road vehicles did not play a significant role in the transportation of hunters, with the single exception of GMU 2, where it was used by 129 (16%) of 803 successful

Table 4. Black Bear Harvests by Mode of Transportation by GMU/GMS in Southeast Alaska, 1975-79 and 1980-84

GMU/GMS	Boat	Aircraft	Off Road Vehicle	Unknown Or other	Total
1A					
1975-79	89	30	2	20	141
1980-84	107	50	5	31	193
Total	196	80	7	51	334
1B					
1975-79	31	5	0	0	36
1980-84	36	7	0	6	49
Total	67	12	0	6	85
1C					
1975-79	188	12	2	43	245
1980-84	174	22	2	98	296
Total	362	34	4	141	541
1D					
1975-79	15	4	16	68	103
1980-84	25	8	4	87	124
Total	40	12	20	155	227
2					
1975-79	84	87	16	125	312
1980-84	116	103	113	159	491
Total	200	190	129	284	803
3					
1975-79	158	39	6	23	226
1980-84	221	64	12	76	373
Total	379	103	18	99	599
5A					
1975-79	39	36	0	4	79
1980-84	51	52	0	13	116
Total	90	88	0	17	195
5B					
1975-84	2	3	0	0	5
6A[a]					
1975-84	2	18	1	10	31

Source: ADF&G 1985c; Griese 1986.

[a] Includes only Minor Harvest Units 0100, 0200, and 0300.

hunters. It is especially noteworthy that the reported use of off-road vehicles increased from 16 successful hunters during the period 1975-1979 to 113 hunters during the period 1980-1984.

In summary, boats were the major overall method of transportation in the Southeast Region, being used in about half of all successful hunts. Aircraft was used on at least 19% of the successful hunts. Use of road vehicles was not determined; the reported use of off-road vehicles increased dramatically in GMU 2.

2. Brown bear. Brown bears occur throughout much of the region, with the exception of most islands south of Frederick Sound.

The mode of access used in obtaining brown bears was recorded as part of the sealing record beginning in the late 1960's, and the results are summarized by GMU in table 5 (ADF&G 1985c). As discussed, identification of transportation means was limited to the categories of boat, aircraft, off-road vehicles, and unknown or other means. Use of road vehicles and transportation on unsuccessful hunts were not recorded.

Boats are clearly the most common overall means of transportation for bear hunters in the Southeast Region and were used to obtain a minimum of 63% of the brown bears sealed during the period 1970-1984 (table 4). Aircraft was used by over 22% of the successful hunters during that period and was the predominant means of transportation by successful bear hunters in GMU 5 and GMS 6A, where they were reported to have been used by 222 (53%) of 416 hunters.

VII. DESCRIPTION OF ACCESS PATTERNS FOR PARTICULAR SPECIES BY COMMUNITY

The descriptions that follow are based on the information sources described above. Recent quantative data are included for the species noted, with the exception of deer hunting data which appear in Fay (in prep. a). Where no data exist, available types of transportation are described in general terms.

A. Yakutat

Yakutat is physically separated from the rest of the region by hundreds of miles of impassable topography. Daily jet service is the major means of transportation to other communites. A long stretch of exposed coastline in either direction restricts boat access to larger vessels and storm-free periods. To the east of Yakutat, however, lies a large expanse of relatively flat glacial outwash plains and terraces, the Yakutat Forelands, with populations of many fish and wildlife species. Yakutat residents make use of a limited local road system in the area west of the Dangerous River and use all-terrain vehicles and road vehicles along the

Table 5. Brown Bear Harvests by Mode of Transportation by GMU/GMS in Southeast Alaska, 1970-84

GMU/GMS and Years	Boat	Aircraft	Off-road Vehicle	Unknown or Other
1A				
1970-84	35	6	0	2
1B				
1970-84	29	3	0	11
1C				
1970-84	41	11	0	9
1D				
1970-84	39	9	8	58
4				
1970-74	332	61	0	32
1975-79	341	64	4	36
1980-84	341	64	4	36
Total	1,014	189	8	104
5A				
1970-84	90	132	9	69
5B				
1970-84	7	44	0	3
6A[a]				
1970-84	0	46	1	15
Total	1,248	440	26	271

Source: ADF&G 1985c.

[a] Includes only Minor Harvest Units 0100,0200, and 0300

flat sandy beaches between Yakutat and the first major river to the east. Wheel and floatplane air taxi operations are also based in Yakutat. The city of Yakutat is located within a protected portion of Yakutat Bay and has a small boat harbor for anchorage of recreational and fishing boats. Access to other portions of Yakutat Bay and the outer coastline is also possible by skiff from the boat harbor or from the Situk River highway bridge.

As shown in table 31 in part 1 of this report, in 1966 through 1985, Yakutat residents hunted moose in areas around Yakutat, the Yakutat Forelands, the Malaspina Forelands, and GMS 6A, east of the Suckling Hills. More specific hunting area and access mode information is contained in Mills and Firman (1986), who also reported on the effects of changing access patterns as described below.

Yakutat goat hunting was limited by regulation in 1984, the year chosen to characterize hunter effort in this report. The Harlequin Lake area, the only goat-hunting area accessible by road, was closed to hunting during that year. Eight Yakutat goat hunters made up 30% of all hunters hunting the Yakutat area and contributed 27% of hunter effort. The majority of goat hunting effort by nonresidents of Yakutat were Alaska hunters who lived outside the Southeast Region or nonresidents of Alaska (ADF&G 1985b). Historically, the Deception Hills southeast of Dry Bay, the Brabazon Range northwest of Alsek Lake, mountainous areas around Ustay, Akwe, and Harlequin lakes, the north shore of Nunatak Fjord, and the cliffs around Icy Bay were used for goat hunting (Mills and Firman 1986).

Mills and Firman (1986) reported on the areas used for harvest of other local resources by Yakutat residents, including fish, bear, seals, deer, furbearers, birds, shellfish, and marine plants.

Yakutat residents sport troll in Yakutat Bay, mostly on the town side of the Bay to Humpback Creek. They also fish the Situk River for steelhead using road access and hiking or using boats. Little remote fly-in sportfishing is done by Yakutat residents; however, Yakutat has recently become known for its world-class sportfishing opportunities for steelhead, chinook, and coho salmon. Access to the freshwater streams where the majority of fishing effort occurs includes the use of airplanes and boats to remote fish camps and highway vehicles to hike in or from which to launch boats in areas accessible by road. No data on the relative use of each mode are currently available. Limited information is available on specific fisheries (Schwan et al. 1984).

Yakutat is an area where transportation patterns have changed dramatically in a short period of time. The area has been the subject of a recent study of the effects of the changes of local resource use patterns (Mills and Firman 1986). Historically, Native settlements were dispersed on the Forelands, with travel on foot or by boat. In the early 1900's, a cannery was built at the modern site of Yakutat, and wage-employment resulted in consolidation of the dispersed settlements. Also, a railroad was built between the townsite and the Situk River. World War II brought an airbase and road construction in the area of the airport and from the airport to the beach southeast of Yakutat. After the war, a road was built to the Situk, and railroad operation ended. In the 1960's, the Forest Service began building Forest Highway #10 in a northerly direction from the town along the Forelands to the upper waters of the Situk River. Road construction continued in stages, to end at the Dangerous River in 1973. In 1975, the Dangerous River was bridged; however, no further road access was provided east of the bridge. In addition to new road access, other forms of hunting and fishing access have been developed. Small aircraft landing strips were built in six areas on the Yakutat Forelands, and public cabins were subsequently built. Finally, daily jet service to Yakutat began in the early 1970's.

Mills and Firman (1986) concluded that the following changes in hunter access patterns have occurred as a result of these changes:

1. Residents of Yakutat continue to rely on boats as a major means of access for hunting and fishing. However, use of boats for moose hunting has declined since construction of Forest Highway #10.

2. Use of highway vehicles for hunting and fishing has been increasing, with highway vehicles now being used by more than twice as many Yakutat households as before construction of the road.

3. The construction of Forest Highway #10 provided increased access to larger portions of the Yakutat Forelands. Since its construction, a large percentage of residents have used the road system for hunting and fishing, in some cases abandoning more traditional, less accessible areas. The road system and the areas it leads to also have been used heavily by nonlocal hunters and fishers, significantly increasing use and competition in certain areas, so that many Yakutat residents have abandoned them.

4. Areas of the Yakutat Forelands that were roaded or easily accessible by roads had significantly lower rates of moose hunter success. In 1984, nonroaded areas had six times the hunter success rate for moose compared to roaded areas, produced more moose per square mile, and accounted for most of the community's moose supply, despite receiving much less hunter pressure.

5. Use of a highway vehicle for moose hunting, although the most common means of transportation for Yakutat residents, was the least productive means of transportation. Fifty-four percent of all Yakutat moose hunters used a highway vehicle as their

primary means in 1984, but only 3% successfully harvested a moose by this means of transportation.

6. The construction of roads and the new convenient access they provide also create additional demands for wildlife. Hunters and fishermen not living in Yakutat have been attracted to the improved access possibilities in the area. New users of the area have had conflicts with existing users. These conflicts have included competition for resources or disruption of one group's activities by another group using a new form of transportation technology.

It should be noted that a reduced success rate along the road corridor may be due to a number of factors, including more moose hunters, reduced moose populations, or displacement of moose. The harvest per unit of effort (i.e., days/moose) may have been increased by the additional time spent by roadhunters vs. those using other forms of transportation.

B. Gustavus

Gustavus is isolated from other Southeast communities by Glacier Bay National Park to the west and north and Excursion Inlet and the rugged Chilkat Mountains to the east. Jet service is daily to and from Juneau in the summer and several times a week in winter. Charter planes, based in Juneau, fly regularly scheduled flights as well. Gustavus has a local road that connects the airport, many residences and public facilities, and a commercial lodge in Glacier Bay National Park. A small boat beaching area is located about 1/2 mi up the Salmon River. A dock and anchorage area exists at the mouth of the Salmon River, and river access is also possible on the Goode River for about a mile inland. Skiff access is used along the beach facing Icy Strait; however, access that requires crossing Icy Strait is weather-dependent.

Moose hunting by Gustavus residents is limited, according to information on moose hunting in 1966 (table 30, part I)) and 1984 (table 31, part I).

C. Haines/Klukwan

Haines is the southern terminus of the Haines Road from Haines Junction, connecting the town with the Alcan Highway, the Yukon Territory, and Interior Alaska, but Haines is isolated from the rest of the Southeast Region. It is also one of the northern termini of the Alaska Marine Highway, linking a number of Alaska communities and Seattle via car ferry. Klukwan is connected by an all-weather road to the Haines Road and Haines, 22 mi away. Winter snow and fog often restrict road travel, and cold temperatures can cause boats to ice up, further limiting travel by water. Scheduled and charter air taxi flights are scheduled daily from an operator based in Juneau; flights, however, are sometimes delayed for several days due to poor weather. Haines is the northern end of the Inside Passage and has anchorage for boats. Skiffs are used along the Chilkat River and Lynn Canal; the mouth of the Chilkat River, however, is not navigable. Several boat launch areas exist along the Haines Road. Boat access into and across Lynn Canal, however, is weather-dependent.

Residents of Haines primarily hunt moose in the Haines area in GMS 1D along the Chilkat River drainage. Hunting also occurs in GMS 1C (table 31, part I).

Based on permit responses in 1984, approximately two-thirds of Haines area goat hunters hunted the Haines portion of GMS 1D, while one-third hunted in the remainder of GMS 1D. Haines hunters made up approximately 68% of the goat hunters and spent approximately 70% of the 1984 goat-hunter-days in the Haines portion of GMS 1D. In the remainder of GMS 1D, Haines residents made up 76% of the hunters and spent 63% of the hunter-days (ADF&F 1985b).

A study of salmon use by residents in the Chilkat and Chilkoot river drainages (Mills et al. 1983) described uses of local resources in these two river valley drainages. The report focussed on salmon because of the key role of salmon harvesting in the overall pattern of local resource use. In 1983, Haines residents harvested salmon for local use with gill nets set along the Chilkat River from Zimovia Point to the vicinity of Wells Bridge. Salmon were also retained from commercial harvests by drift gill net in Lutak Inlet and harvested by rod and reel in both fresh and saltwater areas. Another group of Haines area residents who lived along the Haines Highway from mile 4 to the United States-Canada border set gill nets in the Chilkat River starting at mile 9, and a majority fished downstream of Klukwan. The Chilkat River is large and braided in this area. Nets can be set and worked using small nonmotorized boats or work nets set in sloughs from shore (Mills 1986).

Klukwan residents reported setting nets in the immediate vicinity of Klukwan and also harvesting by rod and reel. As described in Mills (1982a), Klukwan fishermen set gill nets from both shores of the river, crossing a swift, confined portion of the river to the Tsirku fan area in small motor skiffs. They also use a skiff to string the net out along an eddy line. Some use of good fishing sites is traditional. In 1982, certain sites immediately downriver from Klukwan, easily accessible from the Haines Highway, resulted in competition and conflicts over use.

Mills (1982a) also described the 1982 eulachon fishery by Klukwan residents who drive to sites 4 to 9 mi north of Haines and dip net eulachon from the Chilkat River. They also drive to the Chilkoot River to fish for eulachon.

Based on an assessment of recreational fisheries in the Southeast Region, over 50% of sportfish angling in the Haines-Skagway area occurs in freshwater areas, an exception to the pattern in most Southeast Alaskan communities, which are more dependent on marine fisheries. The largest freshwater sport fishery in the region occurs on Chilkoot Lake and River (primarily on the outlet river), which is accessible by road. Freshwater fishing also occurs on the Chilkat River, which parallels the Haines Highway; on Mosquito Lake, accesible by road with a developed campground; on Chilkat Lake, accessible by plane or boat only; and on a few hike-in lakes accessible from the Haines road system. Marine sportfishing occurs primarily within 6 to 8 mi of Haines, because of the necessity to cross unprotected Lynn Canal to travel to more distant areas. Fishing from the beaches on the Chilkat Peninsula and Lutak Inlet also occurs (Schwan et al. 1984).

D. Skagway

Skagway is the southern terminus of the Klondike Highway from the Yukon Territory in Canada, which connects to the Alaska Highway via the Taylor Highway. It is the other northern terminus of the Alaska Marine Highway and also has a small boat harbor. A narrow gauge railway tie to Whitehorse ceased service in 1982. A charter air service is based in Skagway, with regularly scheduled flights to Juneau. A local road system provides access to the Skagway and Taiya river valleys.

Residents of Skagway primarily hunt moose in GMS 1D along the Chilkat River drainage. Limited hunting also occurs in GMS 1C (table 31, part I). Access to these areas, based on permit responses, is described above in the summary section on moose hunting and in table 2.

Based on 1984 permit responses, Skagway goat hunters primarily hunted the Haines portion of GMS 1D (90% of Skagway hunters and 79% of Skagway goat hunter-days in 1984), but some hunters hunted the remainder of GMS 1D as well. They accounted for a major portion of hunters in this subunit who were not Haines residents (22% of hunters and 25% of hunter-days in the Haines portion of GMS 1D, 5% of hunters and 14% of hunter-days in the rest of GMS 1D) (ADF&G 1985b). The modes of access used and success rates of hunters in this subunit are described above in the summary section on goat hunting and in table 3.

As described for Haines, the reported Haines-Skagway area sportfishing effort is approximately equal for freshwater and marine sportfishing. However, Skagway has few sportfishing opportunities, little beach fishing, and poor marine fishing. Angler effort is reported in a combined form on angler surveys; however, based on the lack of opportunities in Skagway, the effort can be assumed to occur primarily in the Haines area. Lower Dewey Lake, accessible by a trail originating from downtown Skagway, is the most popular freshwater fishing site; no roadside fisheries exist (Schwan et al. 1984).

E. Juneau/Douglas

Juneau and Douglas, located on the Inside Passage, are connected by a highway bridge over Gastineau Channel. They are not connected by road to any other Southeast Alaska community. Rugged glaciers to the north and deep fjords to the south make a future road connection unlikely. Juneau has twice-weekly ferry service and at least daily jet flights to Seattle, Anchorage, Yakutat, Sitka, Petersburg, and Ketchikan. It is also a base for several air charter operators with scheduled or charter flights to smaller Southeast Alaska communities. Several small boat harbors are located along Gastineau Channel; however, the navigability of the channel is limited by tide levels. Thus, boats anchored in downtown Juneau's Harris Harbor or the Douglas Harbor must travel south and around Douglas Island to get to the waters north and east of Douglas Island. Juneau has a local road system that extends north to Echo Cove and south to Thane on the mainland. Douglas has a main road approximately 20 mi long on the east side of the island.

Residents of Juneau hunt moose in several locations. In 1984, the greatest number hunted the upper Taku River population, followed by the Chilkat River drainage in GMS 1D, the Yakutat Forelands, and the Malaspina Forelands. A few hunters hunted in the area south of LeConte Bay and in the area east of the Suckling Hills. In addition, a limited permit hunt is held annually in the Berner's Bay area. In 1984, all permit holders were Juneau residents (table 31, part I).

Based on 1984 permit responses, Juneau goat hunters hunted all the goat hunting areas in the region, with the majority of hunting occurring in GMS 1C (28% in the area between the Antler River and Eagle Glacier and River, 42% in the remainder of the subunit), on Baranof Island (14%), and in GMS, 1A and 1B (11%).

Juneau hunters comprised a relatively low proportion of hunters and hunter effort in most hunt areas, with the exception of GMS 1C. All of the hunter effort in the Antler River to Eagle Glacier and River portion of GMS 1C was by Juneau residents and 50% of the hunters in the remainder of GMS 1C were Juneau residents, who expended 42% of the hunter-day effort (ADF&G 1985b).

Thirty-six percent of sportfishing effort in the Southeast Region occurs in the Juneau area, with 90% of the Juneau effort occurring in saltwater adjacent to Juneau, between Doty Cove, Point Retreat, and Benjamin Island. Marine boat angling opportunities are limited immediately south of Juneau; however, the majority of boats are berthed downtown, south of the Mendenhall Bar, which restricts access to the north in Gastineau Channel. Access to more northern fishing areas thus requires travel along the outside of Douglas Island. Juneau has the most extensive roadside access to shoreline areas of any Southeast community. Freshwater roadside angling opportunities are limited because of low stock abundance, small streams, and restrictive regulations; however, fishing occurs in Montana Creek and Peterson Creek. Excellent angling opportunities exist at a few remote, off-road locations, and Juneau anglers fly in to lakes and creeks on Admiralty Island to sportfish (Schwan et al. 1984). More specific sportfishing locations are described in Schwan et al. (1984).

F. Hoonah

Hoonah is located on northern Chichagof Island, on the east side of Port Frederick. A logging road network scheduled for construction in 1986 will eventually connect Hoonah to much of the northeastern portion of the island north of Tenakee Inlet. Hoonah is isolated from other communities, but only a short section of unroaded area separates Hoonah from Tenakee Inlet. A religious community, Mt. Bethers, is located 25 mi to the south of Hoonah, but is accessible only by water. Whitestone logging camp is located between Hoonah and Mt. Bethers and is accessible by road. Scheduled flights occur daily from air taxi operators based in Juneau and Sitka. Both a wheel plane landing strip and floatplane anchorage area are used as landing areas. Hoonah is on the Alaska Marine Highway route and has a small boat harbor.

A few Hoonah residents hunted moose in the Yakutat Forelands in 1966 and 1984 (tables 30 and 31, part I).

Additional information on resource use areas is contained in the Hoonah coastal Zone planning document (CH2M-Hill 1982).

G. Angoon

Angoon is the only major community on Admiralty Island and is located on the west side, on a peninsula between Kootznahoo Inlet and Chatham Strait. Angoon is accessible by air (daily flight from Sitka) or by water via ferry or boats that can anchor in the small boat harbor.

Deer hunting is an important hunting activity in Angoon. In a 1982 study (George and Kookesh 1983), Angoon hunters reported hunting on the west side of Admiralty Island from Hawk Inlet to Point Gardner, on the western side of Chatham Strait north to Wukuklook Creek north of Freshwater Bay, on Chichagof Island, and south to Kelp Bay on Baranof Island. They also reported hunting the north shores of Peril Strait to False Island on Chichagof Island and the south shore of Peril Strait to Rodman Bay of Baranof Island. Preferred hunting areas were based on beaches suitable for boat landings, among other factors. Contemporary Angoon deer hunters travel to hunting areas in boats, most commonly a 16-or-17-ft outboard motor skiff. Hunting deer on the beaches is an important method of hunting, engaged in by 68% of hunters interviewed in Angoon. Hunters also hunt deer in alpine areas and in muskeg openings in the forest.

Information on access for other types of resource use by Angoon residents is not available.

H. Tenakee Springs

Tenakee Springs, located on the north side of Tenakee Inlet, Chichagof Island, is accessible only by water or air (ferry, small boat harbor, floatplane from Juneau or Petersburg). During the winter months, fog sometimes limits flights into the community. There are no roads and few vehicles in Tenakee; a one-lane trail connects the community. All-terrain vehicles (ATVs) and boats are used locally for transportation.

I. Pelican

Pelican, located on the north side of Lisianski Inlet, Chichagof Island, is accessible only by water or air (from Juneau or Sitka). Ferry service is monthly. Pelican's small boat harbor is heavily used during summer months by fishing boats bringing fish into the cannery. Two miles of gravel road exist in the town, but boardwalks connect the road to the ferry terminal and dock. All-terrain vehicles and skiffs are used locally. During winter, travel to and from Pelican by both sea and air is limited by fog, winds, and high seas.

J. Elfin Cove

Elfin Cove is located on northwestern Chichagof Island and is accessible only by water (small boat harbor) or air (charter floatplane from Juneau or Sitka). No roads exist in the community; local access is by boardwalk, trail, or skiff.

K. Sitka

Sitka, located on the west side of Baranof Island, is accessible only by air or water. Besides Port Alexander, it is the only major community on Baranof Island. Sitka has ferry service and daily jet service; several air charter operators are based there. It also has four public and two private small boat harbors and is a popular base for commercial boats fishing the outer commercial fishing districts for salmon, halibut, herring, black cod, and rockfish. Sitka is situated on the outer coast but within a large area of protected waters that extends to the north and south. A road system extends approximately 13 mi from Silver Bay (where a pulp mill is located) to the south to the ferry terminal in Starrigavan Bay to the north.

Gmelch and Gmelch (1985) surveyed local resource use in Sitka. They concluded that most Sitkans reached good hunting and fishing areas by sea or air due to the short road system and the waters and mountains surrounding the town. They found dependence on boats to be high, with many species of fish and shellfish scarce or nonexistent along the shoreline accessible by road because of habitat degradation or local harvesting activity.

Forty-two percent of households surveyed owned a boat, and many owned more than one. The type of boat owned limited the types of food-gathering activities in which Sitkans engaged, with open skiffs used for day trips and beach landings and larger cruisers (average length 18 to 26 ft) used for longer overnight trips. The larger cruisers, however, required good anchorages, which limited the possible destinations.

Deer hunting is an important activity for Sitkans, with the major hunting areas on Baranof, Chichagof, and Kruzof islands, and offshore small island groups. In general, Sitkans travel north and west from Sitka to hunt. They hunt areas on the west side of Baranof Island and east side of Kruzof Island as far north as the mouth of Slocum Arm, offshore islands, and along Salisbury Sound, Peril Straits, and Hoonah Sound, as well as more outlying areas in conjunction with commercial fishing and visiting other communities. A few people traditionally hunt south of Sitka along the west side of Chichagof Island as far as West Crawfish Inlet and the Necker Islands. Sitkans without boats hunt areas along the Sitka road system. Eighty-one percent of hunters surveyed by Gmelch and Gmelch (1985) reported travelling by boat for their last hunting trip, compared to 9% who used a car or truck. Thirty-seven percent responded that walking was involved in the trip, and 10% reported use of an off-road vehicle. The least frequently used form of transportation (5%) was a privately owned airplane. However, one air charter company reported making an average of three deer-hunting charters a week from August through October, with most destinations within 30 minutes flying time. The figures for boat use are somewhat distorted because the survey asked only the form of transportation used in the most recent hunting trip, which would have been a late fall beach hunt, based on the timing of the survey. However, Sitkans reported the areas accessible by roads to be less productive because of their proximity to town and the resultant hunting pressure. Also, people who hunt from the road system tend to be newer residents and less experienced hunters. With time they get to know the area better, buy a boat, travel further away to hunt, and harvest more deer (Gmelch and Gmelch 1985).

Some Sitka residents travel to other areas to hunt moose; no moose are present on the Admiralty-Baranof-Chichagof islands complex. In 1966, Sitka residents travelled to GMUs 1 and 5 to harvest moose (table 31,part I) and in 1984 to GMS 1B (south of LeConte Bay), GMS 1C (Taku River), GMS 1B (Haines), and to the Yakutat Forelands (table 31, part I).

Based on 1984 permit responses, Sitka goat hunters hunted Baranof Island exclusively. Major hunting areas used by Sitkans include the high lakes and mountains northeast of Sitka and due east of Katlian Bay and Nakwasina Sound. Hunters hike in to Goat and Hogan lakes, Katlian, and Blue Lake and charter into Rosenberg, Cold Storage, Goat, Indigo, and Hemmorhoid lakes, and Lake Diana (ibid.). They accounted for 80% of all hunters using the area and 83% of the hunter-days of effort (ADF&G 1985b).

The majority of sportfishing (86%) that occurs in Sitka is marine in nature. Sitka Sound, Katlian Bay, Nakwasina Sound, Goddard, Necker, and Biorka islands are popular sportfishing areas, although adverse weather can restrict use of Sitka Sound. Shoreline angling opportunities along the road system are very limited, with most effort occuring at Starrigavan Bay and along the breakwaters adjacent to Sheldon Jackson Hatchery. Starrigavan Creek, Indian River, and five lakes accessible by road and trails support light freshwater fishing effort, and better angling opportunities exist at remote off-road locations. No roadside steelhead fishery exists in Sitka, but some Sitkans boat or fly into Sitkoh Lake and Creek. Lake Eva is another popular destination, as are lakes with public cabins on Chichagof and Baranof islands (Schwan et al. 1984).

Gmelch and Gmelch (1985) provided additional information on use in specific areas for fishing for subsistence salmon, halibut, freshwater sportfishing, herring, crabbing, shrimping, gathering of intertidal resources such as herring eggs, mollusks, and crustaceans, and trapping furbearers.

In summary, Sitkans generally prefer to travel north through more sheltered waters; all fishing locations south of Sitka require some travelling on the open sea, as do West Chichagof sites. Several areas are used for a variety of hunting and fishing activities along the west side of Baranof Island, the east side of Kruzof Island, southwestern West Chichagof Island, Peril Straits, Hoonah Sound, and in the vicinity of Sitka and Nakwasina sounds. Because of the availablity of excellent hunting and fishing opportunities in these areas and the lower quality of opportunities along the road system, the majority of access is by boat, with planes receiving some use for goat hunting access.

L. Port Alexander

Port Alexander is located near the southeast tip of Baranof Island. The community is accessible via floatplane (from Petersburg, Sitka, Wrangell, or Juneau) or large boats. The long stretch of exposed coastline between Sitka and Port Alexander restrict access via small boats or skiffs to storm-free, calm conditions, which are rare. Travel within the community is by skiff, boardwalks, and footpaths.

M. Hyder

Hyder is connected to the Stewart Highway into British Columbia which connects to the Alcan Highway, but not to any Southeast Alaska communities. Monthly ferry service was initiated to Hyder in the summer of 1985. Otherwise, access is via floatplane from Petersburg or Ketchikan or via large boats. Flights into Hyder are often cancelled because of poor weather conditions. Regular flights are scheduled from Prince Rupert, British Columbia, to the Stewart, B.C., airport, which is just a few miles by road to Hyder. Access by water is restricted to large boats; the exposed waters between Dixon Entrance and Portland Canal often make travel by smaller boats treacherous. Local roads extend west through the Salmon River valley. Hyder residents use road vehicles and snow-machines for local transportation.

N. Petersburg/Kupreanof

Petersburg is located on the northern end of Mitkof Island and Wrangell Narrows on the Inside Passage. The small community of Kurpreanof, site of a state land disposal, is located across Wrangell Narrows and is accessible via a short skiff ride under most weather conditions. However, for harvest reporting purposes, they are considered one community. Petersburg has daily jet service and is serviced by all mainline north and south-bound ferries. It is also a base for air taxi operators. The town has three boat harbors, which are heavily used by commercial fishing boats. The Mitkof Highway system extends for approximately 30 mi along the west side of Mitkof Island along Blind Slough and along the southern end of Mitkof Island. No roads exist in Kupreanof.

The Mitkof Highway is also connected to a logging road network that adds approximately 80 mi to the road system. Travel within Petersburg is primarily by private vehicle; within Kupreanof, by boardwalks, trails, skiffs, and walking along the beach.

In 1984, Petersburg residents primarily hunted moose in GMS 1B, in both Thomas Bay (north of LeConte Bay) and the Stikine River drainage (south of LeConte Bay) (table 31, part I).

Based on 1984 permit responses, Petersburg goat hunters hunted in the goat hunting area comprised of the mainland portions of GMS, 1A and 1B. They comprised 19% of the hunters using the area and contributed 15% of the goat hunter-days in the area (ADF&G 1985b).

Petersburg sportfishing effort is primarily marine (70-75%). Anglers fish as far north as Cape Fanshaw (approximately 40 mi) and south for 20 mi in Wrangell Narrows but mainly in the 15 mi of water between Pt. Frederick and Farragut Bay for chinook salmon and at the mouths of Petersburg Creek, Falls Creek, Blind Slough, and in Duncan Canal for coho salmon. Fishing in saltwater areas near the road system is good, and adequate public access exists. Streams and lakes adjacent to the Petersburg road system provide trout and salmon sportfishing opportunities. There are excellent fishing opportunities in off-road areas, which support light-to-moderate fishing effort. Petersburg Creek is the most popular off-road fishery (Schwan et al. 1984). More specific sportfishing locations are described in Schwan et al. (1984).

O. Wrangell

Wrangell, located at the northern end of Wrangell Island along the Inside Passage, is accessible by air (jet, wheelplane, floatplane) and water (ferry, small boat harbor). A road system extends south along the shoreline of Zimovia Strait and connects to a logging road network.

In 1984, Wrangell residents primarily hunted moose in the Stikine River drainage (table 31, part I).

Based on 1984 permit responses, Wrangell goat hunters hunted in the main goat-hunting area, comprised of mainland portions of GMSs 1A and 1B, excluding Revilla Island. They comprised 8% of all hunters using the area and contributed 5% of 1984 goat hunter-days (ADF&G 1985b).

Most sportfishing effort in the Wrangell area is marine (75-80%) and occurs within 20 mi of town in Eastern Passage, Zimovia, and Sumner Straits. Anglers occassionally travel to Duncan Canal, Bradfield Canal, Prince of Wales Island, and Ernest Sound. Angling opportunities along the road system are not extensive; only one lake and three streams are accessible directly by road and support roadside fisheries. Excellent off-road fishing opportunities exist for salmon and trout and effort is moderate (Schwan et al. 1984). More specific sportfishing locations are described in Schwan et al. (1984).

P. Kake

Kake is located on the west side of Kupreanof Island and is not connected to any other Southeast Alaska community. It is accessible by air (floatplane from Sitka, Petersburg, Ketchikan, or Juneau) or water (via ferry). It has two small boat harbors. Poor visibility or rough water, occasionally make floatplane landings difficult or impossible. Kake has a small local road system and access to an extensive logging road network. Skiffs and other small boats are often used for local transportation. Schwan et al. (1984) did not survey Kake sportfishermen, but the effort is primarily marine and occurs mostly in Frederick Sound and Keku Straits (Jones 1986).

Q. Ketchikan/Ward Cove/Metlakatla

Ketchikan is located on the southwestern end of Revillagigedo Island along the Inside Passage. It has ferry service and daily jet service and a small boat harbor. A road system extends north along the shore of Clover Pass and south around Race Point and up the west shore of George Inlet, connecting both Ward Cove and

Saxman to Ketchikan. Metlakatla, located across Nichols Passage on Annette Island, is accessible only by air (floatplane, from Ketchikan) and water (local ferry). A road system connects Metlakatala to the south end of Annette Island, where a logging road network exists.

In 1966, some Ketchikan area residents hunted moose in GMUs 1 and 5 (table 31, part I). In 1984, they primarily hunted on the Unuk River, the closest moose population. Some hunters also traveled to the Yakutat and Malaspina Forelands areas and to Thomas Bay and the Stikine River (table 31, part I).

Based on 1984 permit responses, Ketchikan goat hunters hunted the mainland portions of GMS, 1A and 1B almost exclusively, comprising 43% of all hunters using the area and contributing 40% of all hunter-days (ADF&G 1985b).

The majority of sportfishing in the Ketchikan area is marine (80%), with 75-80% of day-use fishing occurring near town in the area between Clover Pass and Mountain Point. Approximately 50% of eastern Behm Canal is closed to salmon fishing year round, and 75% is closed from May 1 to August 15. Sportfishing occurs in the vicinity of three major fishing lodges in western Behm Canal. Saltwater shoreline fishing in Ketchikan is limited because of restricted public access; however, Mountain Point, Settlers Cove, and Herring Bay are popular angling sites. The Ward Lake drainage and White River are the only major freshwater fishing areas along the Ketchikan road system; however, access along the White River is currently closed by the land owner. Numerous angling opportunities exist at remote, off-road locations (Schwan et al. 1984). More specific sportfishing locations are described in Schwan et al. (1984).

R. Prince of Wales Island Communities

Prince of Wales Island is extensively roaded. Thorne Bay, Hollis, Klawock, Craig, and Hydaburg are connected by road; the northern and central portions of the island have extensive logging road networks. Point Baker, Point Protection, and Kasaan have no local roads, but Edna Bay is connected to a logging road system.

Prince of Wales Island communities are accessible by air and water. Ketchikan-based air taxi operators fly floatplanes to all communities and can land wheel planes at Klawock. Ferry service exists between Ketchikan and Hollis on the east side of the island. The island is separated from the mainland by the Inside Passage, and the southwest portion of the island is protected by numerous islands providing sheltered waterways. All communities are located in protected bays. Small boat access is thus extensive, however, many unprotected areas are accessible under all weather conditions only by larger boats. All towns have either small boat harbors or moorage facilities.

Deer, black bear, and wolves are the only big game animals present on the island. General information on the mode of access used to hunt black bear on Prince of Wales Island is discussed above in a general section.

Residents of Princes of Wales Island have to travel relatively long distances to hunt moose, which do not occur on the island or nearby mainland. In 1984, some Klawock, Craig, and Thorne Bay residents hunted the Unuk River population. A few Craig residents travelled to the Stikine River, and a few Edna Bay residents travelled to Thomas Bay (table 30, part I).

Based on 1984 permit responses, goat hunters from Prince of Wales Island were primarily residents of Craig and Klawock. They hunted the goat hunting area comprised of the mainland portions of GMS 1A and 1B, accounting for 4% of hunters and 3% of hunter-days in the area (ADF&G 1985b).

Prince of Wales Island residents make extensive use of intertidal resources, inlcuding abalone, chitons, seaweeds, clams, crabs, herring spawn on kelp, and a variety of other mollusks and crustaceans. Gathering activities occur at low (minus) tides from the shore or from a small skiff. Some individuals use snorkel or SCUBA gear. The mode of transportation required to reach favored harvest sites can be a skiff, fishing boat, car, or truck (Mills 1983). Specific locations for harvesting abalone are shown in Mills (1982b), for harvesting intertidal resources in resource mapping for the Southwest Prince of Wales Southeast Tidelands Area Plan (ADF&G 1985d). Other harvest areas are displayed in Coastal Zone Management planning documents for some Prince of Wales Island communities and in Ellanna and Sherrod (1986) for Klawock. Ellanna and Sherrod (ibid.) also provide a descriptions of the ways that resource harvest patterns of Klawock residents have been altered by timber harvest and roadbuilding activities near Klawock. Additionally, the Forest Service was conducting a subsistence use study for North Prince of Wales Island at the time this report was completed. A report should be available in fall, 1986, providing information on resource use patterns by residents of Edna Bay, Port Protection, and Point Baker (Meyers 1986).

Additional information on resource use is available in coastal zone planning documents for Craig (CH2M-Hill 1983b), Klawock (Walsh 1984), and Hydaburg (CH2M-Hill 1983a).

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