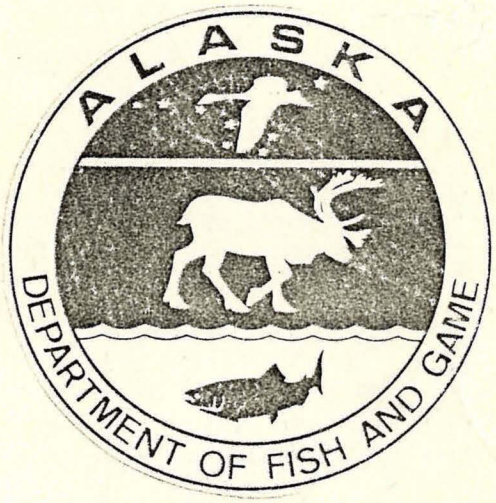
A SYNTHESIS AND EVALUATION OF ADF&G FISH AND WILDLIFE RESOURCES INFORMATION FOR THE WILLOW AND TALKEETNA SUB-BASINS



Prepared by the
Alaska Department of Fish and Game
Habitat Protection Section
for the
USDA - Soil Conservation Service
Interagency Cooperative Susitna River
Basin Study (Agreement # 58 04368 16)
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CONTRIBUTORS

Principal Contacts and Editors	Christopher Estes (Susitna River Basin Coordinator) Devony Lehner-Welch (Assistant Susitna River Basin Coordinator)
Willow-Talkeetna Sub-basins Wildlife Maps	Alice Stickney
Additional Map Information	Paul Arneson Jack Didrickson Sterling Eide Richard Sellers Dan Timm
Introduction	Devony Lehner-Welch
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Chapter 3 - Management Recommendations and Guidelines	
Narration	Devony Lehner-Welch
ADF&G-ADNR Backlog Products	Richard Cannon Loren Croxten Nancy Hemming Thomas Trent
Preliminary Access Policies	Richard Logan

Chapter 4 - Summary: Related Studies, Programs, and Data Needs

Narration	Devony Lehner-Welch Christopher Estes

Appendixes

Appendix A	Kristin Hock
Additional Information:	Bruce Barrett David Burbank David Daisy Jack Didrickson Christopher Estes James Faro Larry Heckart Stan Kubik Robert Lebida Karl Schneider Lance Trasky
Appendix B	Christopher Estes
Appendix C	ADF&G 1975
Appendix D	Kristin Hock Andrew Hoffmann
Appendix E	Andrew Hoffmann
Appendix F	Alice Stickney

INTRODUCTION

The following report and the supplemental information sources cited represent the ADF&G's current contributions to the Susitna River Basin Cooperative Study coordinated by the U.S. Department of Agriculture - Soil Conservation Service. Cooperative River Basin Studies, such as the Susitna Study, provide valuable tools to land-use planners and managers. In particular, these studies:

1) provide inventories of existing river basin resources and conditions;
2) identify general land-use suitabilities, concerns, and conflicts; and
3) suggest alternative plans for resource management and development.

Valuable as River Basin studies can be, however, they have two limitations which must be recognized if study products are to be utilized appropriately. To begin with, the applicability of River Basin studies depends upon the scale and resolution of collected data. In the Susitna River Basin Study, for example, all resource inventories with the exception of soil surveys are presented at a scale of 1:63,360 or smaller. These scales provide the resolution or detail necessary for most resource assessments or general land-use plans. However, site-specific plan developments may require scales of 1:25,000 or larger. In general, the data presented in the Susitna River Basin study are most appropriately used to identify areas for which certain land uses appear suitable,

pending further and more detailed studies, and areas for which certain land uses are clearly unsuitable (e.g., flood plains are clearly unsuitable for many activities). Once general suitabilities are identified, areas requiring further study (e.g., areas suitable for a variety of potential uses) can be distinguished, and detailed studies can be planned.

The second limitation which must be recognized is that resource inventory data cannot substitute for continuing direct and timely consultations with appropriate resource management agencies (e.g., State agencies such as the Alaska Departments of Fish and Game, Environmental Conservation, Natural Resources, etc., and appropriate Federal agencies such as the U.S. Fish and Wildlife Service, Soil Conservation Service, etc.). Once areas potentially suitable for particular uses have been distinguished and it is determined that further investigations are required, appropriate resource agencies can provide valuable advice on study methodologies and assist with the collection of data. After detailed studies are completed, continuing consultation with appropriate agencies during development of land-use plans can ensure that selected land-uses and projects are implemented with minimal degradation to other area resources (e.g., fish and wildlife, water quality, recreational opportunities and utilization, etc.). Timely involvement of appropriate resource agencies during all phases of land-use planning, project design, and implementation can obviate the need for costly environmental mitigation activities later on, and thus benefits project developers, the public, and the resource base.

In order to facilitate timely and cost-effective integration of fish and wildlife concerns into resource development projects, the ADF&G is developing "best management practices." Many of these practices can be readily and inexpensively incorporated into the designs of projects such as subdivisions, agricultural development, mining activities, road construction, etc. Development of best management practices increases the efficiency and effectiveness of Departmental input into project designs.

General resource inventories such as the Susitna River Basin Study, in concert with detailed site-specific studies and consultations with appropriate agencies, provide land planners, managers, and developers with powerful tools which can contribute to the wise use of Alaska's lands and resources. It is hoped that these tools will be fully and appropriately used in making land-use decisions. The land-use decisions made now will profoundly affect the quality of life in Alaska for generations to come.

BACKGROUND

Alaska is a relatively new and undeveloped state. As a result, Alaskans are offered a unique opportunity to apply foresight and experience to resource planning. In particular, Alaskans are fortunate to have an opportunity to conduct comprehensive resource inventories of a relatively undisturbed environment, and to apply the experiences of the Lower 48 states, before committing themselves to particular courses of resource and land-use development. Recognizing this opportunity, the Alaska Department of Natural Resouces (ADNR) in February 1976 requested the U.S. Department of Agriculture-Soil Conservation Service (SCS) to provide assistance in developing basic water- and land-use planning information for Alaska. As a result, the SCS and the ADNR undertook a coordinated resource planning effort under the Cooperative River Basin Studies Program (Public Law 83-566, Sec. 6). The goals for conducting this study program in Alaska are fourfold:

1) to refine and supplement existing resource information in Alaska by collecting and analyzing new field data;
2) to analyze and evaluate potential alternative uses of Alaska's resources;
3) to provide guidelines for the resolution of conflicting resource uses; and
4) to identify and coordinate all present and planned research in studied river basins.

These products and processes are necessary for wise State and local land and water resource planning.

The State, through the ADNR and the SCS, selected the Susitna River Basin as the initial study area (Figure 1). The Susitna River Basin was given first priority for several reasons: 1) the population is growing rapidly due to increased pressure from Anchorage and the possibility of the State Capital relocation to Willow; 2) most of the land in the Susitna River Basin is under State (60%) or private (20%) ownership; and 3) the Susitna River Basin has a wealth of natural resources, including land and water resources capable of supporting a wide variety of uses.

Because of its large size (13 million acres), the Susitna River Basin was divided into four study units: the Willow (1.1 million acres), Talkeetna (4.9 million acres), Beluga (3.9 million acres), and Upper Susitna (3.1 million acres) Sub-basins (Figure 2). This first Cooperative River Basin Study considers only two of these sub-basins, the Willow and the Talkeetna (Figure 3). These two sub-basins were and continue to be under pressures for development. Identification of valuable sub-basin resources is essential in order to ensure that these resources are wisely managed to provide maximum and long-term benefits. The Beluga and Upper Susitna Sub-basins will be evaluated in future studies.

Fish and wildlife are recognized as among the most valuable resources in the Willow-Talkeetna Sub-basins. In particular, the many species present provide a variety of recreational, commercial, and subsistence

Figure 1. Location of the Susitna River Basin

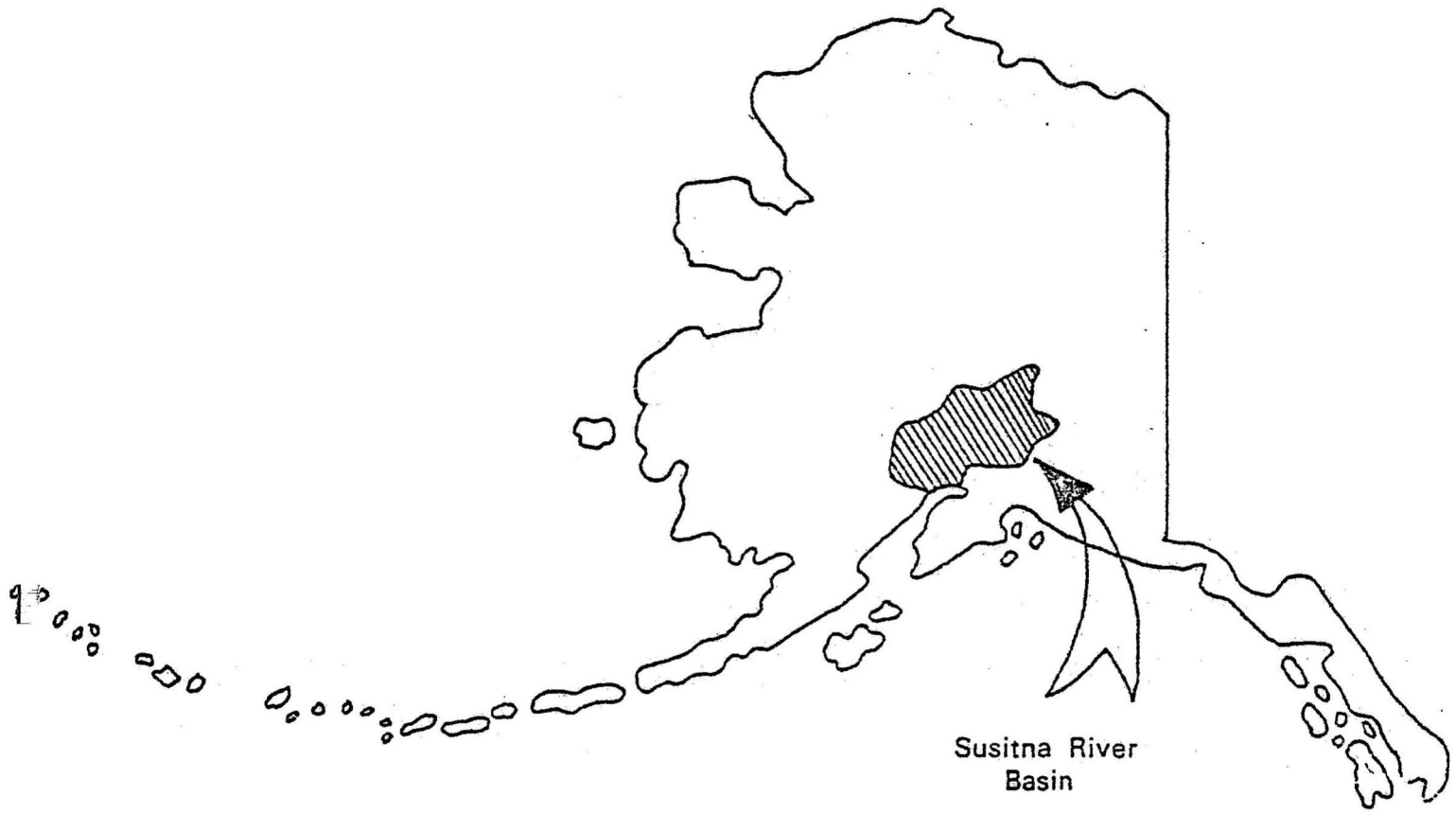
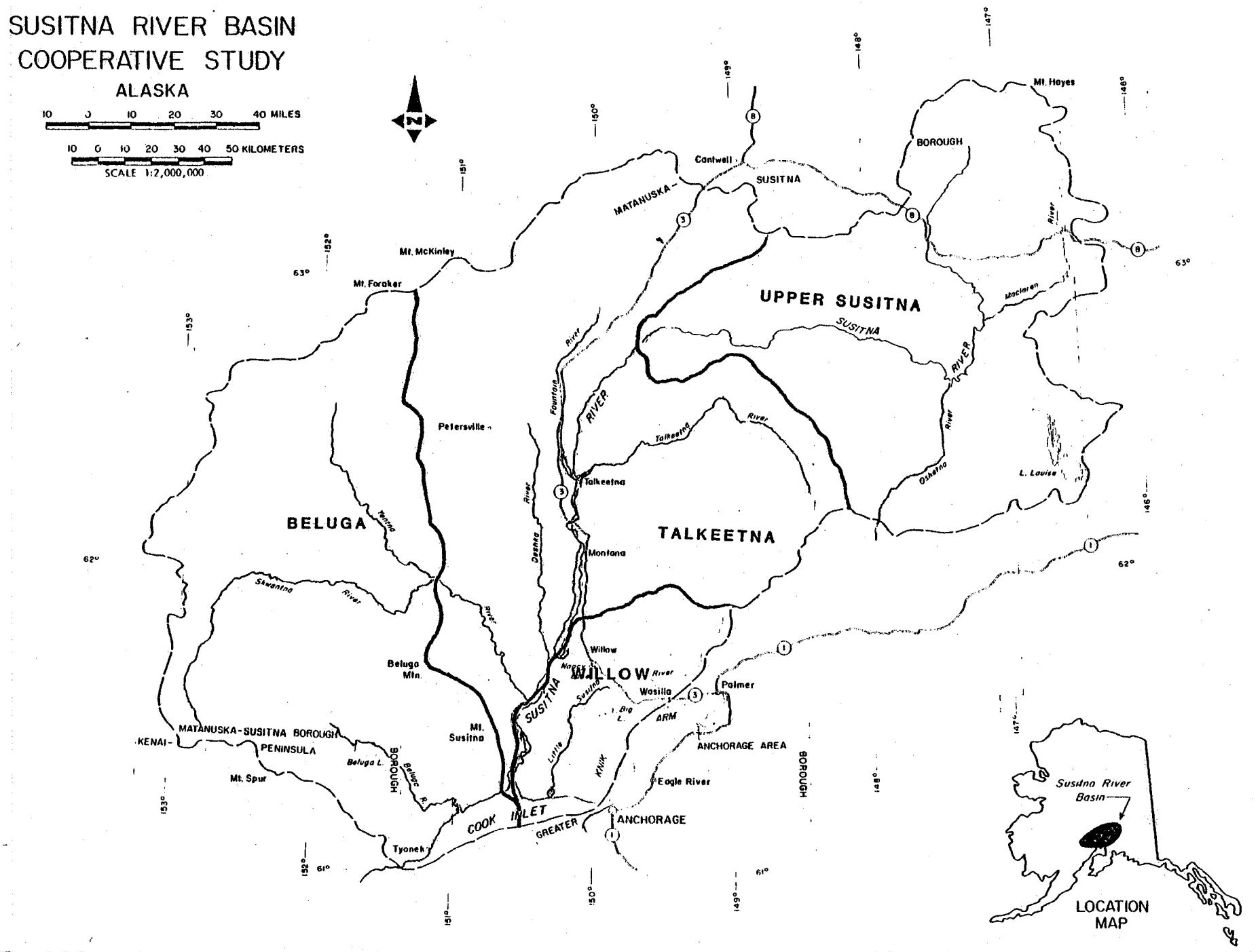
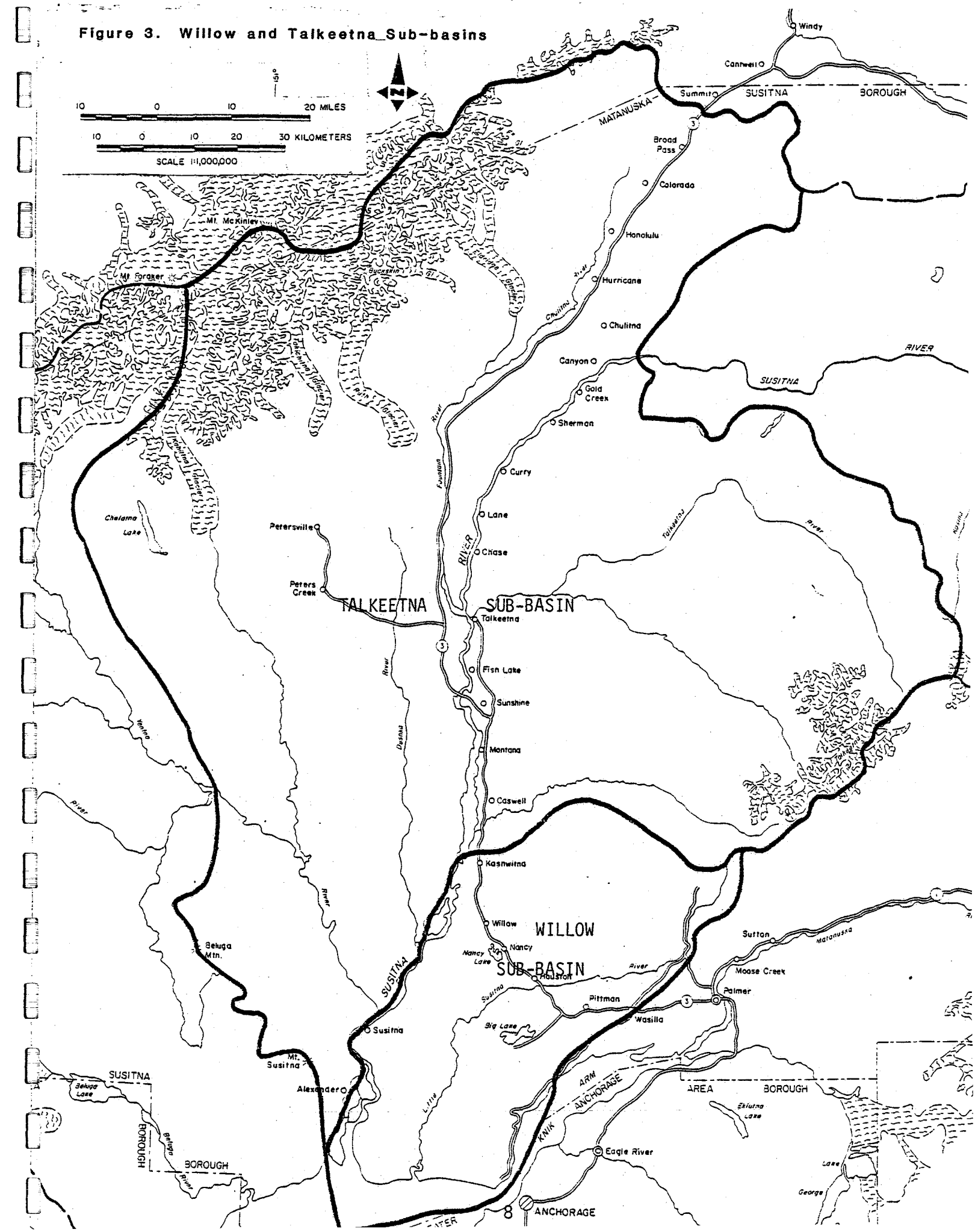


Figure 2. Susitna River Sub-basins



Source:
Base map compiled by SCS, WTSC Cartg. Unit from U.S. Department of Commerce Sectional Aeronautical Charts.

Figure 3. Willow and Talkeetna Sub-basins



opportunities. Waterfowl and gamebird species are numerous, and the Susitna Flats and Palmer Hay Flats are among the most popular waterfowling areas in Alaska (Timm 1978; Timm and Sellers 1979). Eight species of Alaskan big game (black bear, brown bear, wolf, wolverine, caribou, dall sheep, moose, and mountain goat) may be hunted in the Subbasin, as well as many species of furbearers and small game mammals. Mills (1979, 1980) indicated that approximately 100,000 angler-days (or nearly 10% of Statewide sport fishing efforts) are spent sport fishing for the five species of Pacific salmon (pink, chinook sockeye, coho, and chum) and other sport fish in the Willow and Talkeetna Sub-basins; yet they represent only 2% of the State's total land area.

As the agency with chief management responsibility for the maintenance and use of most of the State's fish and wildlife resources, the Alaska Department of Fish and Game (ADF&G) was invited to participate in the Sub-basins study in 1978. ADF&G contributions to a fish and wildlife resource inventory consisted of:

1) preparing a synthesis (represented by this document) of ADF&G information (from publications, files, and interviews of personnel) covering the fish and wildlife resources in the Willow-Talkeetna Sub-basins;

2) providing assistance to the U.S. Fish and Wildlife Service (USFWS) and the USDA in the selection of species to be studied in the Study area;

3) collecting and analyzing fish and wildlife resource and habitat data;

4) working with the USFWS and the USDA in developing land-use and management guidelines designed to protect and enhance fish, wildlife, and their associated habitats; and

5) providing assistance to the USFWS and the USDA in defining areas needing additional investigations.

Data compiled by the ADF&G as part of the resource inventory and evaluation program are presented in the following four chapters: 1) wildlife resources; 2) fisheries resources; 3) management recommendations and guidelines; and 4) summary: related studies, programs, and data needs.

Chapter 1. - WILDLIFE RESOURCES

1.1. Wildlife Resources in the Willow-Talkeetna Sub-basins

The Willow and Talkeetna Sub-basins encompass a large area and contain many diverse habitats*. Habitat types range from a river delta at the mouth of the Susitna River to glacial ice fields in the Alaska and Talkeetna Mountain Ranges.

Because of the area's natural diversity, a wide variety of wildlife species is present. These species provide numerous recreational, subsistence, and commercial opportunities to over half the State's human population (see Background section). Existing information on these species ranges from the most fundamental and generalized to localized and specific data on species managed by the ADF&G. (Thus, as a general rule, more is known about furbearers and game species than about non-game species.) It should be noted, however, that information on all species in the Willow-Talkeetna Sub-basins, even those studied in greatest detail, is still largely preliminary. Moreover, data on all species present in the area, including data on their interrelationships with other species and with their physical surroundings, are necessary for wise land-use and resource planning. Without these data on ecosystem structure and function, modifications to one component of an ecosystem may have unexpected and undesirable repercussions on other components.

*Several habitat categories (e.g., essential habitats, critical habitats, vital habitats, etc.) are recognized by the ADF&G. Definitions of habitat categories are presented in Appendix E.

Although thorough species field inventories have not been conducted in the Willow-Talkeetna Sub-basins, lists of those wildife species believed to be present have been assembled. Tables 1 and 2 list the mammalian and avian species, respectively, which are presumed to occur in the area.

Life history information for many of the species listed in Tables 1 and 2 is presented in Alaska's Wildlife and Habitat, volumes I and II (ADF&G 1973, 1978c*) and in the Catalog of Alaskan Seabird Colonies (USFWS 1978). These volumes, and recent studies conducted by the ADF&G on species within the Willow-Talkeetna Sub-basins, are briefly described in the annoted bibliography contained in Appendix A. Principal ADF&G contacts for additional species-specific data are listed in Appendix D.

The majority of the wildlife information compiled by the ADF&G during this study is of a geographic nature (i.e., species distributions, location of critical habitats), and has been drafted on mylar overlays. Mapping procedures and sources of mapped information are described in Section 1.2.

When referring to maps accompanying this narrative, it is recommended that special consideration be given to those areas which support threatened or endangered species (as described in the State and Federal Endangered Species Acts listed in Appendix B). For example, trumpeter swans (Olor buccinator), formerly considered a threatened species, are known to have

*Volumes I and II of Alaska's Wildlife and Habitat are available for use or purchase at the ADF&G office in Anchorage.

Table 1. Mammals of the Willow-Talkeetna Subbasins (Sources: ADF&G 1973, 1978c; MacDonald 1980; Manville and Young 1965, Youngman 1975)

INSECTIVORA (small insect-eating mammals)	
Masked Shrew	*Sorex cinereus*
Dusky Shrew	*Sorex monticolus*
Water Shrew	*Sorex palustris*
Pygmy Shrew	*Sorex hoyi*
CHIROPTERA (bats)	
Little Brown Bat	*Myotis lucifugus*
LAGOMORPHA (rabbits, hares, pika)	
Collared Pika	*Ochotona collaris*
Snowshoe Hare (varying hare)	*Lepus americanus*
RODENTIA (mammals with two chisel-shaped incisors in each jaw)	
Hoary Marmot	*Marmota caligata*
Arctic Ground Squirrel	*Spermophilus parryii*
Red Squirrel	*Tamiasciurus hudsonicus*
Northern Flying Squirrel	*Glaucomys sabrinus*
Beaver	*Castor canadensis*
Northern Red-backed Vole	*Clethrionomys rutilus*
Meadow Vole	*Microtus pennsylvanicus*
Tundra Vole	*Microtus oeconomus*
Singing Vole	*Microtus miurus*
Brown Lemming	*Lemmus sibiricus*
Muskrat	*Ondatra zibethicus*
Northern Bog Lemming	*Synaptomys borealis*
Meadow Jumping Mouse	*Zapus hudsonius*
Porcupine	*Erethizon dorsatum*
Norway Rat*	*Rattus norvegicus*
House Mouse*	*Mus musculus*
CETACEA (whales, dolphins, porpoises)	
Beluga (white whale)	*Delphinapterus leucas*
CARNIVORA (carnivorous mammals)	
Coyote	*Canis latrans*
Wolf	*Canis lupus*
Red Fox	*Vulpes vulpes*
Black Bear	*Ursus americanus*

*introduced

Table 1 continued -

Brown (grizzly) Bear	*Ursus arctos*
Marten	*Martes americana*
Ermine (short-tailed weasel)	*Mustela erminea*
Least Weasel	*Mustela nivalis*
Mink	*Mustela vison*
Wolverine	*Gulo gulo*
River (Land) Otter	*Lutra canadensis*
Lynx	*Felis lynx*
Harbor Seal	*Phoca vitulina*

ARTIODACTYLA (even-toed hoofed mammals)

Moose	*Alces alces*
Caribou	*Rangifer tarandus*
Mountain Goat	*Oreamnos americanus*
Dall Sheep	*Ovis dalli*

Table 2. Birds of the Willow-Talkeetna Subbasin (Sources: Anchorage Audubon Society, Inc. 1978; Murie 1963)

Common Loon	Gavia immer
Arctic Loon	Gavia arctica
Red-throated Loon	Gavia stellata
Red-necked Grebe	Podiceps grisegena
Horned Grebe	Podiceps auritus
Great Blue Heron	Ardea herodias
Whistling Swan	Olor columbianus
Trumpeter Swan	Olor buccinator
Canada Goose	Branta canadensis
Brant	Branta bernicla
White-fronted Goose*	Anser albifrons
Snow Goose	Chen caerulescens
Mallard	Anas platyrhynchos
Gadwall	Anas strepera
Pintail	Anas acuta
Green-winged Teal	Anas crecca
Blue-winged Teal	Anas discors
Northern Shoveler	Anas clypeata
European Wigeon	Anas penelope
American Wigeon	Anas americana
Canvasback	Aythya valisineria
Redhead	Aythya americana
Ring-necked Duck	Aythya collaris
Greater Scaup	Aythya marila
Lesser Scaup	Aythya affinis
Common Goldeneye	Bucephala clangula
Barrow's Goldeneye	Bucephala islandica
Bufflehead	Bucephala albeola
Oldsquaw	Clangula hyemalis
Harlequin Duck	Histrionicus histrionicus
Common Eider	Somateria mollissima
White-winged Scoter	Melanitta deglandi
Surf Scoter	Melanitta perspicillata
Black Scoter	Melanitta nigra
Common Merganser	Mergus merganser
Red-breasted Merganser	Mergus serrator
Goshawk	Accipiter gentilis
Sharp-shinned Hawk	Accipiter striatus
Red-tailed Hawk	Buteo jamaicensis
Swainson's Hawk	Buteo swainsoni
Rough-legged Hawk	Buteo lagopus
Golden Eagle	Aquila chrysaetos
Bald Eagle	Haliaeetus leucocephalus
Marsh Hawk	Circus cyaneus
Osprey	Pandion haliaetus
Gyrfalcon	Falco rusticolus
Peregrine Falcon	Falco peregrinus

*The Tule White-fronted Goose, a subspecies of the White-fronted Goose, may be nominated for inclusion on the endangered species list in the future (Cannon 1980)

Table 2 continued -

Merlin	*Falco columbarius*
American Kestrel	*Falco sparverius*
Willow Ptarmigan	*Lagopus lagopus*
Rock Ptarmigan	*Lagopus mutus*
Spruce Grouse	*Canachites canadensis*
Ruffed Grouse	*Bonasa umbellus*
Sandhill Crane	*Grus canadensis*
Semipalmated Plover	*Charadrius semipalmatus*
Killdeer	*Charadrius vociferus*
American Golden Plover	*Pluvialis dominica*
Black-bellied Plover	*Pluvialis squatarola*
Hudsonian Godwit	*Limosa haemastica*
Whimbrel	*Numenius phaeopus*
Greater Yellowlegs	*Tringa melanoleuca*
Lesser Yellowlegs	*Tringa flavipes*
Solitary Sandpiper	*Tringa solitaria*
Spotted Sandpiper	*Actitis macularia*
Wandering Tattler	*Heteroscelus incanus*
Ruddy Turnstone	*Arenaria interpres*
Northern Phalarope	*Phalaropus lobatus*
Common Snipe	*Gallinago gallinago*
Short-billed Dowitcher	*Limnodromus griseus*
Long-Billed Dowitcher	*Limnodromus scolopaceus*
Surfbird	*Aphriza virgata*
Sanderling	*Calidris alba*
Semipalmated Sandpiper	*Calidris pusilla*
Western Sandpiper	*Calidris mauri*
Least Sandpiper	*Calidris minutilla*
Baird's Sandpiper	*Calidris bairdii*
Pectoral Sandpiper	*Calidris melanotos*
Dunlin	*Calidris alpina*
Parasitic Jaeger	*Stercorarius parasiticus*
Long-tailed Jaeger	*Stercorarius longicaudus*
Glaucous Gull	*Larus hyperboreus*
Herring Gull	*Larus argentatus*
Mew Gull	*Larus canus*
Franklin's Gull	*Larus pipixcan*
Bonaparte's Gull	*Larus philadelphia*
Arctic Tern	*Sterna paradisaea*
Great Horned Owl	*Bubo virginianus*
Snowy Owl	*Nyctea scandiaca*
Hawk Owl	*Surnia ulula*
Great Gray Owl	*Strix nebulosa*
Short-eared Owl	*Asio flammeus*
Boreal Owl	*Aegolius funereus*
Rufous Hummingbird	*Selasphorus rufus*
Belted Kingfisher	*Megaceryle alcyon*
Common Flicker	*Colaptes auratus*
Hairy Woodpecker	*Picoides villosus*
Downy Woodpecker	*Picoides pubescens*

Table 2 continued -

Black-backed Three-toed Woodpecker	Picoides arcticus
Northern Three-toed Woodpecker	Picoides tridactylus
Say's Phoebe	Sayornis saya
Alder Flycatcher	Empidonax alnorum
Western Wood Pewee	Contopus sordidulus
Olive-sided Flycatcher	Nuttallornis borealis
Horned Lark	Eremophila alpestris
Violet-green Swallow	Tachycineta thalassina
Tree Swallow	Iridoprocne bicolor
Bank Swallow	Riparia riparia
Gray Jay	Perisoreus canadensis
Steller's Jay	Cyanocitta stelleri
Black-billed Magpie	Pica pica
Common Raven	Corvus corax
Black-capped Chickadee	Parus atricapillus
Gray-headed Chickadee	Parus cinctus
Boreal Chickadee	Parus hudsonicus
Red-breasted nuthatch	Sitta canadensis
Brown Creeper	Certhia familiaris
Dipper	Cinclus mexicanus
Winter Wren	Troglodytes troglodytes
American Robin	Turdus migratorius
Varied Thrush	Ixoreus naevius
Hermit Thrush	Catharus guttatus
Swainson's Thrush	Catharus ustulatus
Gray-cheeked Thrush	Catharus minimus
Wheatear	Oenanthe oenanthe
Townsend's Solitaire	Myadestes townsendi
Golden-crowned Kinglet	Regulus satrapa
Ruby-crowned Kinglet	Regulus calendula
Water Pipit	Anthus spinoletta
Bohemian Waxwing	Bombycilla garrulus
Northern Shrike	Lanius excubitor
Starling	Sturnus vulgaris
Orange-crowned Warbler	Vermivora celata
Yellow Warbler	Dendroica petechia
Yellow-rumped Warbler	Dendroica coronata
Townsend's Warbler	Dendroica townsendi
Blackpoll Warbler	Dendroica striata
Northern Waterthrush	Seiurus noveboracensis
Wilson's Warbler	Wilsonia pusilla
Red-winged Blackbird	Agelaius phoeniceus
Rusty Blackbird	Euphagus carolinus
Pine Grosbeak	Pinicola enucleator
Gray-crowned Rosy Finch	Leucosticte tephrocotis
Hoary Redpoll	Carduelis hornemanni
Common Redpoll	Carduelis flammea
Pine Siskin	Carduelis pinus
Red Crossbill	Loxia curvirostra
White-winged Crossbill	Loxia leucoptera

Table 2 continued -

Savannah Sparrow	*Passerculus sandwichensis*
Dark-eyed Junco	*Junco hyemalis*
Tree Sparrow	*Spizella arborea*
White-crowned Sparrow	*Zonotrichia leucophrys*
Golden-crowned Sparrow	*Zonotrichia atricapilla*
Fox Sparrow	*Passerella iliaca*
Lincoln's Sparrow	*Melospiza lincolnii*
Lapland Longspur	*Calcarius lapponicus*
Snow Bunting	*Plectrophenax nivalis*

nesting sites within the Willow and Talkeetna Sub-basins (Timm 1978). The Sub-basins are therefore important to the perpetuation of this species. A subspecies of peregrine falcon (Falco peregrinus anatum), now found on the endangered species list, may utilize the area (Amaral 1980). The Tule white-fronted goose (Anser albifrons) may occur in the Sub-basins and may be nominated for inclusion on the endangered species list in the future (Cannon 1980). Other wildlife species, such as the wolf, brown bear, and bald eagle, although not considered threatened in Alaska are endangered if not eliminated in much of the contiguous United States. Alaskan populations of these species are therefore of National as well as State interest. If the habitat needs of these and other fish and wildlife species are considered and met to the fullest possible extent during land-use planning and implementation of plans, the fish and wildlife resources of the area can continue to provide valuable recreational, commercial, subsistence, scientific, and other benefits to the State and the Nation. (See Chapter 3, "Management Recommendations and Guidelines".)

1.2. Wildlife Maps: Information Sources and Data Limitations*

Map overlays prepared by the ADF&G for the Cooperative River Basin Study were designed to portray a compilation of all currently available ADF&G information on: 1) probable distributions and known ranges of particular wildlife species, and 2) location of known essential wildlife use areas (habitat usage areas), such as winter ranges, calving grounds,

*Wildlife maps of the Willow-Talkeetna subbasins may be viewed at the Anchorage office of the ADF&G. Contact the Susitna River Basin Coordinator.

denning areas, etc. (See Chapter 3, "Management Recommendations and Guidelines" for a description of essential wildlife use areas).

Wildlife information compiled by the ADF&G is displayed on mylar overlays conforming to 53 U.S. Geological Survey topographic quadrangle maps (scale 1:63,360) covering the Willow and Talkeetna Sub-basins. Each of these 53 topographic base maps is accompanied by two mylar sheets (in three cases a third overlay was necessary to portray all available information). One mylar sheet portrays species distributions, ranges, and habitat usage areas obtained from volumes I and II of Alaska's Wildlife and Habitat (ADF&G 1973, 1978c) and from maps previously compiled by the ADF&G for the ADNR backlog land classification program*. The second sheet presents additional information obtained from these sources, and in some cases, information obtained from the Catalog of Alaskan Seabird Colonies (USFWS 1978) and ADF&G biologists familiar with the particular area.

Five ADF&G Game biologists were contacted to supplement the information obtained from literature sources: Paul Arneson, Dick Sellers, and Dan Timm (Anchorage), Jack Didrickson (Palmer), and Sterling Eide (Glennallen). The Anchorage biologists provided additional seabird and waterfowl data, particularly on known trumpeter swan nesting areas. Jack Didrickson identified areas of moose concentrations, especially as indicated by areas of frequent road kills. Sterling Eide identified known caribou calving grounds in Game Management Unit 13.

*The backlog maps prepared by the ADF&G delineated section boundaries of State interest lands which the ADF&G recommended be retained in State ownership. These section lines appear in brown on the wildlife maps compiled for this study.

As noted above, the wildlife distributions and use areas displayed on accompanying maps were identified from literature sources and the professional experiences of ADF&G area biologists. Three points concerning the information portrayed on these maps should be emphasized here:

1) Much of the wildlife information currently available is general and preliminary. In particular most non-game species have received little if any study, and important information is lacking on many game species. As a result, many identified wildlife distributions, ranges, and habitat usages are based on distributions of apparently suitable habitats rather than on direct observations of wildlife movements and activities. This conservative approach, in which wildlife species are assumed to occur in all plausible habitats, is necessary when so many data are still unavailable. Because of the rapid pace at which the habitat may be altered in this area, it is very important to obtain reliable field data on wildlife habitat requirements and distributions as soon as possible. Without field-verified data, habitats supporting high densities of particular species may be rendered unsuitable by developments, while similar but less-productive habitats may be overly protected on the mistaken assumption that they are supporting comparably high wildlife concentrations.

2) Habitat data (e.g., distributions of plant communities, physical conditions, recent disturbances, etc.) and data on specific habitat requirements of various animal populations are preliminary in much of the two Sub-basins. In areas where existing habitat characteristics and species-specific habitat requirements have not been adequately defined, it is not possible to use habitat distributions to map associated wildlife distributions. As a result, the occurrence of particular wildlife species in some areas of the Sub-basins may not have been identified.

3) Many wildlife species were not included during the mapping process because information on their geographic distributions and ranges in the study areas was not available from any of the references utilized. Only those species listed in the map legend (Appendix F) were mapped. In most cases, these are furbearers, game species, or species with other kinds of significance to man. Non-game species warrant future investigation. Such species (e.g., small rodents, insectivores, etc.) play important roles in the Willow and Talkeetna Sub-basin ecosystems. In particular, these species are often important prey for larger avian and mammalian predators, and serve other essential functions in the structure and energetics (food webs) of their biological communities.

General types of data which would be useful for much of the Willow and Talkeetna Sub-basins are outlined in Chapter 4, "Summary: Related Studies, Programs, and Data Needs."

Chapter 2. - FISHERIES RESOURCES

2.1. Information Sources and Data Limitations

The quantity and quality of information which is currently available on the fisheries resources within the Willow-Talkeetna Sub-basins varies widely from area to area; however, four sources of information provide most of the data available on Sub-basin fisheries: 1) Alaska's Fisheries Atlas Volumes I and II (ADF&G 1978a, ADF&G 1978b), 2) Catalog of Waters Important for the Spawning and Migration of Anadromous Fishes (ADF&G 1975), 3) Map overlays entitled: "Streams with Priority Flow Maintenance Requirements for Fish and Wildlife Values" (ADF&G 1978e), and 4) special studies conducted by the ADF&G.

Each of these information sources is described below. However, it is important to remember that much of the information presented in these sources is limited to baseline data. In particular, information on Sub-basin streams is characterized by extensive data gaps and by variability in the detail of different data. Some streams or stream segments, for example, have been studied for many years, while others have not yet been studied, or have only been studied to achieve specific management objectives (e.g., harvest determinations) and thus do not yield historical habitat* and life history data.

In general, data collection in the Sub-basins has been concentrated on streams which have experienced relatively greater amounts of human use

*Refer to Appendix E for ADF&G habitat definitions.

or are in close proximity to planned developments (e.g., streams near the proposed State Capital relocation site). In other words, the choice of streams to be studied in the Sub-basins has often been motivated by their relative importance to humans (e.g., because of accessibility, location, traditional use, etc.). As a result, streams supporting valuable or extensive fisheries habitats may not be adequately identified in the references described below. Moreover, it must be remembered that even streams considered small or economically unimportant by some human standards may contribute in important ways to the integrated ecosystems which provide the aquatic and riparian habitats essential for fish and wildlife. In particular, the contributions of a single or several small streams may collectively be substantial, and even slight alterations to these systems may lead to significant impacts on the fisheries resources, particularly when one "minor" alteration after another degrades one small stream after another. It is, therefore, recommended that the following information be continually updated as new data are collected.

2.1.1. Alaska's Fisheries Atlas, Volumes I and II (ADF&G 1978a, 1978b)*

These two large-format volumes represent compilations of available information on 35 important species of anadromous and freshwater fishes in Alaska. Much of the information synthesized in these volumes formerly existed only in ADF&G files or as the professional experiences of ADF&G

*These atlases are available for use or purchase at the ADF&G office in Anchorage.

biologists. Information compiled was also obtained from other State and Federal agencies, from guides and outfitters familiar with particular areas, and from informed members of the public.

Each volume contains fish life history accounts, descriptions of regulatory areas, and maps showing fish species distributions. Volume I covers 18 of the most socioeconomically important anadromous fish and shellfish species in Alaska, while Volume II covers 17 additional socioeconomically important species of freshwater fishes. Within the Willow-Talkeetna Sub-basins, 11 of the 35 speices are represented; 5 species of salmon from Volume I:

chinook salmon	Oncorhynchus tshawytscha
sockeye salmon	Oncorhynchus nerka
coho salmon	Oncorhynchus kisutch
pink salmon	Oncorhynchus gorbuscha
chum salmon	Oncorhynchus keta

and 6 freshwater species from Volume II:

rainbow trout	Salmo gairdneri
Dolly Varden	Salvelinus malma
lake trout	Salvelinus namaycush
Arctic grayling	Thymallus arcticus
round whitefish	Prosopium cylindraceum
burbot	Lota lota

A complete list of freshwater fishes (Morrow 1980) presumed to occur in the Sub-basins is presented in Table 3.

Table 3. Freshwater Fishes of the Willow-Talkeetna Sub-basins (Source: Morrow 1980)

Lampreys	
Pacific lamprey	*Entosphenus tridentatus*
Arctic lamprey	*Lampetra japonica*
Herring	
Pacific herring	*Clupea harengus pallasi*
Whitefish	
Round whitefish	*Prosopium cylindraceum*
Lake whitefish*	*Coregonus clupeaformis*
Trouts and Salmon	
Rainbow trout/steelhead	*Salmo gairdneri*
Lake trout	*Salvelinus namaycush*
Dolly Varden	*Salvelinus malma*
Pink (Humpback) salmon	*Oncorhynchus gorbuscha*
Chinook (King) salmon	*Oncorhynchus tshawytscha*
Chum (Dog) salmon	*Oncorhynchus keta*
Coho (Silver) salmon	*Oncorhynchus kisutch*
Sockeye (Red) salmon	*Oncorhynchus nerka*
Grayling	
Arctic grayling	*Thymallus arcticus*
Smelts	
Pond smelt	*Hypomesus olidus*
Surf smelt	*Hypomesus pretiosus*
Eulachon (Hooligan)	*Thaleichthys pacificus*
Pike	
Northern pike	*Esox lucius*
Sucker	
Longnose sucker	*Catostomus catostomus*
Codfishes	
Burbot	*Lota lota*

*Trent 1980

Table 3. (continued)

Sticklebacks	
Threespine stickleback	*Gasterosteus aculeatus*
Ninespine stickleback	*Pungitius pungitius*
Sculpins	
Slimy sculpin	*Cottus cognatus*
Coastrange sculpin	*Cottus aleuticus*
Pacific staghorn sculpin	*Leptocottus armatus*
Sharpnose sculpin	*Clinocottus acuticeps*
Flounder	
Starry flounder	*Platichthys stellatus*

2.1.2. Catalog of Waters Important for the Spawning and Migration of Anadromous Fishes*

In the late 1960's, the Alaska Legislature embodied in law its intent to protect anadromous fish habitat by passing the "Anadromous Fish Act" (Alaska Statute 16.05.870). Anadromous species afforded protection under the Act included five species of Pacific salmon, Dolly Varden, rainbow trout, Arctic char, sheefish, whitefish, eulachon, and any other anadromous species known by the ADF&G to be using particular lakes or streams. "These species make up the greatest part of the commercial, sport, and subsistence fisheries of Alaska" (ADF&G 1975).

Although it is recognized that virtually all coastal waters in Alaska provide habitat for the spawning, incubation, rearing, overwintering, or passage of anadromous fishes, the Anadromous Fish Act directed that the ADF&G "specify the various rivers, lakes, and streams or parts of them that are important for the spawning or migration of anadromous fishes." The resultant list could then be used by the ADF&G during permit procedures to ensure that important anadromous fish habitats were not degraded by individuals, organizations, industries, or governmental agencies wishing to undertake an activity which might modify existing water quality or flows at a specific site or downstream.

The first set of three catalogs (each covering one or two regions of Alaska) was published in 1968. A revised set, amended in May 1974, was

*Copies of the Catalogs of Waters Important for the Spawning and Migration of Anadromous Fishes are available from the Anchorage and Juneau offices of the ADF&G.

published in March 1975. In the revised edition, anadromous waters not identified for the first catalogs, or which had become productive through rehabilitation and enhancement projects since original publication, were included; while waters listed in the first catalogs which were no longer supporting anadromous species were deleted. The 1980 State Legislature enacted the Instream Flow Bill, HB-118, which included a financial appropriation for the ADF&G to establish procedures and a program to update the Catalogs on a continuous basis. This process was initiated in the Fall of 1980.*

Table 1 in Appendix C presents those streams identified in the 1975 catalog as important for spawning and migration of anadromous fishes in the Willow-Talkeetna Sub-basins. (The Willow-Talkeetna Sub-basins are within Region II.) Within this area (Figure 3) 53 quadrangles contain over 200 streams identified as important for anadromous fishes. (For an explanation of how streams are identified within the Catalog, see Appendix C).

*It is is important to remember that the present Catalog of Waters Important for the Spawning and Migration of Anadromous Fishes has not been revised since 1974. Furthermore, many streams in the Willow-Talkeetna Sub-basins have as yet received only very perfunctory study. As a result, additions to and deletions from the list presented in Appendix C-Table 1 are inevitable as new information is incorporated into the Catalog. Considering the limitations of existing data, it is wise to assume any stream may provide valuable anadromous fish habitat until there is evidence to the contrary. A conservative approach is further warranted because the cumulative habitat contributions of many small streams may be very important although the habitat provided by each seems insignificant.

2.1.3. Map overlays entitled "Streams with Priority Flow Maintenance Requirements for Fish and Wildlife Values" (ADF&G 1978e)*

Streams believed to provide particularly important or extensive habitats for anadromous species were identified, classified, and mapped on mylar overlays (corresponding to USGS 1:250,000 topographic maps) by the ADF&G as part of the Department's contribution to the Southcentral Alaska Water Resources Study (Level B). These maps essentially represent an application and extension of information compiled in Volume I of Alaska's Fisheries Atlas; additional information (e.g., escapement) was obtained from ADF&G files and biologists, knowledgeable guides and outfitters, and the USFWS.

Two classifications were used in rating streams with priority flow maintenance requirements: 1) "priority" classification was assigned to any stream system with an anadromous fish population; 2) "high priority" classification was assigned to any stream system with an escapement of more than 1,000 fish. In addition, "high priority" classification was applied to stream systems which were the major fish producers in a particular area, regardless of their escapements. "High priority" designation for streams with low escapements (i.e., less than 1,000) was based on the need to protect species such as coho and chinook salmon which generally occur in small spawning populations. The importance of preserving suitable habitat for all stages of a fish's life cycle was also considered during the classification of stream systems.

*These maps are available for use at the ADF&G, Anchorage (contact Region II Habitat Protection Supervisor), or at the ADNR, Anchorage (contact Chief, Land and Water Management).

Stream systems were generally considered single integrated units during the assignment of classifications and, therefore, an entire stream system (watershed) was usually designated "priority" or "high priority". Tributaries to major systems were identified by a separate classification if warranted. For example, a "priority" tributary might be identified flowing into a "high priority" stream. It is important to remember, however, that stream systems do function as integrated units; and that modifications of tributaries (e.g., changes in water quality or flow) will in turn affect conditions in the receiving waters.

Maintenance of the important fish populations occurring in "priority" and "high priority" streams is largely dependent upon the continued availability of seasonal instream flows. Disruption of seasonal flow regimes can imperil fish and wildlife populations by altering the physio-chemical and biological characteristics of required aquatic and riparian habitats. Because of the importance of instream flows to fish and wildlife resources, a discussion of the physical and biological effects of instream flows is presented at the end of this chapter.

2.1.4. Special Studies conducted by the ADF&G

The protection, enhancement, and management of fisheries resources during land-use planning and development depend upon an understanding of the life history phases (e.g., spawning, incubation, rearing, and passage) of fish species, the habitat conditions required during each of these phases, and the needs and desires of the human users of the resources. This information, in concert with environmental data on stream morphology,

substrate characteristics, seasonal discharges, riparian vegetation, aquatic invertebrates, etc., allows planners to identify potential impacts to fisheries of particular land- and water-use decisions, and to determine how negative impacts on existing fisheries resources and human uses can best be mitigated.

General information on fish species' life histories and distributions, such as that presented in Alaska's Fisheries Atlas, provides valuable background data; however, sound site-specific planning decisions which may affect fisheries resources require more stream-specific data.

Stream-specific data are valuable to resource planners and developers because over time, fish populations have adapted to the natural seasonal habitat fluctuations in the particular streams they inhabit. As a result, streamflow alterations may affect different streams and their associated fish populations in different ways. For example, the effects produced by withdrawing a particular volume of flow at a particular time may vary from stream to stream depending on the source of instream flow. Some streams are fed primarily by precipitation (e.g., as rain, snow, etc.), others by glaciers, and still others by groundwater inflow or various combinations of sources. Maximum seasonal flows in precipitation-fed streams are likely to occur earlier in the year than peak flows in glacier-fed streams; while streams fed predominantly by groundwater inflow are likely to show more moderate seasonal changes in discharge. These seasonal variations in flow in turn affect the timing of fish activities, the seasonal availability, quality, and areal extent of

required fisheries habitats, and thus, the impacts likely to accompany particular water withdrawals at particular times (see the following discussion, "Instream Flows" Section 2.2.).

Through natural selection processes, the fish populations within a stream have adapted to the seasonal conditions of that particular stream. Planners must be aware of the differences in conditions and fish populations among different streams in order to take them into consideration during land- and water-use decisions. In response to the need for more specific and localized data, the ADF&G has conducted numerous studies of specific streams and fish species. Major recent fisheries studies within the Willow-Talkeetna Subbasin are annotated in Appendix A. In addition, the SCS specifically provided assistance in funding three special investigations conducted by the ADF&G as part of this Cooperative Study. Two studies were conducted on the Little Susitna River, one in 1978 (Wadman and Delaney 1979) and one in 1979 (Delaney and Wadman 1980). The objectives of these investigations were three-fold:

1) assess existing fisheries resources in the Little Susitna River and determine the enhancement potential of these resources;

2) inventory the Little Susitna River in order to:

   a) identify and define areas used for spawning, rearing, and migration of chinook and coho salmon;

b) determine the seasonal distribution and migrational movements of coho and chinook salmon; and

3) determine habitat preferences of chinook and coho salmon at various life history phases, and relate these habitat preferences to physical habitat characteristics such as stream discharge velocity, substrate type, water depth, etc.

These reports have been submitted to the SCS and are available from the SCS and the Anchorage office of the ADF&G Sport Fish Division.

Willow and Deception Creeks were studied from June to November 1979 (Estes et. al. 1981) to:

1) determine habitat preferences (e.g., preferred discharge velocities, water depths, substrate types etc.) for the spawning and rearing phases of pink and chinook salmon; if possible, conduct similar studies on chum and coho salmon, although they occur in fewer numbers. (It was recognized that determining areas of preference for adult and rearing juvenile salmon might not be accomplished because of limited time, funding and personnel.)

2) establish stream profiles in selected areas of Willow and Deception Creeks to allow continued flow measurements throughout the season. (Utilizing periodic stream cross-sectional

measurements and flow measurements, the types and amounts of wetted aquatic habitat can be measured.)

3) correlate, if possible, the changes in aquatic habitat types and characteristics with actual fish occurrences and distributions. (The ultimate goal was to make this information available for more sophisticated treatment by computer models, and to determine the applicability of using the IFG-2 and 4 computer models for predicting effects of varying stream flows.)

The Willow-Deception Creeks Study will be forthcoming and will supplement this discussion and the recommendations presented in the following Section on Instream Flows (Section 2.2.). As noted above, other completed and ongoing studies providing specific information on the fisheries resources of the Willow and Talkeetna Sub-basins are identified in the annoted bibliography at the end of the report (Appendix A). Additional special studies on Sub-basin streams will be necessary as land- and water-use decisions affecting particular streams are required.

2.2. Instream Flows*

The survival of anadromous and resident fish species within the Willow and Talkeetna Sub-basins depends not only upon identifying and protecting

*This section will be supplemented by the Willow-Deception Creeks Study cited in Section 2.1.4.

streams important for spawning and migration and managing fish populations wisely, but also upon ensuring the availability of adequate seasonal water supplies within these streams. Seasonal water supplies, or instream flows, support habitats used for fish spawning, incubation, rearing, overwintering, and passage of fish. They also support the habitats of other aquatic and terrestrial resources. The ADF&G study of Willow and Deception Creeks cited above represents a first step in quantifying instream flows in the Willow and Talkeetna Sub-basins, as well as an attempt at integrating the flow data with data on fish life history phases and habitat requirements.

The following discussion is presented to provide land-use planners with an understanding of the significant impacts associated with alterations of instream flows, and to recommend basic guidelines for maintaining the instream flows required by fish and wildlife.

Although only lotic environments as they pertain to fish are discussed here, it is important to recognize that different aquatic ecosystems are intimately interrelated with one another and with other components of the hydrologic cycle such as groundwater and precipitation. Change in any component of the hydrologic cycle may affect other components directly and/or in subtle and complex ways. For example, groundwater withdrawals may lower lake and stream water levels; lake pollution may contaminate groundwater, which in turn may transport contamination to other water bodies; modifications of infiltration and runoff rates in a watershed (e.g., through clearing of vegetation) may affect groundwater recharge

and streamflow regimes. As a result of these and other extensive interactions, many complex and pervasive impacts can be produced by human alterations in water quantity and quality.

2.2.1. Instream Flow Effects

Historical records of seasonal instream flows in the Willow-Talkeetna Sub-basins are nonexistent or preliminary. In addition, data on instream flow requirements of specific stocks of Alaskan fishes are also preliminary. As a result, quantification of fisheries-related instream flow requirements on a stream-by-stream basis is not possible at this time. Nonetheless, careful management of instream flows is essential for preserving, maintaining, or enhancing freshwater and anadromous fisheries, other aquatic and riparian wildlife, and instream flow uses such as navigation. If instream-flow dependent resources are to be preserved, management decisions required in the Willow-Talkeetna Sub-basins in the near future must take into account seasonal fish and wildlife instream flow requirements, even if these requirements have not yet been specifically quantified.

Although fish and wildlife instream flow requirements are not yet quantified on a stream-by-stream basis, the profound physical and biological effects of instream flows, and the consequences resulting from seasonal flow modifications, can be indicated on a general level and are summarized below.

2.2.1.1. Physical Effects of Instream Flows

In lotic systems, a variety of physical parameters interact to create particular aquatic environments. The most important of these physical parameters are: flow regime (volume, velocity, and temporal variation of flows), channel morphology (size, shape, gradient, and geologic material of channel), water quality (temperature, turbidity, dissolved gases and salts, etc.), and stream load (bed and suspended loads, and watershed inputs in transport).

Because stream systems are continually working to establish equilibrium among these parameters, change in any one of these factors may initiate readjustments in others. For example, watershed alterations such as land clearing may increase erosion and consequently increase the amount of sediment entering a particular stream. The stream becomes overloaded, unable to transport all of the material entering the channel, and begins to deposit sediments. Over time, this deposition process leads to changes in channel slope and hence stream velocity. Eventually channel slope will increase until the velocity of streamflow produces just enough energy to transport the amount of material entering the stream, and an equilibrium will be achieved.

Analogous chains of events follow any alterations of instream flow (e.g., impoundments, diversions, channelizations, withdrawals, etc.). In each case, the altered stream will attempt to establish equilibrium conditions; and this dynamic process may lead to substantial changes in

flow regime, channel shape, wetted area, substrate characteristics, water quality, etc. Moreover, these changes may be felt considerable distances downstream from the original disturbance, and, after some disturbances such as channelizations and impoundments, stream readjustments may occur upstream (i.e., above culverts or reservoirs). (Impoundments may have further consequences. Reservoirs may, for example, reduce the stability of underlying and adjacent geologic materials by increasing hydrostatic pore pressure and lubricating bedding planes, joints, and fractures.)

It is important to remember that the complexity of the physical interactions outlined above is compounded by the fact that natural flows fluctuate with seasonal and climatic variations. As a result, impacts produced by alterations in lotic systems stem not only from the amount of modification (e.g., volume of flow withdrawal or alteration), but also from the timing of the modification in relationship to normal seasonal flow fluctuations. For example, certain periodic high flows (e.g., bankfull discharge) are responsible for maintaining channel morphology by flushing sediments, transporting bed load, etc. Poorly managed reduction, elimination, or rescheduling of these regular high flows (e.g., during flood control) can therefore have serious consequences on channel characteristics. On the other hand, during some high flows it is possible to determine a particular volume of water which may be withdrawn for human consumption, storage, industrial use, etc. with only minor readjustments of the lotic system. During low flows, withdrawals represent a larger proportion of available instream flow and are more difficult to manage without inducing changes in the lotic environ-

ment. The complexity of these possible interactions, and effects of modifying them, must be carefully examined on a seasonal case-by-case and cumulative basis.

As can be seen, alterations to instream flows may have effects on the physical environment. Physical conditions which affect habitats are essential components of the biological environment. As a result, changes in the physical environment inevitably impact associated organisms, such as fish and wildlife. Because maintaining biological resources depends so heavily on maintaining essential physical habitat conditions, potential changes in the physical environment should be carefully evaluated for their possible effects on biological resources.

2.2.1.2. Biological Effects of Instream Flows

The environments produced by the physical conditions and interactions within each stream system provide habitats for aquatic, riparian, and other organisms. As a result, any alteration in the physical environment affects the associated biotic environment. In this section, examples of the interrelationships of instream flows and the fisheries resources are presented. Although the emphasis here is on fisheries, it should be apparent that instream flows also affect other aquatic organisms and the riparian and terrestrial wildlife associated with the lotic environment. For example, instream flows influence the succession of riparian vegetation, access of predators to waterfowl nesting on islands, and the availability of food and cover for furbearers such as beaver, river otter, muskrat and others (Hinz 1977, Martin 1977).

There are four major physical components of a stream system which determine the productivity of fisheries and their associated food webs (Stalnaker 1979):

1) water quality (e.g., temperatures, dissolved solids, dissolved gases, etc.);

2) watershed inputs in the form of sediments, particulate organic matter and nutrients:

3) flow regime (e.g., volume, wetted perimeter, stage, velocity, and timing of flows): and

4) physical habitat structure (e.g., channel form, substrate characteristics, and riparian vegetation).

Each of these four components is intimately related to instream flows. For example, instream flows determine: the physical aquatic habitat structure (within the constraints of the geological and climatological environment); water quality (i.e., by dilution, aeration, etc.); and the pattern of erosion, transportation, and deposition occurring in aquatic and riparian habitats. Instream flows may therefore be considered one of the most essential determinants of fisheries productivity.

Because instream flows are essential to fisheries productivity, seasonal modifications of these flows will obviously have tremendous impacts on fisheries resources. In particular, modifications of streamflows will

produce a variety of changes in essential fish use areas such as spawning, incubation, rearing, overwintering, and passage habitats. For example, decreased flows may prevent upstream or downstream passage of fish, and may reduce the quality or areal extent of spawning and rearing habitats. Reduced flows may also lead to silt deposition and oxygen reduction in gravel redds, and may, therefore, cause suffocation of incubating eggs and pre-emergent fry as well as of other aquatic organisms. Increased flows may wash away spawning substrate or destroy sheltering areas. Both decreases and increases in flows may alter stream productivity and thus modify food availability in rearing and overwintering habitats.

In addition to modifying essential habitats, alterations in flow regimes may affect the seasonal behavior of fish species. Hynes (1970) presents the following examples of the important interrelationships among seasonal flow regimes, fish movements, and human alterations of the lotic environment:

> Most fish are stimulated to move by rising water, and when the movement is to be upstream this enables them to pass over riffles with greater safety, because the increased width at such points spreads out the discharge and provides zones of slower water which are nevertheless deep enough to swim through.
>
> Descending fish, such as smolts..., are also stimulated to move by rising water ... Under normal circumstances, descending fish readily overcome obstacles, and the cushioning of the water prevents damage at falls, or at any rate at falls which are small enough for them

or their parents to have ascended. But descending fishes follow the bottom contour, not the surface. This presents no problems in a natural stream, but where man has erected dams the habit leads them not over the fall, but to the bottom of the upper edge of the dam, where they tend to become held up.

The complex interrelationships between instream flows and seasonal behavior of fish species is compounded by the fact that seasonal variations in flows required by particular species may have to be quite large. For example, returning salmon species may need 30 - 50 percent of the mean annual flow to ascend the lower and middle reaches of a river system, and even more flow to ascend the headwaters (Hynes 1970). As a result, the preservation of fisheries resources requires not only that certain volumes of instream flow be maintained, but also that specific flows be available at particular times of the year. Tennant (1975) provides a valuable discussion of the "instantaneous flow" percentages of average annual streamflow required to maintain particular levels of aquatic resources, and suggests that stream degradation begins with the first reduction in flow, and not only after an arbitrary minimum flow figure has been reached. Orsborn and Estes (1981) discuss the limitations of and procedures for applying non-field methodologies such as the Montana Method to streams in Alaska and other states. Ott and Tarbox (1977) provide a general literature review of existing instream flow methodologies in their publication "Instream Flow" Applicability of Existing Methodologies for Alaskan Waters. In late 1980, the ADF&G,

under contract to the USFWS, will attempt to develop fish habitat suitability models analogous to terrestrial Habitat Evaluation Procedures (USFWS 1980) for seven species of fish: pink and chum salmon, Dolly Varden, Arctic grayling, round and lake whitefish, and three spine stickelback. All of these species are believed to occur in the Sub-basins.

2.2.2. Instream Flow Recommendations*

This section has attempted to indicate the effects of instream flows on physical environments and biological resources, especially fisheries. Protection of fisheries resources and other instream benefits in the Willow-Talkeetna Sub-basins requires that seasonal resource-maintenance flows be defined, established, and legally reserved.

The ADF&G recommends that decisions whether or not to permit alterations of natural instream flows for a particular project must be based on review of the following information by both fish and wildlife biologists and an instream flow hydraulic engineer:

1) physical impacts of seasonal flow alterations,

2) biological impacts of seasonal flow alterations,

3) seasonal variation in physical and biological impacts,

*Recommendations specifically addressing salmon stock enhancement for Cook Inlet recreational fisheries are contained in ADF&G 1978b cited in Appendix A.

4) loss of opportunities to realize alternative flow benefits (e.g., navigation, recreation, socioeconomics, aesthetics, etc.), and

5) ability to mitigate impacts.

When the above data are not available, it will be necessary to determine whether or not:

1) to apply non-field techniques (e.g., Tennant's Montana Method), to evaluate effects of flow alterations, or

2) to initiate habitat preference and instream flow field studies and computer analysis of field data.

Chapter 3 - MANAGEMENT RECOMMENDATIONS AND GUIDELINES

3.1. Introduction

The following section contains recommendations and guidelines which, if implemented, would contribute to the maintenance of fish and wildlife resources and associated human uses in the Willow-Talkeetna Sub-basins. The reader is also referred to the Instream Flow Recommendations presented in Section 2.2 above, to general recommendations outlined for Game Management Subunit 14A in the draft Alaska Wildlife Management Plans - Southcentral Alaska (ADF&G 1976b); to salmon enhancement recommendations contained in ADF&G 1978b cited in Appendix A; and to general guidelines for maintaining wildlife in subdivisions presented in Guidelines for Wildlife Design in Residential Developments (ADF&G - Habitat Protection Section 1980). ADF&G recommendations presented below address the following topics:

1) essential fish and wildife habitats (use areas) (Section 3.2.1.)

2) criteria for protective buffer zones on State Lands (Section 3.2.2.)

3) preliminary development guidelines and use performance standards for activities on State lands affecting:

   a) endangered species
   b) protected species

c) riparian habitats and wildlife corridors

d) wetlands

e) fish and wildife and their habitats

f) pollution control

g) restoration and rehabilitation

h) erosion and sedimentation

(Section 3.2.3.)

4) preliminary access policies on State lands (Section 3.3.)

Most of these recommendations were developed by the ADF&G during the ADNR "backlog review" described below (Section 3.2), and are preliminary. In addition, although not yet available, proposed ADF&G regulations for protecting fish and game habitat as mandated by Sections 840 and 870 of A.S. Title 16 will be circulated for review by State agencies in late November 1980. Upon completion of interagency review, the proposed regulations will be distributed for public review. Following review and revision, the regulations will be presented for formal adoption by the Boards of Fisheries and Game. (For additional information pertaining to these proposed regulations, contact John Clark, Assistant Chief, Habitat Protection Section, ADF&G, Subport Building, Juneau, Alaska 99801.)

The maps prepared for this study (Section 1.2.) and the recommendations presented below represent first steps to maintaining and enhancing fish and wildlife resources in the Willow and Talkeetna Sub-basins. Other

steps towards integrating the maintenance of fish and wildife resources into water- and land-use planning and development are also being taken during this Cooperative Basin Study. These steps will provide additional management recommendations. For example, the fish and wildlife information provided by the ADF&G is being correlated with a variety of other biological, physical, and cultural data obtained for the Willow and Talkeetna Sub-basins. Many of these data are being enhanced, digitized, and integrated on computer-generated maps so that the relationships between physical, cultural, vegetative, etc. parameters, and fish and wildlife distributions and use areas, can be elucidated. Knowledge of these interrelationships will assist in developing fish and wildlife management plans.

Another step towards integrating fish and wildlife concerns into resource planning is the development and testing of habitat evaluation procedures (HEP) developed by the USFWS-Division of Ecological Services (1980). In developing these procedures, the USFWS has collected and analyzed wildlife data (e.g., species-specific habitat requirements, factors limiting species distributions, etc.) and used these data in developing wildlife habitat-suitability models. Habitat-suitability models represent tools for assessing the potential of a given area to support specific wildlife species based on known physical and biological characteristics of the area, as well as for assessing potential changes in habitat suitability associated with different land uses.

By applying HEP criteria to the computer intergration of Sub-basin data, it is possible to generate maps indicating where the known habitat

requirements and tolerances of particular species appear to be matched by appropriate vegetation, soils, water availability, etc. These wildlife habitat-suitability maps will be developed with the same data base used in mapping other resources under study, and will therefore be readily comparable with maps portraying suitability areas for agriculture, timber, homesites, etc. Computer-generated maps showing wildlife suitability areas (potential species distributions) will be critiqued and refined by State and Federal biologists familiar with mapped areas. If adequate funding becomes available, the maps will also be field verified. Identifying and explaining discrepancies between theoretical (computer-mapped) and actual (observed) wildlife distributions will provide new information for refining the wildlife habitat-suitability models. This iterative process, in which wildlife and environmental data are continually refined and re-integrated, may eventually provide procedures by which habitat suitabilities, sensitivities, etc., and associated wildlife resources, can more readily be evaluated, compared, and made available to resource planners and developers. Computer-generated wildlife habitat-suitability maps and a supplemental fish and wildlife narrative will be available in the SCS-coordinated Willow Subbasin report in early 1981. (Contact Sterling Powell, USDA-SCS, 2221 E. Northern Lights, Anchorage, AK. 99504 for further information.)

The collection of new resource data and the development of new resource-evaluation methodologies during this Cooperative River Basin Study can greatly improve the ability of resource planners and developers to make wise land-use decisions. In particular, the development of methods by

which fish and wildlife resources can be readily assessed, and by which fish and wildlife requirements can be effectively integrated into the water- and land-use planning process in a timely and efficient manner, represents the best hope for maintaining and enhancing the benefits derived from fish and wildlife resources.

3.2. ADNR-ADF&G "Backlog Review"

The ADNR in August 1978 requested the ADF&G to participate in a backlog land classification program by identifying State-interest lands supporting essential fish and wildlife habitats,* as well as State-interest lands important for recreational, commercial, and subsistence human use. These ADF&G identified State-interest lands are delineated on the maps prepared for this study.

During the backlog review, less than 3 months were available for the ADF&G to review a 36-million-acre area including the Willow-Talkeetna Sub-basins (most of it having received only preliminary study), identify and map essential fish and wildife habitat and human use areas, and develop management recommendations applicable to a broad spectrum of species, areas, and human activities. Although general and introductory, many of the backlog management recommendations represent the only formal guidelines presently available. (In addition, data synthesis and evaluation

*See Appendix E for ADF&G definitions of habitat.

conducted during the backlog process provided the ADF&G new knowledge and experience with which to restructure existing programs and establish new programs to improve the fish and wildlife planning process.) Three excerpts from the October 20, 1978 backlog products (ADF&G 1978d) are presented below with the recognition that more sophisticated recommendations and regulations are being developed:

1) discussion of essential fish and wildife habitats ("use areas"), including preliminary "means to protect and maintain",

2) criteria for protective buffer zones on State lands, and

3) development guidelines and use performance standards for activities on State lands.

Most of these use areas, criteria, and guidelines are directly applicable to land-use classification and planning in the Willow-Talkeetna Sub-basins.

3.2.1. Fish and Wildlife Essential Use Areas (Habitats)

The 11 wildlife use areas and the 5 fish use areas described below represent categories of habitats essential to fish and wildlife species. Each species of fish and wildlife utilizes a particular sequence of these use areas during its life history. With the possible exception of

marine mammal breeding and pupping areas, all of these 16 essential fish and wildlife use areas are present in the Willow and Talkeetna Sub-basins.

Use areas represent functional habitat categories (e.g., feeding areas, calving areas, winter range areas, etc.) rather than specific habitat types such as willow-alder shrub communities, herbaceous tundra, birch-spruce forest, etc. Comparable habitat functions are performed for different wildlife species by different habitat types. For example, both riparian-shrub and tundra communities can function as feeding areas, but the former provides food for beavers, moose, etc., the latter for caribou, marmot, and other species. For some species (e.g., voles, shrews, etc.), several or all essential use areas may be contained within a single major habitat type, and geographically distinct use areas cannot be distinguished. (With such species, functional use areas such as burrowing and feeding areas may be represented by microhabitats only inches apart.) For other species, particularly large carnivores and omnivores, functional use categories such as feeding areas or denning areas may be represented by several different habitat types. Wolf feeding areas, for example, may include a variety of habitat types, such as coniferous forests, deciduous forests, shrublands, tundra, etc. depending upon the preferences of seasonally available prey.

Use areas must be available to fish and wildlife species in the proper temporal and spatial pattern. In other words, particular use areas are essential during particular life history phases, and species survival

and reproduction depend upon the required use areas being available when and where needed. Maintaining one, or even several, essential use areas will not ensure the continued presence of a particular species if other use areas are not also available when required by that species. For example, the local existence of high-quality calving or summer feeding areas may not guarantee the continued presence of moose if adequate winter range is not also available and accessible at appropriate times. It is therefore very important to maintain a complete array of use areas, interconnected by passage corridors with adequate food, water, and shelter, in order to maintain the wildlife species which require these areas.

Although use areas identified on the ADF&G maps and described below represent known essential habitat areas necessary for wildlife survival, they do not encompass all existing use areas (some of which may have been overlooked) nor the entire ranges used by particular species seeking food, water, shelter, conditions for reproduction, etc. As a result, human activities and developments in areas outside identified essential use areas may also affect wildlife survival. These effects may be produced in two ways:

1. wildlife moving outside of protected essential use areas (e.g., during feeding, migration, etc.) may come into direct contact with man and/or his structures, roads, development activities, etc. and

2. human activities occurring outside essential use areas may affect environmental conditions within the use areas. For example, industrial, municipal, or residential developments may negatively affect the quality and quantity of ground and surface waters in essential use areas down-gradient from the development sites (e.g., by discharging toxic effluents, increasing erosion, altering infiltration rates in ground-water recharge areas, etc. See also "Instream Flows".)

Negative impacts to fish and wildlife resources caused by human activities outside essential use areas can be eliminated or greatly reduced by considering fish and wildlife needs during the site-specific designing of particular developments. The ADF&G is in the process of developing fish and wildlife land-use guidelines which can be readily incorporated into the design of particular projects; e.g., sub-divisions (ADF&G, Habitat Protection Section 1980), mining developments, etc., and which will benefit both the developers and the general public by permitting continued local enjoyment of fish and wildlife resources. In addition, implementation of the buffer zones and activity guidelines described below can contribute significantly to the maintenance of fish and wildlife resources.

The maintenance and enhancement of species populations is dependent upon the maintenance and accessibility of the essential use areas they require. As a result, maintaining fish and wildlife resources depends upon: 1) locating and mapping essential fish and wildlife use areas, 2) following

management guidelines designed to prevent destruction or degradation of identified use areas, and 3) providing passage corridors which interconnect essential use areas. The wildlife maps compiled by the ADF&G for this Cooperative River Basin Study constitute a preliminary attempt to locate and map essential use areas, while the guidelines and recommendations presented below represent steps towards the protection of essential use areas during land-use planning and development.

3.2.1. Essential Fish and Wildlife Use Areas

Wildlife Use Areas

1. Winter Range

a. Essential Habitat Function

Winter range is that habitat used by a wildlife population on an annual basis during the winter months. It is essential to the perpetuation of populations, and is characterized by forage with nutritional elements sufficient for survival through winter months, adequate cover, and average snow depth levels which are tolerable to a species.

b. Means to Protect and Maintain

During the summer months most species disperse over larger areas where they have little difficulty in finding adequate food, shelter and other requisites. However, during periods of deep snow and low temperatures, they concentrate in areas having adequate available supplies of their winter food species and reduced snow depths. These areas are fewer in number and are absolutely essential to the well-being and survival of individuals and of populations.

These areas must be managed so that they will continue to produce adequate winter food supplies. Disruptive activities, such as snow machine use, during these months of physiological

stress must be avoided. Activities which do not alter the capacity of essential winter range to produce vital food supplies can be allowed during other seasons (time zoning).

2. Summer Range

a. Essential Habitat Function

A summer range is that habitat used by a species on an annual basis during the late spring, summer and early fall months. It is characterized by forage with nutritional elements adequate for rapid growth and for production of fatty tissue. It provides adequate forage for adults and young-of-the-year.

b. Means to Protect and Maintain

Because vital summer ranges provide the majority of food resources utilized for growth and storage of energy reserves and because their availability will regulate the abundance of these animals within a larger geographic region, the continued use of these lands as essential summer range should be maintained and protected. Alteration or destruction of vital habitat components such as vegetative cover or major landforms should be avoided. Compatible uses of these lands will vary depending on the sensitivity of individual species to various types of disturbance.

For example, low density recreational housing in essential moose summer range probably will not seriously reduce its usefulness to moose; however, the same level of activity may cause Dall sheep or caribou to avoid the area. Because disturbance potential and species sensitivities may vary between summer ranges, land use plans should include recommendations from ADF&G wildlife biologists with knowledge of specific areas of the State. Any proposed use or activity that requires alteration of these lands should not be conducted during essential wildlife use periods and the restoration of vegetation and landform should be completed prior to these periods.

3. Calving Grounds

a. Essential Habitat Function

A calving ground is that habitat used by a species on an annual basis during the parturition period. Specific boundaries and total acreage of use may vary from year to year based on overall population size, weather conditions, harassment by insects or predators, and/or other undetermined factors. Generally it is located away from extensive human habitation.

b. Means to Protect and Maintain

These areas are generally small in relative size and possess a unique set of environmental conditions that cannot be provided by other areas. They are essential to the calving or lambing success of a population and must be maintained and protected. Other uses which do not alter these unique environmental conditions can be allowed during other seasons of the year.

4. Migration Corridor

a. Essential Habitat Function

A migration corridor is that habitat essential for population movement between areas of daily or seasonal use. Generally corridors lack distinct boundaries; yet specific areas may experience intense population movement. Use patterns may change from year to year. Corridors are usually characterized by elevation variance, cover availability, food plant distribution, and physiographic barriers at their peripheries. Migration corridors are essential to allow populations the use of various components of their habitat and are essential to the perpetuation of a particular population.

b. Means to Protect and Maintain

These can be regarded as multiple use areas. Many other uses can be allowed as long as these daily and seasonally

used routes are not so heavily utilized or developed that free movement is impeded.

5. Denning Areas

a. Essential Habitat Function

A denning area is that habitat located so as to provide favorable shelter during the winter months and parturition sites for species such as bears and wolves. Pre-denning food supplies are usually relatively abundant nearby. The den itself is constructed in favorable soil conditions, often associated with root structures of shrubs, trees, or other suitable vegetation and where winter snows tend to supplement den warmth by providing insulation. Critical denning habitat needs vary in accordance with the needs of different segments of the population (i.e. sows with cubs) and total population numbers utilizing a particular denning area. As a birthing site, denning areas are critical to the perpetuation of species.

b. Means to Protect and Maintain

These are relatively small areas possessing a unique set of environmental conditions which provide winter protection and maternity dens for several species. They are critical in the life history of such species as bears, wolves,

coyotes, and some members of the squirrel family, and must be afforded full protection.

6. Feeding Areas

a. Essential Habitat Function

A feeding area is that habitat which, by virtue of food abundance, either year-round or seasonally, provides for the nutritional needs of concentrations of one or more species. Utilization of food resources may occur only seasonally but will provide a significant portion of the population's annual food needs. Loss of feeding habitat may lower population numbers.

b. Means to Protect and Maintain

Multiple uses can be allowed in these areas as long as those uses do not diminish the food availability or productivity of the lands. As some of these areas are used only on a seasonal basis, other uses can be allowed during other times of the year.

7. Nesting Areas

a. Essential Habitat Function

A nesting area is that habitat which provides a bird population with the necessary requisites of food, water

and cover during the time of year when breeding, production and growth of the young subject the population to greater stress and vulnerability.

b. Means to Protect and Maintain

These are relatively small areas possessing unique ecological characteristics which make them suitable nesting sites for birds. These areas range from marsh areas which provide nesting areas for waterfowl to mature trees and cliff areas which provide suitable nesting areas for birds of prey. These areas are absolutely essential to the perpetuation of bird species and must be protected. They are used only seasonally, therefore other uses which do not disturb these areas can be allowed during other seasons.

8. Hauling-out Areas

a. Essential Habitat Function

A hauling-out area is that habitat where certain species of marine mammals come ashore for purposes of resting, molting, breeding, pupping and pup-rearing. They are generally characterized by isolation and inaccessibility to humans and predators.

b. Means to Protect and Maintain

These are areas characterized by special ecological conditions which make them suitable for breeding, parturition, pup-rearing, resting and molting. Some marine mammal species utilize one site for several of these functions while other species require separate areas for each function. They are essential to the well-being of some marine mammal species and must be protected. Some of these areas, such as breeding, parturition, and pup-rearing areas are used only seasonally. Uses which do not alter the habitat could be allowed during other seasons.

9. Breeding and Pupping Area

a. Essential Habitat Functions

Breeding and pupping areas are those hauling-out habitats and waters which are used by marine mammals for parturition, rearing young, and breeding. They are generally recognized as critical to the maintenance of populations.

b. Means to Protect and Maintain

These are the most critical of the hauling-out areas and also include coastal marine areas used by whales. These areas are absolutely essential to the well-being and perpetuation of marine mammal species. They are used only seasonally, and other uses which do not alter the habitats or require permanent structures can be allowed

during other times of the year.

10. Staging Areas

a. Essential Habitat Function

A staging area is that habitat used by large numbers of birds as a resting, feeding, and social contact area during spring and fall migrations. They are characterized by providing food, cover, and water in sufficient abundance to annually attract and support concentrations of waterfowl, passerine birds, seabirds and/or shorebirds. These areas represent locations where members of a species, which have been dispersed over large areas for much of the year, gather preparatory to, or during migration.

b. Means to Protect and Maintain

These areas are critical in the life history of some bird species. They are used only seasonally and other uses which will not alter the habitat can be allowed during other seasons of the year.

11. Mineral Licks

a. Essential Habitat Function

A mineral lick is that habitat used by certain wildlife

species on an annual basis to provide mineral elements critical to the nutritional well-being of one or more populations. They contain concentrations of minerals essential to species so that intensive and localized use occurs. Such locations may exert profound influence on movement patterns, social organization, health of the newborn, and may consequently influence genetic variability within affected populations.

b. Means to Protect and Maintain

These are relatively small very scarce areas which supply the essential mineral elements which certain species can obtain on no other portion of their ranges. These elements are essential to the well-being of individual animals as well as to the population and must be afforded complete protection.

Fish Use Areas*

1. Spawning and Incubation Areas

a. Spawning, incubation, and early rearing areas are areas where anadromous and resident fish deposit their eggs, where these eggs are hatched, and where the early stages of rearing occur. General requirements are a maintained and continuous flow of clean water over and/or through a substrate during the period of spawning and the critical incubation phase. These areas may be quite limited within a given stream system and specific requirements may differ with individual fish species.

b. Means to Protect and Maintain

This crucial habitat type must be protected in a manner which controls vehicular use, construction, water use and diversion during spawning and incubation periods. The substrate should remain unaltered by human activity.

2. Migration Routes

a. Essential Habitat Function

Migration routes are those stream reaches utilized by either anadromous or resident fish species for migrational

*Refer also to Instream Flow Recommendations, Section 2.2.2.

passage. These movements may be either seasonal intra-system or ocean migrations. These areas are dependent upon sustained stream flows during the migration period and are much more extensive though not as critical as the spawning and rearing areas.

b. Means to Protect and Maintain

Many compatible uses can be allowed in this habitat so long as flows and water quality are maintained and free fish passage is allowed.

3. Rearing Areas

a. Essential Habitat Function

Rearing areas are those areas inhabited by anadromous or resident fish species during any phase of their life cycle from hatching to maturity. Freshwater rearing areas may be limited by (and thus dependent upon) shelter, magnitude and intensity of flow, substrate material, adequate food sources and water quality.

b. Means to Protect and Maintain

These habitats are crucial to the perpetuation of fish populations and must receive protection. Water flows,

quality, and temperature regimes must be maintained or managed at levels which protect or enhance fish production, and streamside vegetation should remain undisturbed.

4. Over-wintering Areas

a. Essential Habitat Function

Over-wintering areas are those areas inhabited by fish or eggs during the seasonal period between freeze-up and break-up. These areas are often extremely limited in number within drainages or stream systems and are critical to maintenance of certain stocks.

b. Means to Protect and Maintain

These are relatively small areas possessing characteristics which are critical to the over-winter survival of many forms of aquatic life. They require the same measure of protection as do spawning and rearing areas.

5. Milling and Holding Areas

a. Essential Habitat Function

Milling and holding areas are freshwater, saltwater, or estuarine areas where anadromous or resident fish

congregate and hold for a period of time. These concentrations are often associated with fish maturing and preparing for spawning or upstream migrations.

b. Means to Protect and Maintain

These are areas which are relatively few in number and fulfill a critical requirement in the life history of fishes. They must remain unaltered to serve this function. Water flows must remain unaltered, human interference must be minimized, construction and stream crossings, etc. should not occur and pollution must be avoided.

3.2.2. Criteria for Protective Buffer Zones on State Lands

Buffer zones are recognized as an important method of protecting fish and wildlife and their habitats from disturbance or damage. The Department of Fish and Game considers buffer zones to be bands of undisturbed land forms and/or vegetation along rivers, lakes, streams, marine waters and contiguous wetlands, or surrounding wildlife use areas. The zones are measured from the mean high water mark (vegetated banks) in the case of rivers, lakes, and streams; higher high tide for marine waters and from the periphery of essential fish and wildlife use areas for terrestrial sites. The Department recommends establishing buffer zones around anadromous streams and lakes identified in the ADF&G Anadromous Stream Catalogs, essential marine spawning and rearing areas and specified critical fish and wildlife habitats of endangered or protected species or species highly sensitive to human disturbance.

A buffer zone fulfills its function of protecting fish, wildife and their habitats by:

---- preserving the vegetative component of the habitat. This is extremely critical to the existence of wildlife, erosion control and protecting the integrity of water bodies.

---- preventing pollutants from reaching a waterbody.

---- preventing watercourses and wetlands from being unnaturally altered by being filled-in, channelized, dammed or drained. This is particularly

important in the case of a stream which, due to natural course changes, must be controlled in order to protect bankside development.

---- avoiding disruption of fish or wildlife populations during sensitive life history stages.

---- protection of watersheds and recharge areas.

When establishing buffer zones, thought must be given to what is needed to achieve the above objectives and still remain flexible enough for "real-life" situations. This can be accomplished by tying buffers to land uses. This Department considers that buffer zones should be set-backs which will vary in width based on Department of Natural Resources' (DNR) land classifications. The set-back widths incorporate the Department of Fish and Game's best professional recommendations. In this way, buffers can automatically be established when land is classified.

Flexibility can further be maintained by establishing a waiver mechanism to allow limited encroachment. In the case of an applicant wishing to encroach upon an established buffer, it should be demonstrated by the applicant that the proposed activity will not compromise any of the stated objectives. The request for encroachment should be reviewed by both Department of Fish and Game biologists as well as land managers. Hydrologist, silvaculturists, agronomists, geologists and other specialists may need to be consulted, depending upon the magnitude of the proposed activity. This would make the review a truly interdisciplinary approach and would be an obvious advantage to both the applicant and resource manager.

It should be pointed out that, in many cases, an adequate buffer between a waterbody and development can only be established after hydrologic review. For example, 200 to 800 feet may be sufficient to protect a river from development but it may not be sufficient to protect development from the river. In any dynamic system, all construction may have to be located at much greater distances from the river. This problem has been recognized by the Federal government in their "Floodplain Management Guidelines" published in the Federal Register on February 10, 1978. The guidelines were formulated for implementing Executive Order 11988 and were promulgated to control development in floodplains since "floodplains are the scene of: 1) unacceptable and increasing flood losses, and 2) degradation of natural and beneficial values."

In the "Guidelines," a floodplain is defined as "the lowland and relatively flat areas adjoining inland and coastal waters including flood prone areas of offshore islands, including at a minimum, that area subject to a one percent or greater chance of flooding in any given year." A one percent chance floodplain is the 100-year floodplain. Development will be disallowed in this zone. Using E. O. 11988, the Bureau of Land Management recently denied the Alaska Department of Transportation and Public Facilities' request to locate a camp at the Yukon Pipeline Crossing because it fell within this 100-year floodplain.

It is clear that the Federal government is taking some positive steps to prevent degradation of our waters. It is also clear that our proposed buffer zones may be inadequate. However, in the time allotted

for this project, these buffers were considered to be reasonable and relatively workable. We must be aware that further refinement and sophistication is necessary to produce a system that is truly reflective of the real world.

Presently, DNR is operating with twelve land classifications. However, it is expected that in the near future, a new classification system containing nineteen categories will be adopted.* Buffer zones will be defined herein for both the old and the new classifications. Three buffer widths are proposed: minimum or 200 foot buffer, moderate or 400 foot buffer and maximum or 800 foot buffer. These widths were chosen as being realistic in terms of resource protection based on experiences with residential and commercial development, pipeline and related construction, logging and agriculture. All reference to waterbodies includes rivers, lakes, streams, marine waters and contiguous wetlands. Specific recommendations follow:

A. Current Land Classifications (from Natural Resources Title 11, Chapter 1, Section 102)

1. Agricultural Lands . . . . . 400 feet

Agriculture can have detrimental effects on waterbodies through nutrient overloading, erosion, or draining. However, in most cases, agriculture is located near waterbodies for the express purpose of water utilization.

* Current (January 1980) regulations concerning land planning and classification are contained in Appendix B.

Therefore, a moderate buffer is proposed to protect watercourses and yet allow agriculture close enough to the stream or lake to remove water. Water removal itself would have to be reviewed to make sure that this removal does not exceed flow or recharge, that pumps are adequately screened to prevent adverse impact to fish and that fueling is carried out in a manner that precludes spillage of toxic products into the water.

Buffers between agricultural land and wildife habitat are also needed to preserve the habitat, reduce disturbance of populations, possibly reduce damage to crops from wildife and provide wind breaks.

2. Commercial/Industrial lands . . . . . 800 feet

Commercial or industrial facilities should be located at least 800 feet from waterbodies or critical wildlife habitat. The concerns are pollution, erosion, disturbance of fish and wildlife populations and alteration of water courses.

3. Grazing Lands . . . . . 400 feet

Intensive grazing of banks in the continental United States has, in most cases, severely degraded streams, lakes, rivers and coastlines. This problem can be avoided

in Alaska if buffer zones are provided along waterbodies in grazing lands. Pumping from waterbodies for livestock would be subject to the same restrictions listed under Agricultural Lands.

4. Material Lands . . . . . 800 feet

Mining of gravel or related materials requires a wide buffer around waterbodies or critical wildlife areas. Gravel sites located close to waterbodies have resulted in excessive siltation, fish traps, blockage of fish (and probably wildlife) migrations, and shifting of river channels. Anyone who is allowed to remove materials within a buffer zone must be able to demonstrate that siltation will be minimized, the river will not change course, fuel will not be discharged into the water due to human activity and fish and/or wildlife populations will not be disrupted.

Gravel mining during the construction of Trans-Alaska Pipeline System (TAPS) demonstrated how this type of activity could affect waterbodies. For example, Material Site (MS) 63-1.2 was located approximately 200 feet from an oxbow of the Chatanika River. The site was inadequately protected from the river and during the spring of 1976, the first breakup following opening of the pit, the

Chatanika flowed through M.S. 63-1.2. The results were trapping of fish, siltation of the Chatanika River, severe erosion of banks of two tributary streams, access road wash-out and deposition of gravel over extensive amounts of vegetation. These sorts of occurrences must be prevented because, in most cases, repair is difficult and often impossible.

5. Mineral Lands . . . . . 800 feet

Mining of materials such as coal, oil shale, etc. can produce the same detrimental effects (erosion, siltation, fish traps) as gravel mining. In addition, depending upon the substance being mined, toxic pollutants can be introduced from mining activities. One has only to look at the mining areas of Pennsylvania, West Virginia or Montana to appreciate the harm that unregulated mining can have on habitat.

6. Public Recreation Lands . . . . . .200 feet

In most cases, public recreation will have minimal effects upon waterbodies if located outside a narrow buffer. Camp ground septic systems and parking lots in particular must be located away from rivers or lakes in order that nutrient overloading does not occur or that the watercourse is not changed to accomodate the development.

The latter was the case at the Anchor River on the Kenai Peninsula. This river is a highly productive and popular fishing stream that supports several species of salmonids including silver salmon (Onchorynchus kisutch), king salmon (O. tshawytscha), and steelhead (Salmo gardneri). A campground and two cabins were built on the banks of the river. The river began natural shift to the south and eroded away the banks next to the campground and cabins. In order to control the river, it was channelized and graded into a gentle slope. As a consequence, the water is very shallow and the river does not provide the same high quality fishing or aesthetics as it did before. If the campground had originally been built away from the river, it is likely that stream control procedures would not have been necessary.

7. Private Recreation Lands . . . . . 200 feet

For rural lands with a minimum of development, a minimum buffer will usually be sufficient to control the amount of nutrient overloading from septic systems, pollution from fueling and will keep structures far enough away so that the resident will not need to fill, divert or otherwise change a waterbody in order to protect his investment. The Anchor River channelization mentioned earlier, which protected a campground, also protected two cabins.

8. Residential Lands . . . . . 800 feet

A maximum buffer should be provided between residential developments and waterbodies or other critical wildlife habitat. This will not only accomplish the goals of avoiding disturbance or degradation of natural areas, it will provide greenbelts through communities. Green belts are beneficial for animal migrations and human recreation.

9. Reserved Use Lands . . . . . 800 feet

These lands should receive the maximum buffer since it is unknown what their ultimate disposition will be. That they are reserved for government agencies does not alter the fact that resources should be protected, particularly if the lands may be used for future townsite development.

10. Timberlands . . . . . 400 feet

Clear-cutting along fish streams has long been identified as a major problem. Removal of bank vegetation causes erosion and temperature changes within the stream. Such practices as yarding logs through streams break down banks, causes fish blockage and introduces heavy layers of organics which may smother benthic organisms and destroy spawning habitat. Recognizing the severity of problems created by streamside logging, and at the same time the fact that good merchantable timber is often associated with waterbodies, a moderate buffer is proposed.

11. Reclassification . . . . . Variable

Any land that is changed from one category to another should adopt the buffer zone recommended for the new category.

12. Multiple Use . . . . . Variable

Any lands classified for two or more uses should carry the most stringent buffer zone recommendation.

B. Proposed Classification System

1. Agricultural Land . . . . . 400 feet

(See discussion under Current Classification)

2. Commercial Land . . . . . 800 feet

The proposed classification separates commercial and industrial use. A moderate buffer can usually be imposed on commercial developments because the potential for damage would be similar to that of a residential area. Some commercial establishments, such as car washes and service stations, have a much greater potential for stream pollution and should maintain the maximum buffer.

3. Forest Land . . . . . 400 feet

(See discussion under Timber Land, Current Classification.)

4. Grazing Land . . . . . 400 feet

(See discussion under Current Classification.)

5. Greenbelt Land . . . . . 800 feet

This new classification is an extremely important one. The uses of greenbelt lands include wildlife migration routes, recreation, buffers against noise, polluted or silty water, fishery resource protection, flood and erosion control. All of these goals require the maximum buffer designation.

6. Homesite Entry Land*. . . . . 200 feet

Low density, single family dwellings should produce a minimum of pollution, erosion or disruption of wildlife populations, and therefore, require a minimum buffer.

7. Industrial Land . . . . . 800 feet.

(See discussion under Commercial/Industrial Land, Current Classification.)

8. Material Land . . . . . 800 feet

(See discussion under Current Classification.)

* Repealed 10/14/79

9. Mineral Land . . . . . 800 feet

(See discussion under Current Classification.)

10. Open-to-Entry Land*. . . . . 200 feet

This classification encompasses land which is "rural in character and . . . is suitable for low density residential use." As such, a minimum amount of land or water disturbance could be expected and a minimum buffer could be allowed.

11. Private Recreation Land . . . . . 200 feet

(See discussion under Current Classification.)

12. Public Recreation Land . . . . . 200 feet

(See discussion under Current Classification.)

13. Reserved Use Land . . . . . 800 feet

(See discussion under Current Classification.)

14. Residential Land . . . . . 800 feet

(See discussion under Current Classification.)

15. Resource Assessment Land . . . . . 800 feet

This classification applies to lands newly conveyed to

* Repealed 10/14/79

the State and which have not been classified yet. In order to maintain the maximum options, lands under this category should retain the maximum buffer until they are given their final classification.

16. Resource Management Land . . . . . Variable

This classification incorporates the multiple land use concept. As such, the use with the most stringent requirements should determine the buffer width. (See discussion under Multiple Use, Current Classification.)

17. Watershed Land . . . . . 800 feet

Since the goal of this classification is to prevent damage to potable water reserves and provide clean water for various facilities such as fish hatcheries, community water systems, etc., the maximum buffer should be implemented.

18. Wildlife Habitat Land . . . . . 800 feet

Lands under this classification should carry the maximum buffer, since it is likely that the lands receiving this designation will be those of vital importance to wildlife. It may also be the case that some areas, such as those inhabited by endangered species, may require, a much greater buffer zone. For example, during the construction of the TAPS, a set back of 1/2 mile was established

around peregrine falcon nests to protect them from disturbance. Indications are now that the U.S. Fish and Wildlife Service Endangered Species Recovery Team will be recommending buffers of a mile or more in peregrine falcon nesting areas.

19. Reclassification Land . . . . . Variable

Any land that is changed from one category to another should adopt the buffer recommended for the new category.

20. Utility Land

3.2.3. Guidelines for Uses and Activities on State Lands

Forestry, mineral extraction, recreation, commercial and residental development and other potential uses of State lands and resources are important to the growth and well-being of Alaska's economy. However, if not carefully planned these activities can significantly decrease the capacity of these lands to produce fish and wildlife resources. Development activity anywhere in the State has the potential to alter or destroy fish and wildlife habitat. Each type of residential, commercial or industrial use has the potential for a particular combination of habitat disturbances. The amount of damage that results from a particular habitat disturbance depends on the characteristics and vulnerabilities of the specific habitat involved. Only after essential fish and wildlife use areas (see above) and unifying biological and physical processes that support essential use areas are identified and their vulnerabilities to disturbance known can an effective, comprehensive land use plan be developed.

A comprehensive land use plan must protect essential fish and wildlife use areas and maintain unifying ecological processes. Unifying processes are the dynamic flows of energy, nutrients, water, substrate and food as well as species interactions and associations (e.g. food webs) which link essential fish and wildlife use areas and the living resources which depend on them. Attempts to partition or to classify Alaska's lands and waters that do not consider their continuous and highly interrelated nature will fail to protect their fish and wildlife resource production

capacity. Neither piecemeal planning nor treatment of single uses, single issues or single geographic areas will succeed. For example, if an essential waterfowl feeding ground is identified within coastal wetlands, simply not allowing any development or classifying the area as wildlife habitat while disregarding the importance of the adjacent lands to its continued function will be of little benefit. The unifying natural processes that transport and regulate the flow of unpolluted water, nutrients and energy through the feeding grounds must be maintained in the surrounding areas as well. Maintenance does not necessarily mean that the surrounding lands cannot be used or developed; however, it does mean that the manner in which the land is used or developed should be designed or planned to accomodate natural biological and physical processes.

The Alaska Department of Fish and Game strongly recommends in addition to protecting essential fish and wildlife use areas and establishing protective buffer zones around highly sensitive habitats, that development guidelines and use performance standards which ensure the continued maintenance of unifying natural processes be developed and implemented on all State lands. This approach not only provides a viable habitat protection strategy, but in addition provides a positive approach to uses of all kinds by encouraging utilization of the best technological methods and will encourage development of improved technology and engineering. General development criteria for fish and wildlife habitat maintenance and protection should be included in regulations for existing or revised State land use classifications. Specific or more technical performance

standards can then be developed for specific development proposals or leases by interdisciplinary teams composed of resource scientists from DNR, ADF&G and DEC. Approval should be granted jointly by these agencies.

The Department of Fish and Game has prepared the following development criteria for uses and activities on State lands. These criteria represent a first attempt to pull together the knowledge and experience of ADF&G staff who have worked with the TAPS programs, Tongass Land Use Plan, the Alaska Coastal Management Program, oil and gas lease sales and other planning efforts. The Department of Fish and Game is continuing to refine and expand these criteria to better support ongoing land use planning and classification programs in Alaska.

STANDARDS FOR PROTECTION OF SPECIAL FISH AND WILDLIFE AREAS	COMMENTS ON STANDARDS
Endangered Species	
a. For all currently or historically occupied nesting cliffs of the peregrine falcon, Falco peregrinus anatum and Falco peregrinus tundrius:	The Alaska Legislature recognizes that, due to growth and development, certain species or subspecies of fish and wildlife are now and may in the future be threatened with extinction. A.S. 16.20.185 requires that on land under their respective jurisdictions the Commissioner of Fish and Game and the Commissioner of Natural Resources shall take measures to preserve the natural habitat of species or subspecies of fish and wildlife that are recognized as threatened with extinction.
(1) Land use practices and/or development that will alter or eliminate natural habitat conditions within one mile of nesting cliffs is prohibited.	
(2) All human activities (unless specifically authorized) within one mile of nesting cliffs between April 1 and August 16.	
(3) The State will protect and/or retain nesting habitat in public ownership.	The standards outlined are considered general standards governing peregrine falcon essential habitat. It is recognized that these standards may not apply to all situations. A qualified ADF&G or USF&WS biologist should review specific cases and determine appropriate protective measures.
(4) The State will make provision for purchase or otherwise ensure protection for nesting habitat in private ownership.	
(5) All aircraft within 1500 feet of the surface and within a horizonal distance of one mile of nesting cliffs is prohibited between April 1 and August 15.	
b. For all areas within a minimum of fifteen (15) miles of the nesting cliffs which supply a major portion of the food source of peregrine falcons:	
(1) Land use practices and/or developments which could detrimentally alter or eliminate the habitat or food source of peregrine falcons are prohibited.	
(2) The use of harmful pesticides and other environmental pollutants detrimental to the peregrine or its food source is prohibited.	

STANDARDS FOR PROTECTION OF SPECIAL FISH AND WILDLIFE AREAS	COMMENTS ON STANDARDS
(3) The State of Alaska will retain in public ownership or make provision for protection or purchase on private land.	
Protected Species	
a. For all currently or historically occupied nesting areas of Trumpeter swans,	Trumpeter swans are protected under the Migratory Bird Treaty Act of 1918 and international treaties with Mexico and Canada.
(1) Land use practices and/or development that will alter or eliminate natural habitat are prohibited.	
(2) The State will protect and/or retain reproductive habitat in public ownership.	The standards outlined should be implemented as general standards. It is recognized that these guidelines may not apply in all situations. A qualified ADF&G or USF&WS biologist should review specific cases and determin appropriate protective measures.
(3) Activities which cause or create visual or noise disturbance within one quarter mile of swan nesting ponds, marshes, or lakes from May 15 - September 15 is prohibited.	
b. For all currently or historically occupied nesting areas of bald eagles including forests, cliffs, and sea stacks:	Bald eagles and their habitat is protected under the Bald Eagle Protection Act.
(1) Land use practices and/or development including but not limited to removal or disturbance of natural habitat is prohibited.	The standards outlined should be implemented as general land policy. It is recognized that these guidelines may not apply in all situations. A qualified ADF&G or USF&WS biologist should review specific cases and determine appropriate protective measures.
(2) Along coastal or riparian shorelines a non-development zone of at least one quarter mile will be retained in public ownership.	
(3) A continuous zone of uncut timber of at least 330 ft. will be maintained around nesting sites on public lands of the State.	
(4) On private lands eagle nesting sites will not be removed, felled or in any way disturbed.	

STANDARDS FOR PROTECTION OF SPECIAL FISH AND WILDLIFE AREAS	COMMENTS ON STANDARDS
c. Alteration or disturbance of the habitat in marine mammal and migratory seabird rookeries or migratory waterfowl and shorebird nesting or staging areas shall be temporary limited to the non-breeding season and fully restored to natural conditions prior to the next breeding season. Loss of essential migratory bird or marine mammal habitat due to permanent alterations which remove or alter breeding, nesting, pupping, or staging areas will require mitigation.	Disturbance of marine mammals or their essential habitats is prohibited under the Marine Mammal Protection Act and Coastal Management Program 6 AAC 80.150. Disturbance or distruction of migratory bird habitat is prohibited under the Migratory Bird Treaty Act of 1918 and treaties with Japan, Mexico and the Soviet Union as well as the Alaska Coastal Management Program. 6 AAC 80.150.
Riparian Habitats and Wildlife Corridors	
a. For all public and navigable waterbodies, a shoreline zone of at least 200 ft. from high water mark (vegetated banks) in the case of rivers, lakes, and streams; and higher high tide from marine waters:	The standards outlined should be implemented as general standards. It is recognized that these guidelines may not apply in all situations. A qualified ADF&G or USF&WS biologist should review specific cases and determine appropriate measures.
(1) Avoid seismic line cutting within corridors. Attempt to design cuts by winter studies using natural openings in vegetative cover.	The Department of Fish and Game has requested that the Division of Land, Water and Forest Management establish riparian zones either by easement or retention in public ownership along waterbodies on State lands.
(2) The use of existing seismic cuts or other openings in the natural vegetation will be used for siesmic study whenever available.	
(3) Cutting lateral incursions (parrallel corridors) are prohibited.	Based on actual field experience riparian zones ranging from 200-800 ft. were recommended. The most important consideration identified for determining the width of the zone needed to protect waterbodies was the type and intensity of the adjacent land use. Because the site conditions of land (i.e. soils, slope and vegetation type) can vary significantly along a waterbody, some flexibility was needed to regulate activities within an established zone. Therefore, the Department recommended that waivers be granted to applicants for water related activities within the zone when an on-site inspection determined that the proposed development would not impact or would not be impacted by the water body.
(4) If no alternatives are available, seismic cuts normal to shoreline corridors will be designed to avoid sensitive wildlife areas e.g. bald eagle nest sites, spawning areas and times. Along timbered shorelines seismic cuts will leave at a minimum 50 ft. of standing timber along waterbodies.	
(5) Revegetation or scarification will be required for all lands cleared of natural vegetation.	

STANDARDS FOR PROTECTION OF SPECIAL FISH AND WILDLIFE AREAS	COMMENTS ON STANDARDS
(6) Timber or brush cleared for site preparation or seismic studies will be stacked and removed or burned to prevent bud worm infestation. Any timber or other debris deposited in waterbodies will be removed.	Along major river courses larger corridors have been classified for state retention as wildlife and public recreation lands.
(7) No ground contact equipment may enter or cross active (open or flowing) rivers, streams, or lakes except at authorized crossings and, in addition, these activities in waters designated by the Alaska Department of Fish and Game (ADF&G) as anadromous waters require ADF&G approval.	
(8) No explosives will be detonated within one-fourth (1/4) mile of rivers, streams, or lakes designated by the Alaska Department of Fish and Game (ADF&G) as anadromous waters unless a variance has been obtained from ADF&G.	
Wetlands	
a. For a broad range of wetland communities to include but not limited to bogs and marshes which are characteristic of relatively flat areas with little relief and poor drainage. Seasonally saturated soil conditions sustain a predominance of aquatic vegetation; however, species composition may vary considerably from one wetland to another.	Operations in wetlands will require adherence to Section 404 (Clean Water Act of 1977) regulations of the Corps of Engineers, the 404 (6) guidelines of the Environmental Protection Agency (EPA) and Executive Order 11988, Floodplain Management.
(1) Where heavy land equipment is used for seismic investigations exploratory drilling or other activity on wetlands, work shall be performed only in the winter when there is one (1) foot or more of ground frost and a minimum of one (1) foot of snow cover.	By limiting activities by heavy equipment to the winter when there is ample ground frost and snow cover, there should not be any appreciable surface damage.
(2) When technically possible, exploratory drilling work shall be done on upland ground using directional drilling procedures to reach below the wetlands	Directional drilling would avoid the necessity for road construction and work pads and the problem of waste disposal and human disturbance in the wetlands.

STANDARDS FOR PROTECTION OF SPECIAL FISH AND WILDLIFE AREAS	COMMENTS ON STANDARDS
(3) Formation water at production wells shall not be discharged on surface lands, wetlands, or into any flowing or standing water. Formation water shall be reinjected.	Pollution of waterbodies, wetlands, or ground water must be prevented.
(4) When directional drilling from uplands is not technically feasible work pads and/or other disturbances should be located in proximity to existing roads or other disturbed areas.	This would minimize wetland development and subsequent habitat destruction and would, in part, meet the requirements of the EPA guidelines.
(5) Drilling fluids and other wastes, containment berms, fuel and equipment should be removed from the location on or before March 15.	This would minimize wildlife disturbance from machinery and human activity prior to spring thawing.
(6) If an exploratory well is a non producer, at completion of well testing operations, the drill pad shall be removed and the area stabilized revegetated and returned to pre-project condition.	
(7) At production sites, vehicle travel should be restricted to the work pad and access roads.	

GUIDELINES FOR PROTECTION OF FISH, WILDLIFE AND THEIR HABITATS DURING DEVELOPMENT	COMMENTS ON GUIDELINES
I. Protection of Fish and Wildlife and their Habitat	
1. General Guidelines	
a. All activities conducted on State lands and waters must provide for the unrestricted passage of fish.	This guideline does not preclude the site-specific approval of in-stream activities which may temporarily block fish movements during non-critical times. ADF&G will address fish passage under AS 16.05.840 and AS 16.05.870.
b. Pump intakes in lakes, streams or marine waters shall be screened to prevent harm to fish.	No criteria regarding size of screen, etc. has been stated because it would be dependent upon the size of the pump, size of the stream and size of the fish to be protected. Therefore, it will need to be decided on a site-specific basis.
c. When abandoned, water diversion structures shall be removed or plugged and stabilized.	This action is needed to avoid trapping fish. This guideline is covered under AS 16.05.020 Functions of Commissioner of the Department of Fish and Game (ADF&G).
d. If material sites are approved adjacent to or in lakes, rivers, streams, estuaries, coastlines, or wetlands; levees, berms, or other suitable means should be employed to protect fish, assure fish passage and prevent siltation.	Establishing buffer zones would normally preclude the necessity for this guideline. However, if a waiver is granted, waterbodies can still be protected by this means. Authorities to implement this guideline are provided in AS 16.10.010, AS 16.05.870 and AS 16.05.840.
e. Dredging or filling of marine submerged lands and tidelands essential to the rearing or reproduction of marine and anadromous fish, invertebrates, mammals or birds shall be prohibited. Dredging or filling of tidelands shall be restricted to those uses or activities which are water-dependent and allowed only after all alternative means of construction have been considered and upon approval of the Commissioner of the Department of Fish and Game.	The continued maintenance or enhancement of coastal habitats is mandated for all uses and activities conducted on State lands in the coastal zone. The authority to implement this guideline is found in the Coastal Management Standards 6 AAC 80.130(c)(1).

GUIDELINES FOR PROTECTION OF FISH, WILDLIFE AND THEIR HABITATS DURING DEVELOPMENT	COMMENTS ON GUIDELINES
f. The removal or disturbance of intertidal or subtidal plants and animals except for the purpose of recreational, commercial, or subsistence consumption and for the purpose of scientific research or study should be discouraged and shall require prior approval from the Commissioner of the Alaska Department of Fish and Game.	Intertidal and subtidal seagrasses and attached algae (e.g. Kelps) provide an essential source of food and living space for diverse marine birds, mammals, fish, and invertebrates. These highly productive marine plant stands are essential juvenile rearing habitats for many commercially important marine fish. The protection of these resources is a function of the Commissioner of the Department of Fish and Game (AS 16.05.020) and is required under the Alaska Coastal Management Program (6 AAC 80.130).
g. Harbors, breakwaters, jetties, and other permanent coastline structures shall be sited and designed so as to maintain circulation and mixing of water, longshore transport of sediments and the migratory pathways of aquatic life.	The natural erosional-depositional processes which maintain clam beaches should not be altered. In additon, the freshwater-marine water mixing processes of estuaries which provide essential feeding and spawning habitats and migration corridors for marine and anadromous fish shall be maintained (6 AAC 80.130 Coastal Management Standards).
h. Transportation and utility routes shall be designed to avoid alteration of essential habitat areas including waterbodies, coastal wetlands, and tide-flats, and to minimize disruption of drainage and flow patterns in watersheds. Causeway design shall elevate the roadway on pier or piling supports and avoid the need for solid fill. Grade-level roads across lower flood plains shall be located parallel to the path of water flow.	Roadways if built on solid fill and normal to natural drainage patterns act as dams which block water flow. The maintenance of natural flow patterns is essential to the continued productivity of aquatic and marine habitats. Authorities to implement this guideline are provided under AS 16.10.010, 6 AAC 80.080 and 6 AAC 80.130.
i. To minimize damage to marine life, logs shall be bundled prior to dumping into the water to reduce loss and sinking. Logs shall not be permitted to ground at any tidal stage. Log transfer and rafting sites shall be sited away from the mouths of fish streams, eelgrass beds and clam beds. Subtidal slopes of greater than 40% are preferred. Logs shall be readied for transport and moved away from shore as soon as feasible after being deposited in water. Logs shall not be stored in estuaries for long periods of time.	The improper use of marine waters for the storage and transportation of logs can eliminate spawning and rearing habitat for salmon, herring, crabs and shrimp through excessive bark accumulation on the sea floor, toxic log leachates, crushing of marine fauna and flora from grounded logs and decreased light penetration under log rafts. Authorities to implement this guideline are provided under 6 AAC 80.100 and 6 AAC 80.130 of the Coastal Management Standards.

GUIDELINES FOR PROTECTION OF FISH, WILDLIFE AND THEIR HABITATS DURING DEVELOPMENT	COMMENTS ON GUIDELINES
j. Water appropriations should not exceed in-stream flow requirements for fish and wildlife. In-stream flow requirements should be determined by the Department of Fish and Game prior to approval of water appropriation permits.	The dewatering of lakes and streams, can have a severe impact on both aquatic and terrestrial species that are dependent on rivers, stream and lakes for food or living space. The Alaska Statutes for the appropriation and use of water AS 46.15; the Coastal Management Standards 6 AAC 80.130 and the Protection of Fish and Game AS 16.05.870 provide the necessary authority.
k. Exotic, predatory or other destructive animals including domestic livestock shall not be introduced on seabird islands.	Introductions of fox have totally eliminated a number of seabird species on islands. Introduced cattle or raindeer overgraze vegetative cover on islands destroying important seabird nesting areas. (Coastal Management Standards 6 AAC 80.130(c)4.)
l. Any alteration of the habitat in-marine mammal and seabird rookeries or waterfowl nesting and staging areas shall be temporary, limited to the non-breeding season and fully restored to natural conditions prior to the next breeding season. Permanent alterations which remove or alter breeding habitats shall be avoided.	Disturbance of seals, sea lions and seabirds on their rookeries result in significant loss of pups and chicks. (Coastal Management Standards 6 AAC 80.150 and Functions of the Commissioner of ADF&G AS 16.05.020)
m. Dock, piers, causeways, and other in-water structures, shall be sited and designed to allow for the free circulation of barrier island lagoon waters and unrestricted movement of aquatic life. Structures connecting barrier islands to the mainland shall not promote the introductions of fox or other predators to bird nesting areas.	During summer, barrier islands and lagoons along the Arctic coast are heavily used by waterfowl. At this time adult birds, their eggs and young are very vulnerable to predators such as fox. The lagoons are also major spring and summer concentration areas for marine, anadromous and some fresh water fish species. (Coastal Management Standards 6 AAC 80.130(c)5 and AS 16.10.010)
n. Alterations of fish or shellfish spawning beds, rearing and overwintering areas shall be avoided. If alterations cannot be avoided, the proposed modifications must be approved by the Commissioner of Fish and Game.	The areas identified are critical to fish and must be protected. (Coastal Management Standards 6 AAC 80.130 and AS 16.10.010)

GUIDELINES FOR PROTECTION OF FISH, WILDLIFE AND THEIR HABITATS DURING DEVELOPMENT	COMMENTS ON GUIDELINES
o. Fish or shellfish spawning beds, rearing and overwintering areas shall be protected from sediment where soil material is expected to be suspended in water as a result of construction, agriculture, mining, or other activities. Settling basins or other sediment control structures shall be constructed to intercept silt before it reaches rivers, streams, lakes, wetlands, or marine waters.	Silt and sediment above that naturally occurring in a system can be detrimental to fish and other aquatic organisms. It is recognized, however, that some activities unavoidably produce silt. These activities must be accompanied by measures to keep silt out of waterbodies. (Coastal Management Standards 6 AAC 80.130(c)2, AS 16.10.010 and AS 16.05.870.)
p. Any damage to fish or shellfish spawning beds, rearing or overwintering areas caused by construction, development or related activities shall be repaired to the satisfaction of the Commissioner of Fish and Game.	Damage to these critical areas, whether from permitted or non-permitted activities, shall be repaired so that fish populations are not reduced due to loss of suitable habitat. (Coastal Management Standards 6 AAC 80.130)
q. Water shall not be taken from fish overwintering areas or waters that replenish those areas during critical periods defined by the Commissioner of Fish and Game unless authorized in writing by the Commissioner.	Overwintering areas concentrate fish populations and water. Construction and other activities that require water during winter months usually withdraw this water from overwintering areas. This jeopardizes, if not eliminates, fish populations. (AS 16.05.870)
r. Construction, development or related activities in key fish and wildlife areas and in specific areas where threatened or endangered species of animals are found may be restricted by the Commissioner of the Department of Fish and Game during periods of fish and wildlife breeding, nesting, spawning, lambing, and calving activity, overwintering, and during major migrations of fish and wildlife.	This provides the Department with the opportunity to give protection to all fish and wildlife including non-game species and furbearers which are not covered by any other means. (Functions of the Commissioner of ADF&G AS 16.05.020 and Protection of endangered species habitat AS 16.20.185)
s. All construction, development, or related activities shall be designed, constructed, and maintained so as to assure free passage and movement of big game animals.	This precludes a development which may block or obliterate known migration routes primarily for moose, caribou and bison. If permittees can design or plan activities in such a way that big game passage is assured, then permits can be approved. (Functions of the Commissoner of ADF&G AS 16.05.020)

GUIDELINES FOR PROTECTION OF FISH, WILDLIFE AND THEIR HABITATS DURING DEVELOPMENT	COMMENTS ON GUIDELINES
t. A plan for the storage and use of explosives, including but not limited to blasting techniques, timing, and locations shall be submitted to the Commissioner of Fish and Game for approval.	Blasting and storage of explosives is potentially harmful to wildlife and fish, particularly during Dall sheep lambing, caribou or moose calving, raptor nesting, etc. Therefore, some control must be extended over the time, place, and method of blasting. (Functions of the Commissioner of ADF&G AS 16.05.020)
u. No blasting should be done under water or within one quarter (1/4) mile of marine waters, streams, or lakes with identified wildlife or fisheries resources without approval of the Commissioner of Fish and Game.	Both permitted and non-permitted activities can result in serious damage or obliteration of populations or habitat. Each developer should be aware before beginning work on State-selected land, that he will need to plan for rectifying the damage. (Functions of the Commissioner of ADF&G AS 16.05.020 and Protection of Fish and Game AS 16.05.870)
v. All activities that may create new lakes, drain existing lagoons, lakes or wetlands, significantly divert natural drainages, sediment transport, and surface runoff, permanently alter stream or ground water hydraulics or disturb significant areas of stream beds, tidelands or marine lands shall be prohibited unless approved by ADF&G and DNR.	Alteration of natural waters can have long-lasting detrimental effects on fish and wildlife through destruction of habitat, velocity barriers, etc. In addition, changed hydraulic regimes can cause rivers to threaten existing development. These activities must be closely regulated by the responsible agencies. (Protection of Fish and Game AS 16.05.870 and Coastal Management Standards 6 AAC 80.130)
Pollution Control	
1. General	
a. All activities on State land shall be conducted in a manner that will avoid or minimize degradation of air, land, and water quality.	Pollution of all types can have pronounced effects upon the habitat and well-being of terrestrial and aquatic (including marine) species). It is imperative that protection from pollution be provided.
2. Water and Land Pollution	
a. All persons conducting operations on State land should be informed of and comply with the Water Quality Standards of the State of Alaska as approved by the Environmental Protection Agency, and with the requirements of the Environmental Protection Agency's National Pollutant Discharge Elimination System waste discharge permit program and Alaska's Waste Disposal Standards.	Compliance with these standards shall assure that degradation of water and land fish, and wildlife populations, and their habitats will be minimized. (AS 46.03.100)

GUIDELINES FOR PROTECTION OF FISH, WILDLIFE AND THEIR HABITATS DURING DEVELOPMENT	COMMENTS ON GUIDELINES
b. Persons conducting commercial development, agricultural, industrial, fish processing, timbering or construction activities should submit plans and procedures for transportation, storage and distribution of fuel or other hazardous substances to DEC, DNR, and ADF&G for approval prior to handling these substances.	The cumulative damage to the environment from numerous small incidents of pollution such as leaking pipes, overfilled tanks, poor storage methods, transportation incidents is as damaging as that from occasional catastrophic occurrences. (Coastal Management Standards 6 AAC 80.130, Protection of Fish and Game AS 16.05.870 and Interferance with salmon spawning streams and waters AS 16.10.010,)
c. Storage, transfer, or handling areas for petroleum products or hazardous substances must be diked or bermed in such a manner as to provide 110 percent of the total volume of the storage tanks in the relevant area.	If a spill occurs, it would be confined to the immediate area and not contaminate surrounding land or waters. Although not a specific regulation at this time, this guideline could be implemented as regualtion under AS 10.05.870 or AS 16.05.010.
d. Persons shall give notice in accordance with applicable State and Federal Laws or regulations of any spill or leakage or discharge of oil or other hazardous wastes.	The Oil and Hazardous Substance Pollution Control Regulations, 18 AAC 75.080.
e. It is the policy of the State of Alaska that there shall be no discharge of oil or hazardous substances into or on State lands or waters. Persons conducting activities on State lands must recognize their responsibility for the protection of the public and environment from the effects of discharge.	This statement clarifies not only the attitude of the Department of Fish and Game toward spillage, but the attitude of the State as a whole (the Oil Pollution Statute, AS 46.03.740).
f. The temperature or salinity of natural surface or ground waters shall not be altered by any activities conducted on State land unless authorized by DEC and ADF&G.	Raising or lowering the temperature or salinity of coastal or inland waters can severely affect aquatic organisms, causing massive mortality in some cases, and should be avoided (the Alaska Water Quality Standards 18 AAC 70).
g. Logging, mining or agricultural activities should be controlled so that runoff water is maintained at the pre-existing quality, volume and rate of flow. Operations should be closely regulated and monitored to ensure that erosion and sedimentation, detrital, nutrient and toxic runoff including that from biocides and thermal pollution do not occur.	The Alaska Water Quality Standards 18 AAC 70.

GUIDELINES FOR PROTECTION OF FISH, WILDLIFE AND THEIR HABITATS DURING DEVELOPMENT	COMMENTS ON GUIDELINES
h. The ocean dumping or coastal discharge of nonbiodegradable garbage, toxic chemicals, heated waters, sludge, oil, and dredged material shall be probibited. Sewage, industrial effluents and fish processing wastes shall be treated where necessary and made safe before discharging.	The Alaska waste disposal permit, AS 46.03.100.
3. Air Quality	
a. Persons shall utilize and operate all facilities and devices so as to avoid or minimize air pollution and icefog.	Maintenance of high air quality is as important as water quality in most cases. Many animals and plants cannot survive in polluted conditions. For example, sulphur dioxide (SO_2) in concentrations as low as 0.5 parts per million is lethal to lichens utilized by caribou for food. Dall sheep eat plants associated with lichen communities and these would also be adversely affected if lichens are destroyed by excess (SO_2) emissions. (The Alaska Air Quality Regulations 18 AAC 50.)
b. Emissions from equipment, installations and burning materials shall meet applicable Federal, State, and local government emission and performance standards.	
4. Pesticides, Herbicides, and Other Chemicals	
a. Persons shall use only non-persistent and immobile types of pesticides and herbicides registered by the Environmental Protecton Agency pursuant to the Federal Insecticide, Fungicide and Rodenticide Act. Application of pesticides and herbicides shall be in accordance with applicable regulations of the Alaska Department of Environmental Conservation and the U.S. Environmental Protection Agency. Each chemical to be used and its constraint of application shall be approved by DEC, ADF&G, and DNR prior to use.	It is well known that certain chemicals are highly toxic to wildlife. For example, use of the pesticide DDT is one of the main reasons for the endangered status of the peregrine falcon. The DDT causes egg shells to be much thinner than normal and reduces hatching success. Any use of chemicals should be carefully scrutinized (the Alaska Pesticide Control Regulations 18 AAC 90).

GUIDELINES FOR PROTECTION OF FISH, WILDLIFE AND THEIR HABITATS DURING DEVELOPMENT	COMMENTS ON GUIDELINES
5. Sanitation and Waste Disposal	
a. "Waste" means all discarded matter, including but not limited to human waste, trash, garbage, refuse, oil drums, petroleum products, ashes and equipment.	Improper disposal of garbage, sewage, and solid waste has adverse effects upon fish and wildife and their habitats. Sewage leaking into marine waters, a lake or river increases the biological oxygen demand (BOD) and causes nutrient overloading which degrades water quality necessary for sensitive aquatic organisms such as salmon and trout. Non-incinerated garbage attracts wolves, bears, and foxes causing disease problems, threats to human safety and disturbance of normal life cycles. (The Alaska Waste Disposal Statute AS 46.03.100; Oil Pollution Statute, AS 46.03.740 and Solid Waste Disposal Regulations 18 AAC 60.)
b. All waste generated shall be removed or otherwise disposed of in a manner acceptable to DEC, DNR, and ADF&G. All applicable standards and guidelines of the Alaska State Department of Environmental Conservation and other Federal and State agencies shall be adhered to.	
C. 100 Restoration and Rehabilitation	
1. Adequate means shall be provided for repair, acement or rehabilitation of natural resources (including but not limited to revegetation, re-stocking fish or other wildlife populations and re-establishing their habitats) that are seriously damaged or destroyed as a result of construction, development, or related activities. Appropriate means of restoration will be determined by the Commissioner of the Deaprtment of Fish and Game.	Both permitted and non-permitted activities can result in serious damage or obliteration of populations or habitat. Each developer should be aware before beginning work on State-selected land, that he will need to plan for rectifying the damage. (The Functions of the Commissioner, AS 16.05.020 and the Protection of Fish and Game, AS 16.05.870.)
a. Restoration includes erosion and sediment control, revegetation, stabilization and visual amelioration.	

GUIDELINES FOR PROTECTION OF FISH, WILDLIFE AND THEIR HABITATS DURING DEVELOPMENT	COMMENTS ON GUIDELINES
D. Erosion and Sedimentation Control	
1. General Guidelines	
a. All construction, development, and related activities shall be conducted so as to minimize distubance to all surface areas.	Guidelines specify how erosion and sediment can be reduced. All efforts are directed toward preserving integrity of fish and wildlife habitat. (The Protection of Fish and Game AS 16.05.870, Interference with salmon spawning streams and waters AS 16.10.010, and the Coastal Management Standards 6 AAC 80.130.)
(1) The design of all facilities shall provide for the control of erosion and reduction of sediment production or transport.	
(2) Erosion control structures shall be considered to limit induced and accelerated erosion, to reduce sediment production or transport, and to lessen the possibility of forming new drainage channels. The structures shall be designed and operations conducted in such a way as to minimize disturbance to the thermal regime.	
(3) Surface materials suitable for use in restoration taken from disturbed areas shall be stockpiled and utilized during restoration. Erosion and sediment control practices as determined by the needs for specific sites, should include but shall not be limited to revegetation, mulching, and placement of mat binders, soil binders, rock or gravel blankets or structures.	
(4) All disturbed areas shall be left in a stabilized condition.	
(5) All excavated materials in excess of that required for backfill should be disposed of in disposal sites approved by the Department of Natural Resources.	Fish and Game has no authority to regulate disposal in areas other than fish streams. In order to maintain good quality wildife habitat, all waste materials should be put into approved sites.

GUIDELINES FOR PROTECTION OF FISH, WILDLIFE AND THEIR HABITATS DURING DEVELOPMENT	COMMENTS ON GUIDELINES
(6) Construction spoils shall be placed upslope from bench cuts along shorelines to avoid downslope landslides, erosion and stream sedimentation. All highwalls should be reduced and natural contours maintained to minimize slope instability and facilitate reclamation.	
2. River, Stream, or Floodplain Crossings	
a. Temporary access across stream banks should be made through use of fill ramps rather than by cutting through stream banks. Ramps and ramp materials should be removed by the contractor upon termination of seasonal or final use. Ramp materials should be disposed of in a manner consistent with these guidelines.	Preservation of stream integrity is achieved through allowing bank cutting on a site-specific basis only for permanent stream crossing. (The Protection of Fish and Game, AS 16.05.870.)
b. Excavated materials shall not be stockpiled in rivers, streams, lakes, floodplains, tidelands, subtidal lands or wetlands.	Requiring excavated materials to be stored outside waterbodies eliminates the hazards of downstream pollution, blockage of fish passage, filling in lakes, wetlands or tidelands, etc. (The Protection of Fish and Game, AS 16.05.870 and the Coastal Managment Standards 6 AAC 80.130.)
c. Erosion and sedimentation shall be minimized at river, stream and floodplain crossings and during all other permitted in-stream activities.	Erosion and accompanying sedimentation has been proven to be detrimental to aquatic organisms and should be avoided. (The protection of Fish and Game, AS 16.05.870 and the Coastal Management Standatds 6 AAC 80.130.)

GUIDELINES FOR PROTECTION OF FISH, WILDLIFE AND THEIR HABITATS DURING DEVELOPMENT	COMMENTS ON GUIDELINES
E. Plans	
1. Plans shall be submitted for review by DNR, DEC, and ADF&G for the following items before the start of construction, development, or related activities: a Handling Fuel and Hazardous Chemicals b. Air Quality. c. Pesticides, Herbicides and Chemicals d. Solid and Liquid Waste Management e. Erosion Control f. Stream Crossings g. Material Removal h. Disposal of Spoil i. Clearing j. Blasting k. Restoration/Rehabilitation l. Protection of Fish and Wildlife	In order to assess an applicant's competence to conduct his proposed activities on State land and adequately protect the environment, plans shall be required for agency review. Most potential problems can be solved at this stage rather than waiting until the activities are ongoing before they are discovered.
F. State Laws, Regultions, and Requirements	
1. All persons engaged in construction, development, or related activities must abide by all applicable State laws, regulations and requirements.	This guideline serves to remind the developer that he will be regulated through local, State and Federal laws, etc., in addition to the guidelines set forth here. It also makes it incumbent upon the developer to inform himself of applicable laws, regulations and requirements before he is involved in a violation.

3.3. Preliminary ADF&G Access Policies on State Lands*

3.3.1. Methods of Maintaining Public Access to Fish, Wildlife, and Other Environmental Resources

A major concern identified during the process of evaluating resource interests on State lands is the need to ensure continued public use of Alaska's trail systems and waterways. The vast majority of outdoor recreational activities including hiking, hunting, fishing, boating, photography, etc., are totally dependent on access via waterbodies or trails. In addition, it is recognized that travelling the river and trail is itself a recreational experience enjoyed by many Alaskans. To enhance the opportunity of the public to use and enjoy these recreational experiences, corridors are being planned along water routes receiving current or expected recreational use, and surface routes possessing exceptional recreational, scenic, cultural, or historic significance.

From the land management perspective, a recreational corridor is a greenbelt or buffer strip along a trail, river, or highway wide enough to:

1) allow a natural buffer between the travel way and the adjacent inimical distractions from residential, commercial, industrial, agricultural, timber harvest, or resource exploration and extraction activity; and

*Logan 1980

2) to protect significant wildlife and fisheries habitat as well as scenic and cultural qualities.

There are two primary procedures for securing public use of the State's waterways and trails. One is the establishment of restrictive easements which provide pedestrian access. The other is the retention of these corridors in State fee ownership. The use of restrictive easements does offer several advantages. These are:

1. Easements are easily and inexpensively administered. Because the establishment of restrictive easements does not require ownership of State lands, the State passes the responsibility of management on to the land owner; i.e., borough, municipality, or private agent.

2. The public generally accepts and supports establishment of pedestrian easements.

3. The establishment of a fifty foot pedestrian easement along waterbodies is already a State policy.

4. Sufficient development restrictions can be included in the provisions of the easement to provide some assurance that reasonable public access will be allowed.

The actual application of restrictive easements has, however, several important limitations. These are:

1. Frequently, the rights of access are not clearly understood by the landowner or the recreationist.

2. The recreationist only has the right to travel through the easement; provisions for remaining to enjoy recreational pursuits are not included.

3. The State's options for providing or improving recreational facilities or opportunities are essentially non-existent in or along the easement without purchasing land.

4. The State has the responsibility and often bears the expense of enforcing the restrictions and arbitrating owner-user conflicts.

5. The owner is often deprived of full use and enjoyment of the land. This is especially true along heavily used easements.

6. Pedestrian easements, as they are administered presently, provide no protection for wildlife and fisheries habitat or scenic, historic, and cultural values.

7. Restrictive easements provide only minor property rights which can easily be lost through court actions. Easements are considered a last resort in areas experiencing rapidly changing property rights.

8. Perhaps of most importance, easement restrictions often do not accommodate the public's need for recreational opportunities. The right to travel through an area, without being able to stop to camp, fish, or photograph, is generally not adequate to provide a high quality outdoor experience.

3.3.2. Recommendations for Maintaining Public Access

Based on the above considerations, the following actions are strongly recommended to provide and ensure the continued opportunity of the public to use and enjoy Alaska's recreational corridors:

1. Prior to any State land disposal, classification, or reclassification, the Alaska Department of Fish and Game and the Division of Parks will identify important recreational corridors to be retained within the subject lands.

2. The provisions of 50 ft. pedestrian easements along waterbodies should be expanded to include consideration for fish and

wildlife habitat maintenance and scenic, historic, and cultural values. (See recommendations for establishment of protective buffers, Section 3.2.2. above.)

3. If the recreation corridor does not contain enough space to establish necessary waysides or campgrounds, 5-40 acres should be identified for this purpose, as needed, and retained in public ownership. As a guideline, waysides or campgrounds should be established at 5-7 mile intervals.

In addition to these recommendations, the ADF&G has been working with other agencies to:

1. Promote passage of patent language regarding access easements.

2. Develop a corridor policy to be implemented by the ADNR.(The Department of Natural Resources, Division of Parks, has drafted a corridor policy paper which could serve as a foundation for this effort. For further information, contact Ron Crenshaw, ADNR-Division of Parks, 619 Warehouse Avenue, Suite 210, Anchorage, Alaska 99501.)

Chapter 4 - Summary: Related Studies, Programs, and Data Needs

The value to the Alaska Department of Fish and Game and other participating agencies of the Willow-Talkeetna Sub-basin Study cannot be measured solely by the initial study products produced. Many of these products, such as this synthesis of ADF&G information, will rapidly become outdated as new information is collected. (Editors' Note: Already, much of the information presented here has been expanded and refined in the final interagency Willow Subbasin report which will be available from the SCS in early 1981. For more information, contact Sterling Powell, 2221 East Northern Lights Boulevard, Anchorage, Alaska 99504). The value of this interagency resource assessment must also be measured in terms of the new programs, methodologies, research studies, policies, communication channels, etc., it has generated. Measured in these terms, the values of this River Basin Study are substantial and likely to continue to increase.

To begin with, "intangible benefits" (benefits that cannot be readily evaluated or measured) have been numerous. Among these benefits are:

1. the establishment of new interagency working realtionships and communication channels;
2. opportunities to apply methodologies in use by other agencies (e.g., HEP*, computer-integrated terrain unit mapping, interpretation of remote sensing data) and to provide feedback on potential values, limitations, and improvements of these methodologies;

*"Habitat Evaluation Procedures," USFWS, Division of Ecological Services (1980)

3. increased familiarity with data, resources, and assistance available from other agencies; and
4. numerous opportunities to identify ADF&G data needs to other data-collecting agencies.

4.1. River Basin-related Programs

Tangible by-products of the Willow-Talkeetna Sub-basin Study are of even greater consequence than the "intangibles" mentioned above. Below are listed and described the major ADF&G programs to which this study has given rise or added impetus (additional ADF&G studies are described in Appendix A). These studies will eventually greatly supplement information presented here.

4.1.1. Instream Flow Program

The River Basin Studies provided support to the ADF&G to:

a) train personnel to collect biological and physiochemical instream flow data;
b) train personnel to analyze the above data;
c) acquire equipment to collect and analyze instream flow data;
d) evaluate various instream flow methodologies; and
e) develop plans for the establishment of a Departmental Instream Flow Program. Objectives of this program would include:

    1. develop institutional procedures for reserving stream flows;

2. store data for adjudicating instream flows;
3. consult professional hydraulic engineers to develop ungaged procedures for use when field data are unavailable and the collection of field data is not appropriate;
4. collect fish and wildlife aquatic habitat preference data;
5. collect hydraulic data for instream flow analysis;
6. provide instream flow data to the Department Biometrician for computer analysis; and
7. provide technical support to the Department with respect to the collection of both biological and physiochemical data for the determination of instream flows for both fish and wildlife.

4.1.2. Resource Assessment Branch of the ADF&G

A new branch is being established within the Habitat Protection Section to keep abreast of developing methodologies and procedures for land and water resource data collection, analysis, evaluation, and application; and to identify, test, and "custom-fit" methods which meet the needs of the Department and other users. Of particular interest will be new methods to evaluate capabilities of lands and waters to produce fish and wildlife, and to increase opportunities for human use and enjoyment of fish and wildlife resources. Goals of the branch also include: 1) creating and training an interdisciplinary professional staff, including physical and biological scientists, engineers, data managers, land use planners, resource specialists, etc., to provide an integrated approach to solving resource problems; 2) developing and testing resource evalu-

ation techniques appropriate for particular locales, problems, or activities; 3) assisting regional planning programs such as future River Basin Studies; and 4) developing procedures for effectively implementing and monitoring land-use plans, guidelines, standards, etc. (For further information on the Resource Assessment Branch, contact Richard Cannon, ADF&G, Anchorage).

The River Basin Study provides valuable examples of field data collection methods (both aquatic and terrestrial), land-capability/suitability analyses, land-use planning procedures, and interagency cooperation upon which to build; in addition to providing baseline resource data for an extensive area.

4.1.3. ADF&G Regional Wildlife Management Plans

The ADF&G has initiated a process to update and implement the regional Alaska Wildlife Management Plans drafted by the Department in 1976 (see Appendix A). Each regional plan identified primary and secondary management objectives for big game, small game, furbearers, and protected species within individual Game Management Units in the region. Revised objectives and specific implementation procedures will be presented to the Board of Fisheries and Game for formal adoption. The resource inventory compiled during this Sub-basin Study will provide a useful data base for the update of the wildlife plans in the Susitna area. In addition, familiarity with the HEP Program gained during the Study will assist in identifying and evaluating potential wildlife habitats, as well as in assessing changes in habitat suitability caused by particular

developments or management activities (for further information on regional wildlife management plans, contact Jim Faro, ADF&G, 333 Raspberry Road, Anchorage, Alaska 99502).

In addition to these ADF&G programs, resource inventories and planning activities of other agencies are already employing the data and experience acquired in the Willow-Talkeetna Sub-basin studies. Ongoing planning activities include: 1) development of Susitna Area Plans and geo-based data management system by the ADNR; 2) transmission-line corridor studies by Commonwealth, Inc. addressing potential Healy-Willow intertie; and 3) Cook Inlet Region Inc. feasibility studies for a proposed coal liquifaction (methanol) plant in the Buluga Sub-basin.

4.2. Data Needs

Existing data sources and ongoing studies covering the fish and wildlife resources of the Willow-Talkeetna Sub-basins have been summarized here. Throughout this summary, the need to continually augment and update available data has been stressed. Therefore, detailed site-specific studies may be required as new developments are planned in these sub-basins. Below are summarized the major types of biological data which should be continually updated in order to manage particular populations wisely or to integrate fish and wildlife concerns into specific human activities or developments. In addition, recommendations for data management systems are also briefly presented.

4.2.1. Biological Data Needs

1. Seasonal species inventories, including species abundance and

distribution;

2. study of species seasonal life history phases;
3. examination of seasonal species-habitat relationships, e.g., identification of seasonal habitats required for life history phases and spatial and temporal utilization of existing habitats;
4. identification of seasonal species interrelationships, e.g., food webs, predator-prey competition;
5. evaluation of species status, e.g., historical and existing population estimates, genetic research, estimation of survival rates under various environmental conditions; and
6. assessment of seasonal human demands for particular species, e.g., location of human use areas, types and amounts of uses provided by particular species, etc.

4.2.2. Data Management Recommendations

The synthesis presented on the maps and in this narrative indicate existing ADF&G fish and wildlife information. This preliminary information is rapidly being augmented by programs listed above (Section 4.1.) as well as by studies outlined in the Annotated Bibliography (Appendix A). It is important to insure that as new data are collected, they be readily available to appropriate resource agencies. Computerized data management systems will soon be on line in several agencies (e.g., ADF&G, ADNR, USF&WS, among others) to assist with the storage, retrieval, and analysis of resource data.

To serve the needs of the greatest number of agencies and the public, the ADF&G recommends that computer systems employed for data management include the following capabilities:

1. compatibility of software among systems used by different agencies;
2. ability of agencies to control access to their own data files, (to prevent unsupervised use of preliminary or sensitive data);
3. identification of agency and principal contact for each data file; and
4. identification of data limitations.

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ACKNOWLEDGEMENTS

The editors would like to express their appreciation to the many individuals cited in this publication for their contributions to this project. Also included should be Evelyn Huttunen, Vikki Benner, and Sylvia Barrett for the many hours expended typing this document and Adrienne Horton who insured that we balanced our books.

Special appreciation is extended to the USDA Soil Conservation Service for its support and funding of this project (an added thank you to Sterling Powell, the overall Coordinator of the Program).

Appendix A: Annotated Bibliography of ADF&G Studies in the Willow-Talkeetna Sub-basins.

Introduction

The following annotated bibliography represents a compilation of ongoing and completed studies conducted by the ADF&G in the Willow and Talkeetna Sub-basins. Most of these studies were conducted by ADF&G personnel during 1977, 1978, and 1979 field seasons. In addition, particularly important baseline studies conducted by the ADF&G and other agencies over the past 15 years are also listed*.

*It is important to note that the ADF&G conducts numerous fish and wildlife restoration studies on an annual basis under the Dingell-Johnson and Pittman-Roberts Acts. These reports can be obtained from the Region II Sport Fish and Game Divisions.

Alaska Department of Fish and Game (ADF&G) 1973. Alaska's wildlife and habitat, volume I. ADF&G. Juneau. 44 pp. + maps.

This document provides information on Alaska's big game species, including black bear, brown/grizzly bear, wolf, wolverine, moose, caribou, Dall sheep, mountain goat, and others. Information is presented in three sections: Section 1: Wildlife Species Accounts, contains general life history accounts; Section 2: Game Management Unit Accounts, provides general descriptions of the game management units throughout Alaska and describes migration and uses of species within individual units; and Section 3: Wildlife Distribution Maps, provides maps at a scale of 1:250,000 on which species distributions in Alaska are marked.

_____. 1978a. Alaska's wildlife and habitat, volume II. ADF&G. Juneau 74 pp. + maps.

This document represents the companion volume to Alaska's wildlife and habitat, volume I (above) and provides information on Alaska's small game, raptors, and seabirds. The organization of material follows that described above.

_____. 1978b. Plan for supplemental production of salmon and steelhead for Cook Inlet recreational fisheries. ADF&G. Anchorage. 63 pp.

This document identifies specific sites, salmon stocks, and other factors necessary to achieve salmon enhancment goals outlined for Cook Inlet recreational fisheries in the 1975 statewide salmon enhancement plan.

Appendix A continued-

_____. 1979a. Abstracts to annual performance reports for Federal Aid in Fish Restoration and Anadromous Fish Studies. Juneau. 20:25 pp.

The following four studies are pertinent to the Willow-Talkeetna Sub-basin Study:

1) G-I-D Inventory and Cataloging of the Sport Fish and Sport Fish Waters of Upper Cook Inlet by D. Watsjold;

2) G-I-H Inventory and Cataloging of the Sport Fish and Sport Fish Waters of Western Prince William Sound, Lower Susitna River and Central Cook Inlet Drainages by S. Kubik and R. Wadman;

3) G-III-D Population Studies of Game Fish and Evaluation of Managed Lakes in the Upper Cook Inlet Drainage by A. C. Havens; and

4) SW-I Alaska Statewide Sport Fish Harvest Study by M. Mills.

_____. 1979b. Annual report survey-inventory of activities; Part I, moose, elk, deer (edited by R.A. Hinman). Fed. Aid in Wildl. Rest. 10(W-17-10): 157 pp.

_____. 1979c. Annual report of survey-inventory of activities; Part II, furbearers, wolf, wolverine, small game (edited by R.A. Hinman). Fed. Aid in Wildl. Rest. 10(W-17-10): 92 pp.

Appendix A continued-

_____. 1979d. Annual report of survey-inventory of activities; Part III, black bear, brown bear, polar bear, caribou (edited by R.A. Hinman). Fed. Aid in Wildl. Rest. 10(W-17-10): 170 pp.

_____. 1979e. Annual report of survey-inventory of activities; Part IV, sheep, mountain goat, bison, muskoxen, marine mammals (edited by R.A. Hinman). Fed. Aid Widl. Rest. 10(W-17-10): 123 pp.

For Willow-Talkeetna data in Part I, refer to sections dealing with moose in game management units 14 and 16. In Part II refer to sections dealing with furbearers, wolves, wolverines, and small game in game management units 14 and 16. In part III refer to sections dealing with sheep, mountain goats, and marine mammals in game management units 14 and 16.

_____. 1979f. Susitna hydroelectric project, preliminary final plan of study. ADF&G. Anchorage. 82 pp.

This paper presents the two phase five-year Plan of Study to evaluate the potential impacts of the proposed Devil Canyon and Watana Dams on the aquatic and terrestrial biological resources in the area, including the area immediately above the dam sites to the mouth of the Susitna River in Upper Cook Inlet. The proposed aquatic studies are designed to pursue six general objectives: 1) determine abundance and distribution of adult anadromous fish populations within the Susitna drainage; 2)

determine abundance and distributions of selected resident and anadromous fish populations; 3) determine spatial and seasonal habitat requirements of both resident and anadromous fish species during each of their respective life history stages; 4) determine the different values of resident and anadromous fish stocks (i.e., economic, recreational, aesthetic and social); 5) determine the impact of the Devil Canyon project on the Susitna aquatic ecosystem and what, if any, mitigations will be required; and 6) determine a long-term plan of study to monitor the project and its impacts during and after completion. The proposed wildlife studies concentrate on six large game species in the areas to be inundated by the dams. They are: 1) moose (proposed studies also cover the Susitna River corridor below the dams); 2) wolf; 3) wolverine; 4) bears (black and brown/grizzly); 5) caribou; and 6) Dall sheep. Each proposed substudy includes background information and an outline of procedures and costs incurred.

_____. Marine/Coastal Habitat Management. 1979a. Uses of State concern and special habitats. ADF&G. Marine/Coastal Habitat Management, Anchorage. n.p.

This document is a composite of maps, at a scale of 1:125,000, detailing five different concerns along the entire Alaska coastline and a brief narrative to further explain sections one and five. Of particular interest are the maps of the Susitna River and Upper Cook Inlet areas, one map for each area for each concern, for a total of 10 maps. The five concerns are: 1) habitat and species enhancement projects, research,

and monitoring activities; 2) established State game refuges, sanctuaries and critical habitat areas (includes 19 species and categories); 4) known anadromous fish streams, rivers and lakes; and 5) special habitats (includes 12 species and categories). The narrative describes the location, purpose, sensitivity, and management goals for each of the site locations given on maps dealing with concern one. In conjunction with the maps on special habitats, concern five, the narrative explains the various special habitat areas and gives an overview of the location, management plans and management goals. In the Cook Inlet area the following four special habitats are covered: 1) waterfowl and shorebird habitat; 2) brown/black bear spring habitat; 3) Dall sheep wintering/lambing habitat; and 4) moose wintering/calving habitat.

_____. Marine/Coastal Habitat Management. 1979b. Seasonal process for Alaska's coastal zone, 1979. ADF&G. Anchorage. n.p.

Willow-Talkeetna information is contained on maps of Coastal Seasonal Processes Upper Cook Inlet (map #43, scale 1:250,000); there are two maps: one on winter conditions (November-April) and one on summer conditions (May-October). On these maps, brief information in narrative form is presented on tides, wind and water, geology, circulation, hydrology, climate, vegetation, coastal mammals, anadromous fishes, marine fishes, marine mammals, marine invertebrates, coastal birds, and ice conditions (winter conditions map only).

Appendix A continued-

Bader, D. 1975. Report to the Federal/State Land-Use Planning Commission for Alaska, management committee and members, and Mt. McKinley management extensions. ADF&G. Anchorage. n.p.

This report identifies the wildlife species of monetary value found within the McKinley Planning Area, as well as their locations and estimated populations. The present and potential wildlife resource use is discussed in terms of trophy, sport, and subsistence hunting, photography, and protected and controlled visual uses. This use list forms the basis of a species-by-species listing on existing and potential monetary values for consumptive uses within the park expansion and cooperative management areas. The totals computed are $1,141,033 and $25,222,086 respectively. From this information two proposals are drawn for the use of the proposed land addition to McKinley Park.

Burbank, D. 1979. (Study in progress.) A study of the surface circulation in Upper Cook Inlet and the Norton Sound/NE Bering Sea region based on iso-density analysis of the suspended sediment distribution observed in LANDSAT imagery. ADF&G. Anchorage. (Data collection for this study is in the planning stages.)

Appendix A continued-

Delaney, K.J. and Wadman, R.D. 1980. Little Susitna River juvenile chinook and coho study 1979. ADF&G. Anchorage. 40 pp.

This report is a continuation of the Little Susitna River juvenile chinook and coho study of 1978 using 1979 data. (See Wadman and Delaney 1979, below.)

Didrickson, J.C. and K.P. Taylor. 1978. Lower Susitna Valley moose population identity study. Fed. Aid in Wildl. Rest. Proj. W-17-8 and W-17-9. ADF&G. Anchorage. 20 pp.

In November 1975, 49 moose were marked with collars in the Peters-Dutch Hills portion of game management subunit 16A; 24 were radio-collared and 25 were visual-collared. Tracking was terminated in August 1977 after 706 observations were made; 624 radio-collar and 82 visual-collar observations. Three winter areas were identified in the study area with an average distance of 13 km between summer and winter range for female radio-collared moose. Six of the nine radio-collared females returned to the previous year's calving area an average distance of 3.6 km between the 1975 and 1976 areas. Of four radio-collared bulls, three stayed within 8x20 km areas and one ranged in a 16x32 km area. During the observation period, six mortalities were noted; two deaths were from unknown causes, two deaths were results of predation (one bear-kill and

one wolf-kill), and two deaths were a result of hunting. The calf/cow ratios for radio-collared moose were 44.4:100 and 71.4:100 in November 1975 and August 1977 respectively. Up to a 64% survival rate was determined from spring to August.

Estes, C.C. 1979. Proposal for a special study instream flow demonstration project FY 1981-82. ADF&G. Anchorage. 22 pp.

The proposed study will:

(1) generate and analyze data essential for future instream flow comprehensive statewide planning and regulation including the evaluation of existing statutory regulations, interagency relationships, regulation mechanisms, staffing and research needs; and
(2) develop and demonstrate new analytical tools necessary for development of both a regional and a statewide instream flow evaluation and regulation plan.

Faro, J. 1979. Personal communication. ADF&G. Anchorage.

The Game Management Plans published 5 years ago (see ADF&G 1976b in "References") are being improved and updated. Revised plans will be developed over the next 5 years, with the first plans slated for review

by the public and then the Game Board in the spring of 1980. Approximately 21 plans will be submitted on priority areas including McNeil River for brown bear, Goat Mountain for mountain goats, the Tustumena area for moose and the Nelchina River area for caribou. Completed plans will encompass all game species throughout Alaska, and will be developed from a human-use rather than a wildlife population standpoint. Thus a single plan manages a detailed area, usually smaller than a game management unit.

Havens, A.C. 1979. (in preparation.) Population studies of game fish and evaluation of managed lakes in the Upper Cook Inlet drainage. ADF&G. Fed. Aid in Fish Rest., Annual Report of Performance, 1978-1979. Project F-9-12 (G-I-D).

This is a continuation of the study abstracted under ADF&G 1979a.

Lebida, R.C. 1976. Willow Creek glaciation and flooding investigations. ADF&G. Anchorage. 37 pp.

Aerial and ground surveys were conducted in September and November 1976 to investigate and assess winter glaciation and flooding problems in Willow Creek. Observations revealed several homes constructed on the immediate creek flood plain. Shallow riffle areas were found to prevent

large ice blocks from flowing downstream. Ice accumulation in these areas created dams, glaciation, and overflow flooding. Background information and recommendations are presented.

_____. 1979. Personal communication. ADF&G. Palmer.

Robert Lebida is supervising ongoing work on coho salmon habitat evaluations in Upper Cook Inlet to determine the magnitude, utilization, production potential, and characteristics of the available coho salmon rearing habitat. Also, under investigation are rehabilitation and enhancement needs, and their feasibility in the Matanuska-Susitna Valley.

Under the supervision of Robert Chlupach, evaluation of the Big Lake Hatchery Program is also underway. This project will evaluate the Upper Cook Inlet sockeye and coho stocking program to determine cost effectiveness, biological implications, and potentials in Big Lake, Nancy Lake, and Wasilla-Cottonwood Lakes. Smolt counts will be estimated, smolt age classes, species and origins will be determined, and adult returns will be enumerated.

Appendix A continued-

McCoy, G.A. 1978. Water resources of the new capital site, a Phase I Progress report prepared for the Alaska Capital Site Planning Commission. U.S. Geological Survey. Anchorage. n.p.

(Appendix only) A compilation of water quality and quantity data collected in the capital site area during 1978 is presented. Also several composite log graphs of test wells are given.

Metsker, H. 1978. Investigations of chemical compounds found in fish and bird tissues taken from stream systems in Matanuska, Tanana, Valdez and Kenai Peninsula. U.S. Fish and Wildlife Service. Anchorage. n.p.

In 1978, fish tissues were collected from Wasilla Lake, Delta Clearwater River and Lake, and streams and lakes near Willow to investigate contaminant residues. Contaminant residues analyzed included chlorinated pesticides, organophosphate pesticides, polychlorinated biphenyls (PCB) and toxaphene. It was found that old, large, or fat fish contained more contaminants than young, small, or lean fish. There did not appear to be significant differences in contaminant levels between fish species. Of the 15 fish collected from the Matanuska Valley, 86% contained DDE residue contaminants (the most frequent pesticide occurring in the tissue samples), and 53% contained PCBs. These figures are compared

with a 22-fish sample taken from the Tanana Valley, where 63% contained DDE and 59% contained PCBs. None of the fish contained sufficient amounts of any contaminant residue to cause stress or physiological damage to the fish.

Mills, M. J. 1979. Statewide sport fish harvest report, report to the Board of Fisheries, 1979. ADF&G. Anchorage. n.p.

The results of the 1978 postal survey of Alaska's anglers are summarized and compared with the 1977 results. Of the angler population sampled, 66-80% responded. The tabulated information correlates well with creel census findings and biologist's estimates.

_____. 1980. Willow Creek sport fish economic study (in progress). ADF&G. Anchorage. n.p.

This is the first volume of a series of site-specific economic studies covering local sport fisheries.

New Capital City Environmental Program--Phase I source documents 1-5. 1978. Capital Site Planning Commission. Anchorage.

A list of the title, authors, and primary content of the five documents follows. All source documents are available from Alaska State Library

in Juneau, but only source document 2 (fisheries studies) is available from the ADF&G Anchorage office.

1) Hydrologic Studies - Well water availability and surface and subsurface drainage studies by CH_2M-Hill; stream gaging and water quality, and Nancy Lake limnological study by USGS Water Resoruces Division.

2) Fish and Wildlife Studies - fisheries studies by D.A. Watsjold and L.J. Engel; moose habitat analysis by U.S. Soil Conservation Service (SCS).

3) Geotechnical Studies - geologic materials and hazards analysis by R&M Consultants.

4) Meteorology and Air Quality Studies - meteorological plan by Dames and Moore; installation of snow depth stations by SCS.

5) Staff Report - planning implication of Phase I and recommendations for Phase II by R. Morehouse.

Appendix A continued-

Timm, D.E. 1978. Relationships between trumpeter swan distribution and cabins in the Susitna Basin, Alaska. ADF&G. Anchorage. n.p.

Swans were sighted at a total of 343 different swan use areas during surveys conducted in 1975 and 1978. In 1978, 303 (88%) of these areas were inspected and swans were present in 170 of them. Cabins were present in only 30 of the 170. For unoccupied swan use areas (areas without cabins), adults with broods had an average return rate (from 1975-1978) of 62%, while the return rate for adults without young averaged 46%. For occupied areas (areas with cabins), the return rate was lower, with return rate decreasing with increasing numbers of cabins. When one to two cabins were present, the reuse rate was 48%, for three to five cabins, the reuse rate was 36%, and for six or more cabins the reuse rate was only 8%. For all surveys, an average of 2-3 adult swans were seen in areas without cabins, and 0.95 adult swans in areas with cabins. Depending on the number of cabins present, anywhere from 43 to 93% fewer swans were seen than in areas without cabins.

U.S. Fish and Wildife Service (USFWS). 1978. Catalog of Alaskan seabird colonies. U.S. Fish and Wildlife Service, Washington, D.C. 32 pp. + maps.

A brief species account is given for each of the major seabird species along the Alaska coast. Data on colony location, size, and species

composition are presented, as well as tables and illustrations to summarize data on populations throughout Alaska.

Wadman, R.D., and K.J. Delaney. 1979. Little Susitna River juvenile chinook and coho study 1978. ADF&G. Anchorage. 40 pp.

This report was prepared in partial fulfillment of the SCS-coordinated Susitna River Basin Cooperative Study contract. The 1978 study of juvenile coho and chinook on the upper half of the Little Susitna River employed juvenile trapping, and adult counts from the air, ground, and water. The study results indicated a chinook and coho smolt outmigration prior to the mid-April "break-up". Seaward migration for chinook smolts continued until mid-July, after which no 1+ individuals were captured. On the other hand, limited numbers of 1+ cohos were caught into October indicating that cohos migrate as 1+ smolts, or that they seek portions of the lower river for further rearing and migrate later as 2+ smolts. It was also found that: 1) fry dispersed from the point of emergence with increased growth; 2) chinook fry preferred faster waters and coho slower waters; 3) the greatest numbers of fry remained in the major spawing areas; and 4) large numbers of coho fry move into the Nancy Lake system to complete their freshwater rearing.

Appendix A continued-

Watsjold, D.A. 1973. Anadromous fish population studies, Matanuska Valley and East Side tributaries of the Susitna River and tributaries of the Chulitna River. Fed. Aid in Fish Rest., Annual Report of Performance, 1972-1973. Project F-9-5 (G-II-H): 19 pp.

Boat and foot surveys on Willow, Montana, and Moose creeks during 1972 indicated minimum escapements of 370, 317, and 21 king salmon (Oncorhynchus tshawytscha) respectively. During streambank surveys of spawning silver salmon (O. kisutch) in established index areas on Wasilla, Cottonwood, Birch, Fish, and Meadow Creeks, maximum counts of 19, 21, 69, 118, and 27 silver salmon, respectively, were obtained. During an economic survey conducted on nine streams, a total of 214 parties (806 individuals) were interviewed. Of those interviewed, 591 (73.3%) were Alaska residents and 215 (26.7%) were non-residents. Of the residents interviewed, 96.8% lived in the Anchorage area. An estimated 7,345 cars (21,153 anglers and 6,537 non-anglers) were on the nine streams during the 36-day survey, with an estimated average of 3.77 persons per car. A minimum of $34.73 per trip, or $17.19 per day, was spent by each party in the survey area. A minimum of $191,925 was spent in the Anchorage area and $63,167 was spent in the Matanuska-Susitna Borough.

_____. 1979. (in preparation.) Inventory, cataloging, and population sampling of sport fish and sport fish waters in Upper Cook Inlet. ADF&G. Fed. Aid in Fish Rest., Annual Report of Performance 1979-1979. Project F-9-12 (G-I-D).

This is a continuation of the study abstracted under ADF&G, 1979a.

Appendix B: State and Federal Laws Cited in Text

STATE LAWS

Alaska Statutes, Title 16 - Fish and Game

Title 16 Section 16.05.020 (Functions of Commissioner) mandates the Commissioner of the Alaska Department of Fish and Game to "manage, protect, maintain, improve, and extend fish, game and aquatic plant resources of the State in the interest of the economy and general well-being of the State". Section 16.05.050 mandates the Commissioner to "assist the U.S. Fish and Wildlife Service in the enforcement of Federal laws and regulations pertaining to fish and game".

Section 16.050.870 (Protection of fish and game) mandates the Commissioner to "specify the various rivers, lakes, and streams, or parts of them that are important for the spawning or migration of anadromous fish." In addition, this section states that "if a person or governmental agency desires to construct a hydraulic project, or use, divert, obstruct, pollute, or change the natural flow or bed of a specified river, lake or stream, or to use wheeled, tracked, or excavating equipment or log-dragging equipment in the bed of a specified river, lake, or stream, the person or governmental agency shall notify the commissioner of this intention before the beginning of the construction or use." Furthermore, "if the commissioner determines to do so, he shall, in the letter of acknowledgement, require the person or governmental agency to submit to him full plans and specifications of the proposed construction or

work, complete plans and specifications for the proper protection of fish and game in connection with the construction or work, or in connection with the use, and the approximate date the construction, work, or use will begin, and shall require the person or governmental agency to obtain written approval from him as to the sufficiency of the plans or specifications before the proposed construction or use is begun". The purpose of this section is to protect and conserve fish and game and other natural resources.

Sections 16.20.180 - 16.20.210 (Endangered species) establish a program for the "continued conservation, protection, restoration and propagation" of "species or subspecies of fish and wildlife [which] are now and may in the future be threatened with extinction". Section 16.20.185 (Protection of habitat) mandates the commissioners of Fish and Game and Natural Resources to "take measures to preserve the natural habitat of species or subspecies of fish and wildlife that are recognized as threatened with extinction."

Instream Flow Bill - HB 118

In 1980, HB 118, the Instream Flow Bill, was passed by the Alaska Legislature and signed into law by the Governor. The bill amends the "Water Use Act", AS 46.15, and enables private individuals, State or Federal agencies to compel the State to reserve water for beneficial instream flow uses such as fish and wildlife maintenance and protection, water quality, recreation, navigation, etc.

Alaska Coastal Management Program (ACMP)

The recently approved Alaska Coastal Management Program (ACMP) mandates that all State, Federal, and local government agencies must coordinate all planning and development activities in the State's coastal zone to ensure adequate consideration and protection of Alaska's coastal waters and resources. As the Willow-Talkeetna Sub-basins overlap Alaska's coastal zone (Figure 4), and activities within the Sub-basins will directly influence coastal waters, all land-use and development plans must be consistent with the Coastal Standards and with the Mat-Su Borough's District Coastal Plan once it is completed and approved. The Coastal Standards are presently in effect and all State and Federal actions must be consistent with them. Section 6AA 80.130 states that "habitats in the coastal area which are subject to the Alaska Coastal Management Program include:

(1) offshore
(2) estuaries
(3) wetlands and tidal flats
(4) rocky islands and sea cliffs
(5) barrier islands and lagoons
(6) exposed high energy coasts
(7) rivers, streams, and lakes
(8) important upland habitat"

COASTAL BIOPHYSICAL BOUNDARIES

COOK INLET

NORTH OF THE FORELANDS

Zone of direct influence extends to South Twin Glacier.

Zone of direct influence extends to Yentna Glacier.

Zone of direct influence extends north to include Devil's Canyon.

SKWENTNA RIVER

YENTNA RIVER

TALKEETNA SUB-BASIN

WILLOW SUB-BASIN

N

W E

S

The biophysical coastal zone boundaries for upper Cook Inlet are defined as follows:

Zone of Direct Interaction

A. Landward Limit
Landward, the zone of direct interaction is defined by saltwater intrusion into marshes and rivers and areas of active coastal erosion such as the bluffs fronting Turnagain and Knik arms. Saltwater intrusion occurs up to 10 km (6 mi) inland in the Susitna Flats and as far as 32 km (20 mi) upstream in the Susitna River. Coastal bluffs experiencing rapid erosion range in height from several meters (less than 10 ft) to over 30 m (greater than 100 ft). Salt spray, ice coating, intertidal spawning, vegetation transitions and important wildlife habitat also occur within the zone of direct interaction.

B. Seaward Limit
Seaward, the zone of direct interaction is defined by nearshore sediment transport and deposition out to the 5 m (18 ft) depth contour. This is a high energy zone which is actively perturbed by tidal currents, ice scour, breaking waves, sediment dynamics and freshwater dilution.

Zone of Direct Influence

A. Landward Limit
The landward zone of direct influence in upper Cook Inlet is defined where the bulk of anadromous fish spawning and rearing takes place, where some moose seek out lowland areas for overwintering and calving, and where coastal wetland habitat attracts a large number of nesting birds and small mammals. Direct influence includes all coastal drainages, their primary tributaries, and adjacent wetlands to the 305 m (1,000 ft) contour. The zone extends up the main-stem of the Susitna River to include Devil's Canyon. Important uplands which directly support or impact coastal processes are also included within the zone of direct influence. The upland extent of direct influence is best defined by the 61 m (200 ft) contour in the Mat-Su Valley, 122 m (400 ft) contour in the upper Kenai Lowlands and Tyonek area, the 305 m (1,000 ft) contour in the greater Anchorage area, Turnagain watersheds, and Trading Bay region and the ridgeline of steep coastal mountains in Turnagain Arm.

B. Seaward Limit
Seaward, the zone direct influence includes the marine waters of Cook Inlet extending south to Kalgin Island. Turbulent mixing between marine and fresh water takes place in the vicinity of Kalgin Island. The characteristic marine waters of upper Cook Inlet which include high turbidity and low salinity interface with the waters of lower Cook Inlet in this region. This is also the average southern limit of upper Inlet sea ice.

Zone of Indirect Influence

A. Landward Limit
The landward zone of indirect influence extends to include the margins of glaciers, the headwaters of coastal drainages in the Cook Inlet Basin and their adjacent wetlands. This zone includes the limits of spawning and rearing areas for anadromous fish, important waterfowl habitat, important upland big game and small mammal habitat and the inland extent of forseeable uses which may have a direct and significant impact on the coastal waters.

B. Seaward Limit
Seaward, the zone of indirect influence includes all of Cook Inlet and the Gulf of Alaska to the limits of important migrations of anadromous fish, marine mammals and waterfowl dependant on the coastal zone of upper Cook Inlet for a portion of their life histories.

General Description - The upper Cook Inlet region is a large basin enclosed by the Alaska Range, Talkeetna Mountains and Chugach Mountains to the west, north and east, respectively. The southern physiographic boundary of upper Cook Inlet is generally placed at East and West Forelands although the typical coastal environment of this region extends south to the vicinity of Kalgin Island.

The marine environment is strongly influenced by the discharge of three major drainage systems, the Susitna, Matanuska and Knik rivers. About one-hundred other rivers, streams and tributaries empty into upper Cook Inlet. This large freshwater input contributes to a dramatic lowering of salinity during the summer months. Many of the rivers and tributaries originate at glaciers located in the surrounding mountain ranges. The sedimentary products of these glaciers combine with terrestrial erosion to produce rivers which are heavily laden with silt and debris. The marine waters of upper Cook Inlet can be characterized as highly turbid, well-mixed and low in salinity.

The shoreline is chiefly composed of high eroding bluffs of unconsolidated glacial till and low coastal marshes and bogs. Turnagain Arm has a steep mountainous shoreline. Extensive tidal flats are produced by river induced sediments occur throughout upper Cook Inlet. The tidal range averages 8.5 m (28 ft). Sea ice is usually present between November and April.

Marine plants and animals have adapted to the stressed environment of this region by rapid growth during the summer months and the utilization of detrital nutrients for growth and reproduction. The numerous coastal salt marshes are highly productive environments important to reproduction and rearing of birds, fish and mammals. In addition, coastal marshes function as critical molting and staging areas for fall and sprng migrations of water birds. The numerous lowland lakes and bogs in this region also provide nesting and rearing habitat for water birds, fish and small mammals.

Upper Cook Inlet serves as a migratory pathway for anadromous fish on their way to spawning areas in clear water tributaries. Young salmon rear in streams and lakes before begining their seaward migration. Beluga whales and harbor seals are the only marine mammals present and seasonally migrate in to feed on eulachon (hooligan) and salmon during the summer.

Portions of the upper Cook Inlet region have been heavily impacted by both natural and man-made changes during recent years. Urbanization of the Anchorage area and Matanuska Valley has resulted in the alteration of habitat due to the cutting of trees, draining wetlands, siltation of streams and the introduction of pollutants. The fish and wildlife populations have declined primarily due to the loss of habitat in conjunction with increased hunting and fishing pressure. The 1964 earthquake produced dramatic changes to the coastal environment. Subsequent land subsidence, saltwater intrusion and flooding in some areas has altered coastal marshes, aquifers, spawning areas, soils, and wildlife habitat. The environment and ecology of the upper Cook Inlet region will remain in a high dynamic state due to recent and continuing impacts.

UPPER COOK INLET COASTAL MARSH

Potter Marsh

This coastal salt marsh is typical of the extensive wetland habitat found around upper Cook Inlet. Although altered by a major roadway, railroad and urban development around the perimeter, Potter Marsh has retained its function as a migration and nesting area for waterbirds. The marsh comprises only 2% of the total salt marsh habitat in upper Cook Inlet yet it is an important and obvious feature of the coast.

Vegetation within Potter Marsh is composed primarily of sedges, rushes and grasses. The tidal exchange bathes the roots with nutrients and water and protects them from freezing during the winter. Salt marsh vegetation is the first to emerge in the spring. Plant debris and nutrients flowing out of the marsh support green algae and marine invertebrates living on the extensive tidal flats. Tree snags provide habitat for woodpeckers, owls, hawks and eagles.

Small mammals including muskrats, mink, beavers, shrews and voles are part of the Potter Marsh environment. Moose often move through willow vegetation near the marsh during the winter.

Bank swallows nest in cliffs along Turnagain Arm. Swallows subsist on insects produced in the marsh.

ANCHORAGE

Tidal Flats

Tidal Flats

TURNAGAIN ARM

The fall migration begins in early August and extends through October. Vegetation, small fish and invertebrates living in the marsh are important to birds staging for the fall migration.

The spring migration of waterbirds begins in mid-April when the marsh thaws. The migration peaks during May and is followed by nesting and molting activities until August.

Fish salmon enter Potter Marsh about the third week in June to spawn in Rabbit Creek. Salmon eggs hatch during the winter and the smolt move into the marsh during the spring. Some smolt may rear in the marsh during the summer before migrating to the ocean.

CHICKALOON

Zone of direct influence ends here.

SUTTON

PALMER

WASILLA

BIG LAKE

KNIK

KNIK

MATANUSKA RIVER

KNIK RIVER

EKLUTNA

EKLUTNA FLATS

EKLUTNA RIVER

MATANUSKA-SUSITNA BOROUGH

GREATER ANCHORAGE AREA BOROUGH

PETERS CREEK

BIRCHWOOD

CHUGIAK

KNIK GLACIER

LAKE GEORGE

EAGLE RIVER

EAGLE RIVER FLATS

PETERS CREEK

EAGLE RIVER

SHIP CREEK

43

POINT MAC KENZIE

POINT WORONZOF

ANCHORAGE

CAMPBELL CREEK

POINT CAMPBELL

TIKE ISLAND

SEWARD

ANCHORAGE AREA BOROUGH (USGS)

POINT POSSESSION

RABBIT CREEK

BIRD CREEK

TURNAGAIN ARM

SEWARD

ANCHORAGE

GLACIER CREEK

GIRDWOOD

HOPE

CHICKALOON FLATS

SIX MILE CREEK

RESURRECTION CREEK

CHICKALOON RIVER

PORTAGE

PRINCE WILLIAM SOUND

KENAI MOUNTAINS

SUSITNA FLATS

THEODORE RIVER

LITTLE SUSITNA RIVER

LEWIS RIVER

BELUGA RIVER

CAPPS CREEK

CHUIT CREEK

STRAIGHT CREEK

MARINE/COASTAL HABITAT MANAGEMENT
ALASKA DEPARTMENT OF FISH AND GAME
ANCHORAGE

COASTLINE
DIRECT INTERACTION
DIRECT INFLUENCE
INDIRECT INFLUENCE

SCALE 1:250,000

0 5 10
MILES
0 5 10
KILOMETERS

1 JULY 77
Revised 6 April 78

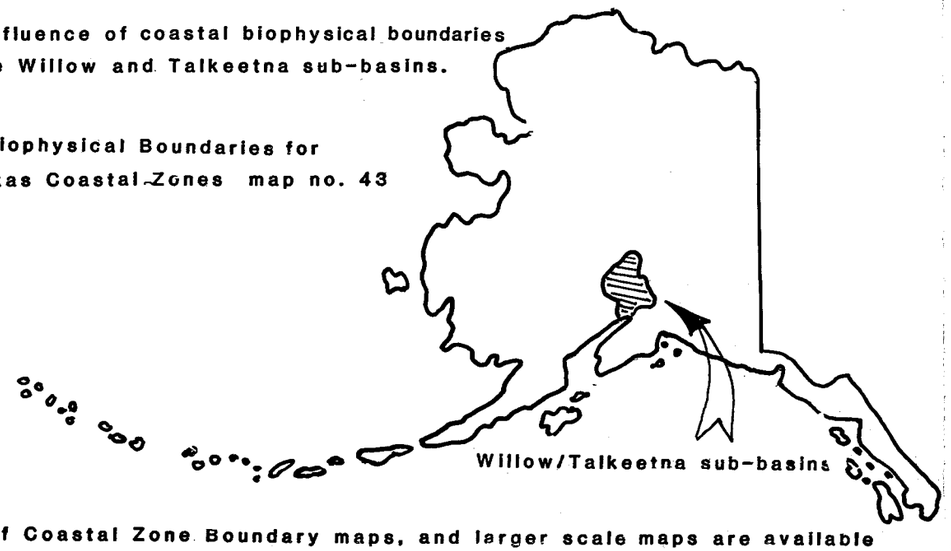


Figure 4. The influence of coastal biophysical boundaries on the Willow and Talkeetna sub-basins.

Adapted from: Biophysical Boundaries for Alaskas Coastal Zones map no. 43

(complete sets of Coastal Zone Boundary maps, and larger scale maps are available from the Arctic Environmental Information and Data Center , AEIDC. Anchorage.)

These coastal zone habitats, which are specifically defined in the Standards, must be identified within the Willow-Talkeetna Sub-basins in all development feasibility studies. In addition, Section (b) states that habitats contained in (a) of this section shall be managed so as to maintain or enhance the biological, physical, and chemical characteristics of the habitats which contribute to their capacity to support living resources. Specific guidelines are also provided for each coastal habitat. The Coastal Zone Management consistency requirements are mandated in both the Alaskan and Federal Coastal Zone Management (CZM) Acts and in the Fish and Wildlife Coordination Act. The question of consistency with CZM standards should be treated as a separate step when determining the feasibility of projects.

The Alaska Department of Fish and Game is mandated under these laws to insure that adequate planning, study, and evaluation of the fish and wildlife resources in the Willow-Talkeetna Sub-basins are completed and become a part of the decision-making information used to determine the feasibility of a project. If a project is approved, these studies will be the basis for mitigation plans or the formulation of mitigation studies to offset project impacts. Mitigation, as defined in Section 1508.20 of the National Environmental Policy Act Implementation Regulations (NEPA PL 91-190) includes:

(a) Avoiding the impact altogether by not taking a certain action or parts of an action;

(b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation;

(c) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;

(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and

(e) Compensating for the impact by replacing or providing substitute resources or environments.

FEDERAL LAWS*

Fish and Wildlife Coordination Act (FWCA)

Fish and Wildlife Coordination Act (16 U.S.C. 661-66c; 48 Stat. 401) as amended. The Act of March 10, 1934, as amended by the Acts of August 14, 1946 (60 Stat. 1080), August 12, 1958, Public Law 85-624 (72 Stat. 563) and July 9, 1965, Public Law 89-72 (79 Stat. 216), authorizes the Secretary of the Interior to assist Federal, state and other agencies in development, protection, rearing and stocking fish and wildlife on Federal lands, and to study effects of pollution on fish and wildlife. The Act also provides for donating land and funds in furthering purposes of the Act and for appropriation of funds. The Act requires consultation with the U.S. Fish and Wildlife Service and the wildlife agency of any state wherein the waters of any stream or other water body are proposed or authorized to be impounded, diverted, channelized or otherwise controlled or modified by any Federal agency, or any private agency under Federal permit or

*For a more complete list of Federal laws affecting fish and wildlife, see USDI-USFWS. 1979. Selected List of Federal Laws and Treaties Relating to Sport Fish and Wildlife. USFWS, Washington, D.C. 20240.

license, with a view to preventing loss of or damage to wildlife resources in connection with such water resource project. The Act further authorizes Federal water resource agencies to acquire lands or interests in connection with water use projects specifically for mitigation and enhancement of fish and wildlife, and provides for management of such lands by the U.S. Fish and Wildlife Service or State wildlife agencies. Projects involving impoundments of less than 10 acres and Tennessee Valley Authority projects are excluded.

Coastal Zone Management Act (CZM)

Coastal Zone Management Act of 1972 (16 U.S.C. 1451-1464; 86 Stat. 1280), as amended. Public Law 92-583, approved October 27, 1972, established a program aimed at assisting states in developing land and water use programs for the coastal zone. A grant-in-aid program is authorized under the administration of the Secretary of Commerce. Section 307 of the Act (16 U.S.C. 1456; 86 Stat. 1285) directs the Secretary of Commerce to consult and cooperate with other Federal agencies in carrying out his responsibilities under the Act, and requires that, prior to approval of any state's coastal zone management program which "includes requirements as to shorelands which also would be subject to any Federally supported national land use program," the Secretary of Commerce obtain concurrence of the Secretary of the Interior. The Act also directs that, to the maximum extent practicable, subsequent Federal actions affecting the coastal zone be consistent with approved State management programs.

National Environmental Policy Act (NEPA)

National Environmental Policy Act of 1969 (42 U.S.C. 4321-4347; 83 Stat. 852). Public Law 91-190, approved January 1, 1979, requires all Federal agencies to consult with each other and to employ systematic and interdisciplinary techniques in planning and decision making. It also requires them to include in every recommendation or report on proposals for legislation or other major Federal actions significantly affecting the quality of the human environment a detailed statement on: (1) the environmental impact of the proposed action, (2) any adverse environmental effects which cannot be avoided should the proposal be implemented, (3) alternatives to the proposed action, (4) the relationship between local short term uses and enhancement of long term productivity and (5) any irreversible and irretrievable commitments of resources involved in the proposed action. Such environmental impact statements are required to be available to the public and other agencies. The Act also established the Council on Environmental Quality.

Executive Order 11990 (Wetlands)

This order was issued by President Carter "in order to avoid to the extent possible the long-term and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative". All Federal agencies are required to comply with this EO in their planning and decision making processes.

Executive Order 11988 (Floodplains)

This order was issued by President Carter "to avoid to the extent possible the long-term and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative". All Federal agencies are required to comply with this EO in their planning and decision-making processes.

Endangered Species Act

Endangered Species Act of 1973 (16 U.S.C. 1531-1543; 87 Stat. 884), as amended. Public Law 93-205, approved December 28, 1973. The 1973 Endangered Species Act provides for the conservation of threatened and endangered species of fish, wildlife and plants by Federal action and by encouraging the establishment of state programs. The Act authorizes the determination and listing of endangered and threatened species and the range in which such condition exists; prohibits unauthorized taking, possession, sale, transport, etc., of endangered species; provides authority to acquire land for the conservation of listed species with land and water conservation funds; authorizes establishment of cooperative agreements and grant-in-aid to those states which establish and maintain an active and adequate program for endanagered and threatened wildlife; and authorizes the assessment of civil and criminal penalties for violating the Act or regulations. Section 7 of the Endangered Species Act requires Federal agencies to insure that any action authorized, funded or carried out by them does not jeopardize the continued existence of listed species or modify their critical habitat.

Appendix C: Instructions for Using the Catalog of Waters Important for the Spawning and Migration of Anadromous Fishes

The Catalog of Waters Important for the Spawning and Migration of Anadromous Fishes was intended for use with ADF&G Commercial Fish regulatory area maps (Figure 5) and U.S. Geological Survey (USGS) 1:63,360 (inch-per-mile) maps. The regulatory area maps indicate the first five digits of the eight-digit ADF&G number, while township and range, latitude and longitude from the USGS maps are used to differentiate between streams having the same first five digits in their eight-digit ADF&G number. Therefore, to find the listing for a given stream:

1. Determine the ADF&G commercial fisheries regulatory area and sub-area in which the stream lies.

    a. This is done by using the ADF&G regulatory map provided in Figure 5.

    b. Position of the stream is determined with reference to the mouth of the stream.

2. Turn to the section of the catalog in which stream numbers having the same first five digits as the regulatory area and sub-area are found.

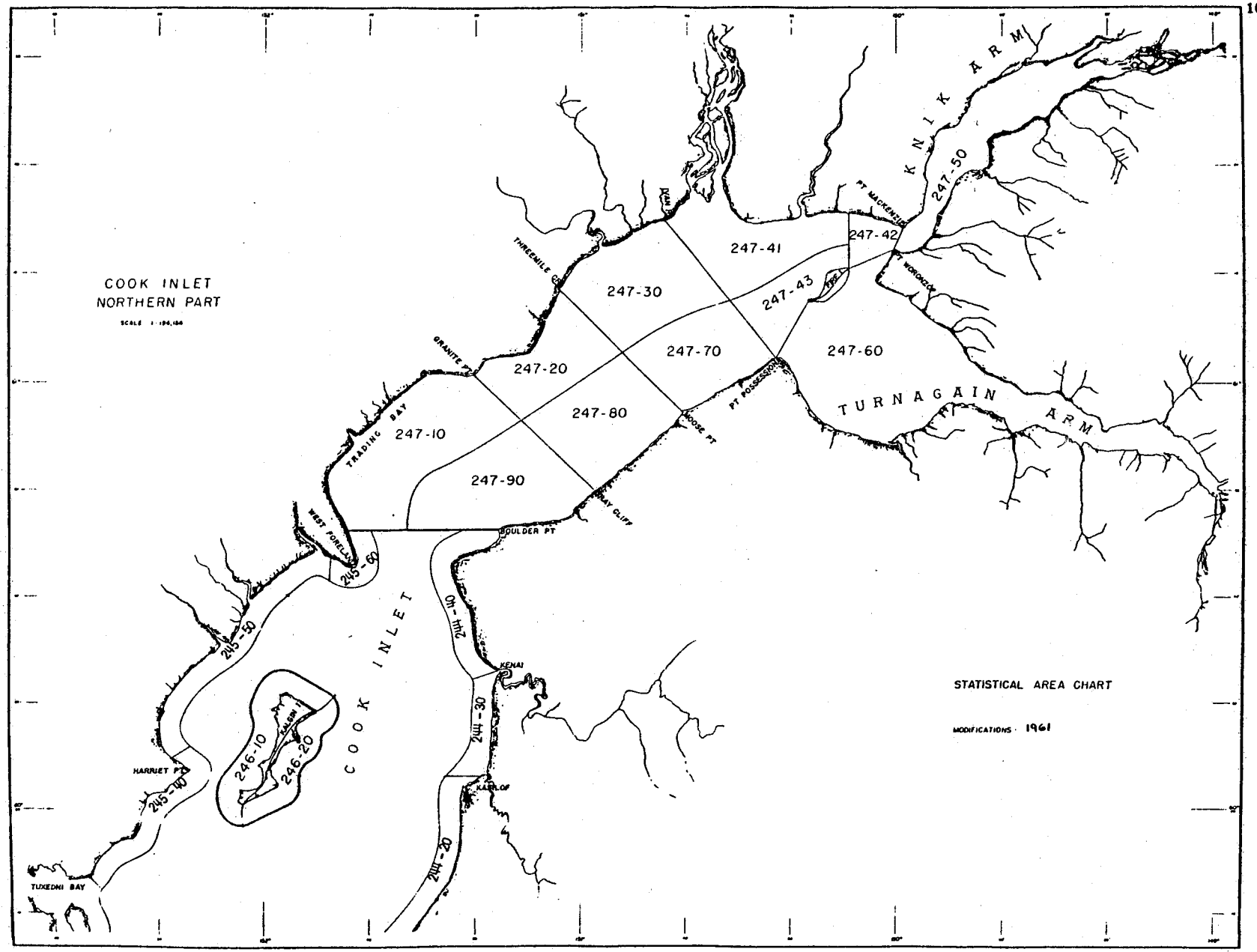


Figure 5. Commercial Fisheries Regulatory Areas.

3. Using a USGS map of the area, find the township and range or latitude and longitude of the mouth of the stream. Other maps or navigational charts may be used to determine latitude and longitude.

4. With reference to latitude and longitude, township and range, or both, determine which stream of those in the general regulatory area listing is the one you are looking for.

   a. The name of the stream or river can also be used, but most streams in Alaska remain unnamed.

   b. Streams are also referenced by Environmental Protection Agency (EPA) number and the abbreviation of the USGS inch-per-mile map on which they appear.

If you cannot find a stream listed, please double check. You are encouraged to contact any local Department of Fish and Game office in order to make sure the stream is in fact not listed.

Abbreviations

An alphabetical list of USGS quadrangle abbreviations used in the Willow-Talkeetna Sub-basins and a list of other abbreviations used in the Catalog follow.

Column Headings

F&G Number - eight (8) digit number assigned by the Alaska Department of Fish and Game. The first series of three numbers is the major statistical area in which the stream lies. The second series of two numbers is the statistical sub-area within the larger area. The last three-digit number is that of the individual stream.

Example:

2 4 7	4 1	0 0 0
Statistical area	Statistical sub-area	Stream number

Minor Basin - A delineation of the State into geographic units generally based on watershed. There are twelve minor basins in Alaska (Alaska constitutes major basin sixteen).

Base Stream - A three-digit number assigned to a particular stream by a joint EPA-State of Alaska project.

Name- Name of a stream obtained from a prior Anadromous Stream Catalog or USGS maps. If no name was available, a descriptive name was utilized in some cases.

Appendix C continued -

Type - Indicates Lake - L

Creek - C

River - R

Slough - X

Other - O

MER - Meridian

TWP - Township

Range - Range

Sect - Section

USGS - United States Geological Survey - The first two letters represent a coding for the USGS map for that area (eg. TY is for Tyonek). The third letter and the following number represent the inch-per-mile USGS map upon which the stream appears. An alphabetical listing of abbreviations for USGS inch-per-mile-maps covering the Willow-Talkeetna Sub-basins follows below.

LAT - Latitude

LONG - Longitude

These are all North and West respectively. Determinations are based on the most accurate maps available. In some cases the determination for "seconds" of degrees was approximated.

EPA Main - A number assigned by the Environmental Protection Agency (EPA). If a number is available, it indicates the "parent" stream number, in other words the number of the stream into which the stream listed under EPA SUB flows.

EPA SUB

The number given to a particular stream by the EPA - State of Alaska stream STORET numbering program. The STORET numbering system is used by the EPA and other water-oriented agencies and is a national classification system. Each stream flowing into the ocean is called a first-order or base stream and is listed under the column with a three-digit number unique within that minor watershed. Tributary streams are first numbered under the "EPA SUB" column with a number that reflects something about their character. If the first digit is "2" the stream is second order, or it flows directly into the main stem of the base stream. If the first digit is "3" it flows into a second-order stream, etc.

Appendix C continued -

Code numbers are assigned consecutively in the upstream direction. Based on the observer looking upstream, even-numbers are assigned to tributaries entering the base river from the right-hand side and odd-numbers to tributaries entering from the left-hand side. The first tributary encountered is given the number ten or twenty higher than the previous number. In general, if a stream has a code value of N then the next stream will have a value of N+10 or N+20 depending on whether it enters the major stem on the opposite or the same side of the stream. As there is the remote possiblity of duplication of numbers for tributaries into the same base stream system, the EPA MAIN lists the parent stream of the EPA SUB stream.

Appendix C continued -

Abbreviations and identifying codes for USGS (1:63,360) maps covering the Willow-Talkeetna Sub-basins:

AN (Anchorage):	B-8
	C-7, C-8
	D-6, D-7, D-8
HE (Healy):	A-4, A-5, A-6
	B-4, B-5, B-6
MM (Mt. McKinley):	A-1, A-2
	B-1
TA (Talkeetna):	A-1, A-2, A-3, A-4
	B-1, B-2, B-3, B-4
	C-1, C-2, C-3, C-4
	D-1, D-2, D-3, D-4
TM (Talkeetna Mountains):	A-4, A-5, A-6
	B-3, B-4, B-5, B-6
	C-3, C-4, C-5, C-6
	D-5, D-6
TY (Tyonek):	B-1, B-2
	C-1, C-2, C-3
	D-1, D-2, D-3, D-4

DEPARTMENT OF FISH AND GAME — ANADROMOUS FISH STREAM CATALOG

F.C.G. #	NAME	TP	MFR	TWP	RANGE	SECT	USGS	LAT	LONG	MNR BSN	BASE STRM	EPA MAIN	EPA SUB
247-30-000	IVAN	R	SM	14N	008W	32	TYR2	61-14-45	150-44-15	07	136	0000000	0000000
247-41-000		C	SM	18N	006W	11	TYC1	61-48-30	150-18-42	07	143	0000000	2000260
247-41-000	ALDER	C	SM	30N	006W	23	TAC1	62-49-30	150-20-10	07	143	0300370	0040040
247-41-000	ALEXANDER	C	SM	15N	007W	06	TYB2	61-24-45	150-35-40	07	143	0000000	2000090
247-41-000	ALEXANDER	L	SM	19N	009W	10	TYC3	61-44-40	150-54-00	07	000	0000000	0000000
247-41-000	AMBER	L	SM	24N	007W	15	TAA2	62-10-30	150-32-00	07	000	0000000	0000000
247-41-000	ANSWER	C	SM	24N	004W	06	TAA1	62-12-10	150-04-45	07	143	0300030	0040020
247-41-000	ANSWER-BALDY	L	SM	25N	004W	24	TMA6	62-14-30	149-55-30	07	000	0000000	0000000
247-41-000	BARTHOLF	C	SM	22N	002E	31	AND6	61-57-20	149-10-00	07	143	2000500	0300460
247-41-000	BEAR	C	SM	30N	008W	30	TAC2	62-39-45	150-49-05	07	143	0300370	0050030
247-41-000	BEAR	C	SM	19N	009W	22	TYC3	61-43-45	150-53-00	07	143	2000090	0300190
247-41-000	BEAR	C	SM	24N	009W	32	TAA2	62-12-30	150-53-15	07	143	0300320	0040220
247-41-000	BIRCH	C	SM	25N	005W	12	TAA1	62-14-00	150-06-30	07	143	0000000	2000760
247-41-000	BIRD	C	SM	28N	008W	06	TAC2	62-34-25	150-53-10	07	143	0040200	0050350
247-41-000	BLAIR	L	SM	28N	005W	03	TAC1	62-32-45	150-09-50	07	000	0000000	0000000
247-41-000	BOAT	P	FM	20S	010W	08	HFA5	63-10-45	149-30-10	07	143	0300690	0040060
247-41-000	BUNCO	L	SM	28N	007W	02	TAC2	62-32-15	150-00-20	07	000	0000000	0000000
247-41-000	BYERS	C	SM	30N	005W	04	TAC1	62-43-30	150-13-00	07	143	2000950	0300340
247-41-000	BYERS	L	SM	31N	005W	36	TAC1	62-44-30	150-06-25	07	000	0000000	0000000
247-41-000	CACHE	C	SM	27N	010W	33	TAB2	62-22-45	151-07-50	07	143	0300320	0040400
247-41-000	CALIFORNIA	C	SM	28N	013W	27	TAB4	62-29-40	151-38-10	07	143	0050110	0060030
247-41-000	CAMP	C	SM	25N	011W	26	TAB3	62-18-45	151-14-45	07	143	0300380	0040290
247-41-000	CASWELL	C	SM	21N	004W	06	TYN1	61-56-30	150-04-45	07	143	0000000	2000520
247-41-000	CHELATNA	L	SM	28N	012W	00	TAB3	62-29-30	151-28-00	07	000	0000000	0000000
247-41-000	CHULITNA	P	SM	26N	005W	23	TAB8	62-20-15	150-09-15	07	143	0000000	2000950
247-41-000	CHULITNA EST FK	R	FM	21S	010W	08	HFA6	63-06-30	149-31-30	07	143	2000950	0300720
247-41-000	CHULITNA MID FK	R	FM	21S	010W	07	HFA5	63-06-30	149-31-30	07	143	0000000	2000950
247-41-000	CHULITNA WST FK	R	FM	21S	011W	35	HFA6	63-03-15	149-36-00	07	143	2000950	0300690
247-41-000	CHUNILNA	C	SM	26N	004W	04	TAB1	63-43-00	149-15-00	07	143	2000920	0300070
247-41-000	CLEARWATER	C	SM	24N	013W	02	TAA4	62-12-30	151-36-30	07	143	2000140	0300660
247-41-000	CLOUD	C	SM	32N	005W	19	TAD1	62-50-50	150-16-50	07	143	0040140	0050020
247-41-000	COAL	C	SM	32N	003W	04	TMD6	63-15-25	149-14-10	07	143	2000950	0300590

Table 1 Anadromous fish streams in the Willow-Talkeetna Sub-basins. (ADF&G 1975)

F & G #	NAME	TP	MER	TWP	RANGE	SECT	USGS	LAT	LONG	MNR BSN	BASE STRM	EPA MAIN	EPA SUB
247-41-000	COFFEE	R	SM	30N	005W	07	TAC1	62-42-35	150-16-30	07	143	2000950	0300410
247-41-000	COLORADO	C	FM	19S	011W	25	HEA6	63-14-10	149-33-30	07	143	0300690	0040120
247-41-000	COLORADO	C	SM	28N	013W	26	TAB4	62-29-25	151-37-40	07	143	0040350	0050080
247-41-000	COPELAND	C	FM	21S	011W	31	HEA6	63-03-15	148-52-30	07	143	0300650	0040080
247-41-000	COSTELLO	C	FM	20S	010W	08	HEA5	63-12-00	149-29-00	07	143	0040060	0050010
247-41-000	COTTONWOOD	C	SM	27N	012W	34	TAB3	62-23-35	151-27-40	07	143	0040290	0050070
247-41-000	COTTONWOOD	C	SM	28N	008W	06	TAC2	62-32-35	150-49-10	07	143	0040200	0050340
247-41-000	COW	L	SM	17N	005W	09	TYC1	61-35-00	150-11-20	07	000	0000000	0000000
247-41-000	CROOKED	C	FM	20S	008W	30	HEA5	63-09-30	149-09-00	07	143	0300720	0050040
247-41-000	CRYSTAL	C	SM	32N	006W	25	TAD1	62-49-55	150-18-15	07	143	0300410	0040140
247-41-000	DEADHORSE	C	SM	29N	004W	10	TAC1	62-37-05	150-00-15	07	143	0000000	2001140
247-41-000	DEVIL	C	SM	32N	002E	34	TMD5	62-49-30	149-03-00	07	143	0000000	2001530
247-41-000	DISAPPOINTMENT	C	SM	27N	002W	05	TMB6	62-27-20	149-40-05	07	143	2000920	0300250
247-41-000	DOLLAR	C	SM	27N	010W	01	TAB3	62-27-05	151-02-10	07	143	0040400	0050110
247-41-000	DONKEY	C	SM	23N	011W	32	TAA3	62-02-15	151-18-10	07	143	2000190	0300540
247-41-000	DONKEY CREEK	L	SM	24N	012W	22	TAA3	60-09-00	151-26-30	07	000	0000000	0000000
247-41-000	EIGHTMILE	C	SM	22N	010W	31	TYD4	61-57-35	151-01-55	07	143	0300470	0040010
247-41-000	EIGHTMILE	L	SM	20N	010W	06	TYD4	61-51-00	151-08-00	07	000	0000000	0000000
247-41-000	FALLS	C	SM	28N	009W	31	TAB3	62-28-30	151-00-45	07	143	0040400	0050190
247-41-000	FISH	C	SM	18N	007W	36	TYC2	61-36-30	150-28-25	07	143	2000190	0040030
247-41-000	FISH	C	SM	15N	007W	26	TYB2	61-22-00	150-30-00	07	143	0000000	2000060
247-41-000	FISH	L	SM	25N	004W	17	TAA1	62-15-05	150-03-45	07	000	0000000	0000000
247-41-000	FISH	L	SM	22N	009W	00	TYD3	61-57-30	150-57-30	07	000	0000000	0000000

Table 1 continued

Appendix C continued -

F & G #	NAME	TP	MER	TWP	RANGE	SECT	USGS	LAT	LONG	MNR BSN	BASE STRM	FPA MAIN	FPA SUB
247-41-000	FISH LAKE	C	SM	21N	009W	08	TYD3	61-55-30	150-57-30	07	143	2000190	0300420
247-41-000	FLAG	C	SM	26N	014W	24	TAB4	62-19-50	151-48-00	07	143	2000190	0300780
247-41-000	FLATHORN	L	SM	16N	006W	19	TYB2	61-27-45	150-25-30	07	000	0000000	0000000
247-41-000	FOUNTAIN	R	SM	31N	004W	06	TAD1	62-47-50	150-05-10	07	143	0040010	0300470
247-41-000	FOURTH OF JULY	C	SM	25N	014W	04	TAB4	62-18-30	151-54-30	07	143	0300730	0040090
247-41-000	GATE	C	SM	25N	006W	30	TAA1	62-14-00	150-26-50	07	143	0300220	0040110
247-41-000	GOLD	C	SM	31N	002W	20	TMD6	62-46-05	149-41-20	07	143	0000000	2001360
247-41-000	GOLD	C	SM	28N	009W	10	TAC2	62-31-35	150-54-30	07	143	0040400	0050370
247-41-000	GOOSE	C	SM	23N	004W	30	TAA1	62-03-45	150-05-20	07	143	0000000	2000580
247-41-000	GRANITE	C	SM	33N	002W	19	TMD6	62-56-00	149-42-30	07	143	2000950	0300640
247-41-000	GRANITE	C	SM	16N	008W	25	TYB2	61-27-00	150-36-00	07	143	2000090	0300030
247-41-000	HARDAGE	C	FM	20S	010W	34	HEA5	63-08-00	149-27-00	07	143	0300720	0040060
247-41-000	HEWITT	C	SM	22N	011W	14	TYD4	61-59-30	151-17-45	07	143	2000190	0300490
247-41-000	HIDDEN	R	SM	32N	004W	32	TAD1	62-49-10	150-04-30	07	143	2000950	0040010
247-41-000	HONOLULU	C	FM	21S	011W	35	HEA6	63-03-15	149-35-30	07	143	2000950	0300700
247-41-000	HORSESHOE	L	SM	17N	004W	12	ANC8	61-34-25	149-55-30	07	000	0000000	0000000
247-41-000	HORSESHOE	L	SM	15N	005W	27	TYB1	61-21-45	150-08-50	07	000	0000000	0000000
247-41-000	HUNGRYMAN	C	SM	25N	009W	05	TAB2	62-17-50	150-58-40	07	143	0300320	0050020
247-41-000	IDAHO	C	SM	28N	013W	15	TAC4	62-31-10	151-39-00	07	143	0040350	0050110
247-41-000	INDIAN	R	SM	31N	002W	09	TMD6	62-47-15	149-39-15	07	143	0000000	2001370
247-41-000	IRON	C	SM	27N	001W	15	TMB5	62-26-30	149-28-06	07	143	2000920	0300340

Table 1 continued

DEPARTMENT OF FISH AND GAME ANADROMOUS FISH STREAM CATALOG

F & G #	NAME	TP	MFR	TWP	RANGE	SECT	USGS	LAT	LONG	MNR RSN	BASE STRM	EPA MAIN	EPA SUB
247-41-000	JOHNSON	C	SM	23N	012W	16	TAA3	62-05-10	151-29-45	07	143	2000190	0300610
247-41-000	KAHILTNA	R	SM	20N	008W	05	TYD2	61-51-10	150-46-45	07	143	2000190	0300320
247-41-000	KASHWITNA	R	SM	21N	004W	18	TYD1	61-55-00	150-06-00	07	143	0000000	2000500
247-41-000	KASHWITNA NO FK	R	SM	22N	003W	10	TMA6	61-59-10	149-50-45	07	143	2000500	0300090
247-41-000	KICHATNA	R	SM	23N	012W	08	TAA4	62-05-55	151-30-05	07	143	2000190	0300630
247-41-000	KROTO	C	SM	19N	006W	26	TYC1	61-40-00	150-19-00	07	143	0000000	2000290
247-41-000	KROTO	L	SM	27N	008W	12	TAB2	62-26-55	150-39-20	00	000	0000000	0000000
247-41-000	LAKE	C	SM	18N	004W	26	ANC8	61-37-30	149-56-15	07	165	0000000	2000390
247-41-000	LAKE	C	SM	21N	009W	15	TYD2	61-37-30	149-56-15	07	143	2000190	0300380
247-41-000	LANE	C	SM	28N	005W	12	TAC1	62-31-55	150-06-05	07	143	0000000	2001060
247-41-000	LARSON	L	SM	26N	003W	00	TNB6	62-20-15	149-53-10	07	000	0000000	0000000
247-41-000	LITTLE COAL	C	SM	32N	003W	02	TMD6	62-53-55	149-46-15	07	143	2000950	0300600
247-41-000	LITTLE HONOLULU	C	FM	21S	011W	36	HEA6	63-03-10	149-34-15	07	143	0300700	0040020
247-41-000	LITTLE SHOTGUN	C	FM	21S	012W	35	HEA6	63-02-40	149-48-00	07	143	0040010	0050030
247-41-000	LITTLE SUSITNA	R	SM	14N	006W	35	TYB1	61-15-15	150-17-30	07	165	0000000	0000000
247-41-000	LITTLE WILLOW	C	SM	20N	005W	27	TYD1	61-48-40	150-09-30	07	143	2000400	0300010
247-41-000	LOCKWOOD	L	SM	19N	007W	08	TYD2	61-45-30	150-34-25	07	000	0000000	0000000
247-41-000	LONG	C	SM	29N	008W	12	TAC2	63-05-20	149-35-25	07	143	0300370	0040430
247-41-000	LONG	C	FM	21S	011W	14	HEA6	63-05-20	149-35-25	07	143	0300690	0040010
247-41-000	LUCY	L	SM	32N	003W	06	TMD6	62-53-40	149-53-15	07	000	0000000	0000000
247-41-000	LYNX	L	SM	18N	004W	19	TYC1	61-38-00	150-03-20	07	000	0000000	0000000
247-41-000	MARTIN	C	SM	26N	008W	03	TAB2	62-30-40	150-44-15	07	143	0040200	0050110
247-41-000	MCCALLIE	C	FM	21S	012W	10	HFA6	63-06-00	149-49-00	07	143	0300650	0040190
247-41-000	MCKENZIE	C	SM	29N	004W	32	TAC1	62-34-00	150-03-20	07	143	0000000	2001080
247-41-000	MIDDLE	L	SM	15N	005W	22	TYB1	61-23-00	150-09-30	07	000	0000000	0000000

Table 1 continued

Appendix C continued -

F G G #	NAME	TP	MER	TWP	RANGE	SECT	USGS	L A T	L O N G	MNR BSN	BASE STRM	EPA MAIN	EPA SUB
247-41-000	MILLS	C	SM	26N	011W	17	TAB3	62-20-45	151-21-00	07	143	0040290	0050050
247-41-000	MONTANA	C	SM	23N	004W	07	TAA1	62-06-18	150-04-20	07	143	0000000	2000640
247-41-000	MOOSE	C	SM	20N	008W	27	TYD2	61-47-30	150-41-45	07	143	2000190	0300280
247-41-000	MOOSE	C	SM	22N	006W	21	TYD2	61-59-10	150-23-45	07	143	2000290	0300220
247-41-000	MOOSE WEST FORK	C	SM	26N	006W	30	TAB1	62-19-00	150-26-30	07	143	0300220	0040210
247-41-000	MY	L	SM	16N	005W	25	TYB1	61-27-00	150-06-25	07	000	0000000	0000000
247-41-000	NAKOCHNA	R	SM	24N	014W	24	TAA4	62-09-25	151-45-00	07	143	0300630	0040060
247-41-000	NANCY	L	SM	19N	004W	03	TYC1	61-41-00	149-59-00	07	000	0000000	0000000
247-41-000	NANCY=LILLY	C	SM	19N	004W	28	TYC1	61-42-10	150-00-25	07	165	0000000	2000390
247-41-000	NEIL	L	SM	21N	006W	04	TYD1	61-56-00	150-22-40	07	000	0000000	0000000
247-41-000	NINEMILE	C	SM	24N	006W	08	TAA1	62-11-30	150-23-50	07	143	0300220	0040080
247-41-000	NUGGET	C	SM	28N	009W	15	TAC2	62-30-38	150-55-00	07	143	0040400	0050310
247-41-000	OHIO	C	FM	22S	011W	32	TMD6	62-58-20	149-42-00	07	143	2000950	0300650
247-41-000	PARKER	L	SM	23N	007W	35	TAA2	62-02-15	150-29-15	07	000	0000000	0000000
247-41-000	PARTIN	C	SM	33N	004W	25	TMD6	62-54-00	149-57-00	07	143	0300470	0040140
247-41-000	PASS	C	SM	33N	003W	36	TMD6	62-54-08	149-46-15	07	143	2000950	0300620
247-41-000	PASS	C	SM	27N	012W	28	TAB4	62-24-10	151-30-40	07	143	0040290	0050090
247-41-000	PETERS	C	SM	24N	009W	14	TAA2	61-10-40	150-42-55	07	143	0300320	0040200
247-41-000	PIERCE	C	SM	16N	007W	07	TYB2	61-29-45	150-35-35	07	143	2000090	0300050

Table 1 continued

F & G #	NAME	TP	MER	TWP	RANGE	SECT	USGS	LAT	LONG	MNR BSN	BASE STRM	EPA MAIN	EPA SUB
247-41-000	PORTAGE	C	SM	32N	001W	14	TM05	62-49-50	149-22-40	07	143	0000000	2001450
247-41-000	PRAIRIE	C	SM	29N	002E	15	TMC5	62-36-30	149-03-30	07	143	2000920	0300630
247-41-000	QUESTION	C	SM	24N	004W	12	TAA1	62-10-45	150-05-45	07	143	2000720	0300030
247-41-000	QUESTION	L	SM	25N	004W	30	TAA1	62-13-30	150-05-00	07	000	0000000	0000000
247-41-000	RABIDEUX	C	SM	24N	005W	15	TAA1	62-10-15	150-11-15	07	143	0000000	2000710
247-41-000	RAINBOW	L	SM	26N	001E	17	TM85	62-20-00	149-19-00	07	000	0000000	0000000
247-41-000	RAMSDYKE	C	SM	29N	008W	04	TAC2	62-38-05	150-45-20	07	143	0300370	0040450
247-41-000	RED	C	SM	23N	013W	23	TAA4	62-03-55	151-36-15	07	143	0300610	0040010
247-41-000	RED	L	SM	22N	015W	19	TYD4	61-59-40	152-10-00	07	000	0000000	0000000
247-41-000	REDSHIRT	L	SM	18N	005W	27	TYC1	61-37-30	150-10-16	07	000	0000000	0000000
247-41-000	ROCKYS	L	SM	24N	005W	29	TAA1	62-09-00	150-14-45	07	000	0000000	0000000
247-41-000	RUTH	R	SM	29N	006W	02	TAC1	62-37-30	150-22-10	07	143	0300370	0040200
247-41-000	SCOTTY	L	SM	26N	006W	23	TAB1	62-19-30	150-19-00	07	000	0000000	0000000
247-41-000	SECTION HOUSE	L	SM	24N	004W	18	TAA1	62-09-45	150-04-15	07	000	0000000	0000000
247-41-000	SEVENMILE	C	SM	20N	011W	18	TYD4	61-49-30	151-20-45	07	143	0040010	0050070
247-41-000	SEVENMILE	L	SM	20N	011W	14	TYD4	61-49-30	151-13-10	07	000	0000000	0000000
247-41-000	SEVENTEENMILE	C	SM	25N	008W	05	TAB2	62-17-30	150-36-45	07	143	2000290	0300380
247-41-000	SHEEP	C	SM	22N	004W	30	TYD1	61-59-35	150-04-00	07	143	0000000	2000540
247-41-000	SHEEP	R	SM	26N	003W	02	TMB6	62-22-25	149-47-00	07	143	2000920	0300160
247-41-000	SHELL	C	SM	21N	012W	26	TYD4	61-52-30	151-25-00	07	143	0300470	0040140
247-41-000	SHELL	L	SM	22N	012W	00	TYD4	61-52-30	151-25-00	07	000	0000000	0000000
247-41-000	SHERMAN	C	SM	30N	003W	10	TMC6	62-42-30	149-58-00	07	143	0000000	2001280
247-41-000	SHOTGUN	C	FM	21S	011W	31	HEA6	63-03-20	149-44-40	07	143	0300650	0040110
247-41-000	SHOVEL	C	SM	25N	009W	28	TAA2	62-13-20	150-56-30	07	143	0040250	0050010

Table 1 continued

Appendix C continued -

F & G #	NAME	TP	MER	TWP	RANGE	SECT	USGS	LAT	LONG	MNR RSN	BASE STRM	EPA MAIN	EPA SUB
247-41-000	SHOVEL	L	SM	25N	009W	36	TAA3	62-13-00	151-03-40	07	000	0000000	0000000
247-41-000	SKIHI	C	SM	33N	005W	27	TAD1	62-54-55	150-08-00	07	143	0040010	0050270
247-41-000	SKWENTNA	R	SM	22N	010W	20	TYD4	61-59-10	151-08-30	07	143	2000190	0300470
247-41-000	SLATE	C	SM	27N	013W	13	TAB4	62-25-35	151-35-45	07	143	0040290	0050140
247-41-000	SPINK	C	SM	31N	005W	21	TAC1	62-46-45	150-14-05	07	143	2000950	0300430
247-41-000	SPINK	L	SM	31N	005W	17	TAC1	62-46-45	150-14-05	07	000	0000000	0000000
247-41-000	SQUAW	C	FM	20S	009W	06	HEA5	63-14-00	149-18-00	07	143	2000950	0300490
247-41-000	STEPHAN	L	SM	30N	003E	00	TMC4	62-42-30	148-53-00	07	000	0000000	0000000
247-41-000	STERN	C	SM	28N	013W	15	TAC4	62-31-15	151-39-00	07	143	0300380	0040350
247-41-000	SUCKER	C	SM	18N	008W	35	TYC2	61-36-50	150-39-30	07	143	2000090	0300130
247-41-000	SUNFLOWER	C	SM	26N	011W	03	TAB3	62-22-00	151-17-40	07	143	0300380	0040350
247-41-000	SUNSHINE	C	SM	24N	005W	14	TAA1	62-10-33	150-07-35	07	143	0000000	2000720
247-41-000	SUSITNA	R	SM	14N	007W	29	TYB2	61-15-00	150-36-00	07	143	0000000	0000000
247-41-000	SWAN	L	SM	28N	006W	09	TAC1	62-34-30	150-23-20	07	000	0000000	0000000
247-41-000	SWIFT	C	SM	33N	005W	25	TAD1	62-54-55	150-07-40	07	143	0040010	0050260
247-41-000	TALACHULITNA	R	SM	21N	012W	35	TYD4	61-52-00	151-16-30	07	143	0300470	0040150
247-41-000	TALKEETNA	L	SM	26N	004W	29	TAB1	62-12-00	150-03-30	07	000	0000000	0000000
247-41-000	TALKEETNA	R	SM	26N	005W	24	TAB1	62-11-00	148-29-00	07	143	0000000	0000000
247-41-000	THUNDER	C	SM	28N	009W	30	TAC2	62-29-05	151-00-00	07	143	0040400	0050210
247-41-000	THURSDAY	C	SM	20N	012W	27	TYD4	61-47-45	151-24-45	07	143	0040150	0050060
247-41-000	TOKOSITNA	R	SM	30N	005W	20	TAC1	62-40-45	150-17-00	07	143	2000920	0300370

Table 1 continued

F & G #	NAME	TP	MER	TWP	RANGE	SECT	USGS	LAT	LONG	MNR RSN	BASE STRM	EPA MAIN	EPA SUB
247-41-000	TRAIL	C	SM	17N	007W	19	TYC2	61-32-40	150-36-50	07	143	2000090	0300090
247-41-000	TRAPPER	C	SM	20N	006W	04	TYD1	61-51-00	150-22-00	07	143	2000290	0300140
247-41-000	TRAPPER	C	SM	25N	005W	15	TAB1	61-51-00	150-22-00	07	143	0000000	2000770
247-41-000	TRAPPER	L	SM	22N	005W	00	TYD1	61-59-30	150-14-00	07	000	0000000	0000000
247-41-000	TREASURE	C	SM	25N	009W	27	TAA2	62-21-35	151-11-10	07	143	0300320	0040250
247-41-000	TROUBLESOME	C	SM	29N	005W	05	TYC1	62-37-30	150-14-30	07	143	2000920	0300340
247-41-000	TROUBLESOME	L	SM	30N	004W	01	TYC1	62-40-00	149-58-00	07	000	0000000	0000000
247-41-000	TWENTYFIVEMILE	L	SM	28N	007W	33	TAA2	62-28-45	150-35-10	07	000	0000000	0000000
247-41-000	TWENTYMILE	C	SM	24N	007W	27	TAB2	62-15-05	150-39-10	07	143	2000290	0300370
247-41-000	TWIN	C	SM	26N	012W	22	TAB3	62-20-05	151-28-00	07	143	0050050	0060070
247-41-000	WHISKERS	C	SM	26N	005W	03	TAB1	62-22-40	150-10-10	07	143	0000000	2000970
247-41-000	WHISKEY	L	SM	22N	012W	24	TYD4	61-59-30	151-24-00	07	000	0000000	0000000
247-41-000	WHITSOL	L	SM	18N	006W	07	TYC2	61-40-10	150-25-20	07	000	0000000	0000000
247-41-000	WIGGLE	C	SM	26N	005W	24	TAB1	62-20-45	150-06-30	07	143	2000920	0300010
247-41-000	WILDHORSE	C	SM	30N	008W	30	TAC2	62-39-35	150-50-50	07	143	0050030	0060020
247-41-000	WILLOW	C	SM	28N	008W	06	TAC2	62-32-50	150-49-10	07	143	0050340	0060030
247-41-000	WILLOW	C	SM	20N	005W	34	TYD1	61-47-00	150-09-40	07	143	0000000	2000400
247-41-000	WOLVERINE	C	SM	27N	013W	13	TAB4	62-25-38	151-36-40	07	143	0040290	0050160
247-41-000	WOLVERINE	C	SM	17N	009W	01	TYC3	61-36-40	150-45-01	07	143	0300130	0040010
247-41-000	YENLO	C	SM	23N	009W	30	TAA2	62-03-45	150-59-20	07	143	0300380	0040070
247-41-000	YENTNA	R	SM	17N	007W	13	TYC2	61-33-45	150-28-30	07	143	0000000	2000190
247-41-000	YENTNA EAST FRK	R	SM	25N	014W	01	TAB4	62-16-50	151-46-30	07	143	0000000	2000190
247-41-000	YENTNA WEST FRK	R	SM	25N	014W	01	TAB4	62-26-50	151-46-30	07	143	2000190	0300730

Table 1 continued

Appendix C continued -

DEPARTMENT OF FISH AND GAME ANADROMOUS FISH STREAM CATALOG

F E G #	NAME	TR	MER	TWP	RANGE	SECT	USGS	L A T	L O N G	MNR BSN	BASE STRM	FPA MAIN	FPA SUB
247-41-000	YOUNGSTOWN	C	SM	25N	013W	28	TAA4	62-13-50	151-39-00	07	143	2000190	0300670
247-50-000	BIG	L	SM	17N	004W	25	ANC8	61-32-00	149-54-00	08	000	0000000	0000000
247-50-000	BLODGETT	L	SM	17N	002W	08	ANC8	61-34-40	149-40-20	08	000	0000000	0000000
247-50-000	CORNELIUS	L	SM	18N	001E	27	ANC7	61-37-45	149-15-10	08	000	0000000	0000000
247-50-000	COTTONWOOD	L	SM	17N	001E	05	ANC7	61-36-30	149-19-00	08	000	0000000	0000000
247-50-000	EAGLE	P	SM	14N	003W	01	ANB8	61-19-40	149-44-25	08	035	0000000	0000000
247-50-000	FISH	C	SM	16N	003W	35	ANB8	61-26-15	149-46-05	08	197	0000000	0000000
247-50-000	GOOSE	C	SM	15N	003W	19	ANB8	61-22-30	149-53-05	08	195	0000000	0000000
247-50-000	LUCILE	C	SM	17N	003W	14	ANC8	61-34-00	149-46-45	08	197	2000100	0300020
247-50-000	MEADOW	C	SM	17N	003W	19	ANC8	61-33-30	149-52-30	08	197	0000000	2000100
247-50-000	MULE	C	SM	14N	004W	12	ANB8	61-19-00	149-55-00	08	192	0000000	0000000
247-50-000	NICKLASEN	L	SM	18N	001E	21	ANC7	61-37-45	149-16-00	08	000	0000000	0000000
247-50-000	STEPHAN	L	SM	16N	004W	14	ANB8	61-29-30	149-56-00	08	000	0000000	0000000
247-50-000	THREEMILE	C	SM	16N	003W	16	ANB8	61-28-40	149-48-55	08	197	0000000	2000080
247-50-000	THREEMILE	L	SM	16N	003W	02	ANC8	61-30-05	149-45-30	08	000	0000000	0000000
247-50-000	THUNDERBIRD	C	SM	16N	001W	25	ANB7	61-26-45	149-21-40	08	025	0000000	0000000
247-50-000	WASILLA	C	SM	17N	001W	36	ANC7	61-31-00	149-23-00	08	002	0000000	0000000
247-50-000	WASILLA	L	SM	17N	001W	02	ANC7	61-35-15	149-23-45	08	000	0000000	0000000

Table 1 continued

Appendix D: ADF&G Principal Contacts for Supplemental River Basin Information

TERRESTRIAL SPECIES

Game Division

With the exception of migratory birds, marine mammals, and Federally threatened and endangered species, all the bird and mammal resources in the State are protected and managed by the Game Division of the Alaska Department of Fish and Game. The Division's activities can be divided into three major categories: wildlife population management, hunter safety, and wildlife investigations.

For information on the Game Division's activities in the Willow-Talkeetna Sub-basin contact:

1. Sterling Eide, Region II Supervisor
2. Karl Schnieder, Research Coordinator
3. Jim Faro, Management Coordinator
4. Suzanne Miller, Biometrician

Alaska Department of Fish and Game
Game Division
333 Raspberry Road
Anchorage, Alaska 99502
Phone: (907) 344-0541

Appendix D continued -

Contacts for species-specific information follow:

Species	Contact	Work Location	Phone Number
Beaver	Bud Burris	Fairbanks	452-1531
	Dick Bishop	Fairbanks	452-1531
	Jim Faro	Anchorage	344-0541
	Pete Shepherd	McGrath	524-3325
	Nick Steen	Palmer	754-4246
	Jack Didrickson	Palmer	754-4246
Brown and Black Bear	Lee Glenn	Anchorage	344-0541
	Lee Miller	Anchorage	344-0541
	Ron Modafferi	Anchorage	344-0541
	Jim Faro	Anchorage	344-0541
	Sterling Eide	Anchorage	344-0541
	Jack Didrickson	Palmer	754-4246
Snipe	Dan Timm	Anchorage	344-0541
	Dick Sellers	Anchorage	344-0541
Ptarmigan and Spruce Grouse	Jerry McGowan	Fairbanks	452-1531
	Ron Modafferi	Anchorage	344-0541
	Don Cornelius	Glennallen	822-3461
	Robert Weeden	U of A (Fairbanks)	479-7083

Appendix D continued -

Species	Contact	Work Location	Phone Number
Snowshoe Hare	Don Cornelius	Glennallen	822-3461
	Jean Ernest	Fairbanks	452-1531
Moose	Sterling Miller	Anchorage	344-0541
	Karl Schneider	Anchorage	344-0541
	Jack Didrickson	Palmer	754-4246
	Al Franzmann	Soldotna	262-9368
	Paul Arneson	Anchorage	344-0541
Marten	Jim Faro	Anchorage	344-0541
	Bud Burris	Fairbanks	452-1531
	Loyal Johnson	Sitka	747-8488
Trumpeter Swan	Dan Timm	Anchorage	344-0541
Red Squirrel	Don Cornelius	Glennallen	822-3461
	Dave Klein	U of A (Fairbanks)	479-7671
	Sam Harbo	U of A (Fairbanks)	479-7671
Caribou	Greg Bos	Anchorage	344-0541
	Jerry Sexton	Anchorage	344-0541
	Ken Pitcher	Anchorage	452-1531
	Jim Davis	Fairbanks	452-1531
	Ray Cameron	Fairbanks	452-1531
	Sterling Eide	Anchorage	344-0541

Appendix D continued -

Species	Contact	Work Location	Phone Number
Wolf	Jerry Sexton	Anchorage	344-0541
	Warren Ballard	Glennallen	822-3461
	Bob Stephenson	Fairbanks	452-1531
	Loyal Johnson	Sitka	747-8488
Wolverine	Warren Ballard	Glennallen	822-3461
Dall Sheep	Dave Harkness	Anchorage	344-0541
	Lyman Nichols	Cooper Landing	595-1223
	Wayne Heimer	Fairbanks	452-1531
	Don Cornelius	Glennallen	822-3461
Mountain Goat	Lyman Nichols	Cooper Landing	595-1223
	Don Cornelius	Glennallen	822-3461
	Warren Ballard	Glennallen	822-3461
	John Schoen	Juneau	586-6702
Red Fox	Jim Faro	Anchorage	344-0541
	Jean Ernest	Fairbanks	452-1531
	Bob Stephanson	Fairbanks	452-1531
	Christian Smith	King Salmon	246-3340

Appendix D continued -

Species	Contact	Work Location	Phone Number
Lynx	Ted Spraker	Soldotna	262-9368
Coyote	Ted Spraker	Soldotna	262-9368
	Bob Stephenson	Fairbanks	452-1531
Mink	John Burns	Fairbanks	452-1531
Short Tailed-Weasel	John Burns	Fairbanks	452-1531
Least Weasel	John Burns	Fairbanks	452-1531
Land Otter	Roger Smith	Kodiak	486-4791
	Loyal Johnson	Sitka	747-8488
Muskrat	Sterling Eide	Anchorage	822-3461
	Jean Ernest	Fairbanks	452-1531
Hoary Marmot	Don Cornelius	Glennallen	822-3461
Artic Ground-Squirrel (Furbearers in general)	Herb Melchior	Fairbanks	452-1531

Appendix D continued -

Species	Contact	Work Location	Phone Number
Northern Flying-Squirrel	Herb Melchior	Fairbanks	452-1531
Harbor Seal	Ken Pitcher	Anchorage	344-0541
Gulls and other seabirds	Paul Arneson	Anchorage	344-0541
All Willow Basin Species	Ken Taylor	Dillingham	842-5925

Appendix D continued -

AQUATIC SPECIES

Aquatic species are managed by the Sport Fish, Commercial Fish, and Fisheries Rehabilitation Enhancement and Development (FRED) Divisions. Because of their diverse areas of responsibility, general descriptions of each Division are presented below. Also listed are the Regional Supervisors and principal contacts.

Sport Fish Division

The Sport Fish Division is responsible for managing and developing Alaska's vast sport fish resources. Management activities include: regulating catch, seasons, and equipment; protecting and developing public access to fishing areas; artificially stocking lakes and streams; and determining whether or not proposed land uses are compatible with sport fisheries. Research conducted by the Sport Fish Division includes: lake and stream investigations, fish life history studies, land use studies, instream flow data collection and analysis, and harvest studies.

For information on this Division's activities in the Willow-Talkeetna Sub-basin contact:

1. Russ Redick, Region II Supervisor
2. Larry Heckart, Research/Management Coordinator

Appendix D continued -

3. Mike Mills, Biometrician and Instream Flow Computer Analysis Coordinator
4. Tom Trent, Susitna Hydroelectric Aquatic Studies Program Supervisor*
5. Christopher Estes, Instream Flow Data Collection Coordinator*

Alaska Department of Fish and Game
Sport Fish Division
333 Raspberry Road
Anchorage, Alaska 99502
Phone: (907) 344-0541
*(907) 274-7583

Commercial Fish Division

The Commercial Fish Division is charged with the responsibility of managing all commercial and subsistance fisheries in the State, with the exception of halibut. To fulfill these objectives, the Division is divided into three major functions: fisheries management, research, and administration.

Management is involved with monitoring catch and escapement and recommending regulations for: season openings and closures, areas for fishing, types of gear to be used, etc. Species managed include: salmon, herring, shellfish, and ground (bottom) fish.

Research activities deal with fish stock separation, fish tagging and recovery, computer storage and analysis of data, development and application of sonar equipment, and forecasting of salmon runs. Shellfish research is concerned with stock assessments, life history studies, and investigations of population dynamics of the various species.

For information concerning Commercial Fish Division's activities in the Willow-Talkeetna Sub-basin contact:

1. Al Kingsbury, Region II Supervisor (Acting)
2. Al Kingsbury, Research Coordinator
3. Ken Florey, Management Coordinator (Anchorage)
4. Gary Sanders, Management Coordinator (Soldotna)
5. Fred Jamsen, Biometrician

Alaska Department of Fish and Game
Commercial Fish Division
333 Raspberry Road
Anchorage, Alaska 99502
Phone: (907) 344-0541

Fisheries Rehabilitation, Enhancement and Development (FRED) Division

The FRED Division of the Alaska Department of Fish and Game is responsible for the rehabilitation, enhancement, and development of the State's

fisheries for the continued use of all citizens. In addition, the FRED Division encourages technological development and economic utilization of the fisheries resources. Major FRED Division programs include: development of a State-wide system of hatchery facilities, artificial stocking of lakes and streams (including artificial egg plants), design and construction of fish passes, and stream clearance activities.

Dave Daisy, Region II FRED Supervisor, should be contacted for information on FRED's activities in the Willow/Talkeetna Sub-basin.

Alaska Department of Fish and Game
FRED Division
333 Raspberry Road
Anchorage, Alaska 99502
Phone: (907) 344-0541

Appendix D continued -

ADF&G CONTACTS FOR ADDITIONAL FISH AND WILDLIFE INFORMATION

Habitat Protection Section

The Habitat Protection Section provides assistance in the following areas:

1. designing particular developments (e.g., subdivisions; commercial, industrial or agricultural projects; recreational facilities, etc.) so as to minimize negative impacts on fish and wildlife resources;

2. developing guidelines, criteria, citing standards, etc., for development activities;

3. identifying fish and wildlife values and associated human uses provided by public-interest lands, and, in some cases, by other lands;

4. recommending methodologies for the inventory and evaluation of fish and wildlife resources and the assessment of potential environmental impacts of proposed developments;

Appendix D continued -

5. Title 16 permitting and enforcement; and

6. identifying the institutional aspects of defining and reserving instream flow values.

Additional information pertaining to the Habitat Protection Section's programs are discussed in:

Clark, J.A. 1980. Alaska's habitat protection program. ADF&G, Habitat Protection Section, Juneau. n.p.

For specific information on the Habitat Protection Section's activities in the Willow-Talkeetna Sub-basin contact:

1. Bruce Barrett, Region II Habitat Protection Supervisor (Acting)
2. Lance Trasky, Marine Coastal Habitat Management Supervisor
3. Richard Cannon, Resource Assessments Program Supervisor*

Alaska Department of Fish and Game
Habitat Protection Section
333 Raspberry Road
Anchorage, Alaska 99502
Phone: (907) 344-0541
*(907) 274-0516

Subsistence Section

The Subsistence Section's principal duties are: 1) to evaluate the role of subsistence hunting and fishing in the lives of State residents, and 2) to quantify the amount, nutritional value, and dietary contribution of food acquired through subsistence hunting and fishing. The Section also evaluates the impact of laws on the subsistence way of life and provides information to the public and various agencies to assist in establishing regulations.

For information on the Subsistence Section's activities in the Willow-Talkeetna Sub-basin contact Ron Stanek, Resource Specialist II.

Alaska Department of Fish and Game
Subsistence Section
333 Raspberry Road
Anchorage, Alaska 99502
Phone: (907) 344-0541

Appendix E. Habitat Definitions.

Habitat is the sum total of environmental conditions (climate, vegetation, topography, hydrology, other organisms, etc.) with which an organism or population interacts in its search for food, shelter, water, space, and reproductive opportunities. This general definition is frequently qualified to convey more specific meaning. It can be qualified to emphasize: 1) habitat function, for example, essential habitats - those areas which support specific fish and wildlife activities such as spawning, nesting, denning, etc.; 2) habitat sensitivity, for example, vital habitats - those areas which are essential and unusually susceptible to environmental degradation; 3) habitat suitability, for example, prime habitats - those areas particularly well suited for a species.

The definition of habitat can also be qualified legislatively in order to protect certain environments and restrict activities affecting them, for example, critical habitats - areas especially crucial to the perpetuation of fish and wildlife and where all other uses not compatible with that primary purpose are restricted. Thus when the term habitat is encountered, special attention should be given to any qualifications that might be indicated.

Appendix F -

Key to Using the Maps of the Susitna/Talkeetna Sub-Basins

Wildlife resources of the area are coded with a capital letter (ie: A=Black Bear).

Specific habitat usage, if known, is coded with a numerical subscript (ie: C_3=C-Moose; 3-winter range).

The ☐ in the lower right-hand corner denotes the presence of specific animals throughout the entire quadrangle.

A ☐ denotes the presence of specific animals throughout the quadrangle, but only in appropriate habitat.

Sources of information within the ☐ :

A letter-number combination denotes that the source is the DNR backlog maps.

Letter-number combinations with an "*" are taken from Alaska's Wildlife and Habitat, volume 1.

A simple letter denoting presence throughout the quadrangle, but no specific activity, comes from Alaska's Wildlife and Habitat, volumes 1 and 2.

A letter with a "▲" denotes that the animal occurs occasionally throughout the quadrangle; source is Alaska's Wildlife and Habitat, volumes 1 and 2.

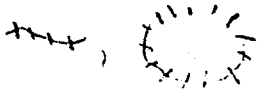
Marks on the Map

(brown) —— = ADF&G State-interest lands (DNR backlog maps)

(blue) —— = additional information, or presence (AK. W&H, vol. 1)

(green) - - - = additional information, or presence (AK. W&H, vol. 2)

(purple) —— = seabird catalog information (USF&WS)

 = high-density areas, or known concentration sites (AK. W&H, vol's 1 and 2)

Appendix F - continued

Marks on the Map (continued)

(brown)  source of maps in left-hand corner (input from area biologists)

(red)  input from Jack Didrickson, Dave Harkness

(orange)  input from Paul Arneson, Dan Timm

Appendix F - continued

I. Wildlife Resources

A. Black Bear (*Ursus americanus*)

B. Grizzly Bear (*Ursus arctos*)

C. Moose (*Alces alces*)

D. Caribou (*Rangifer tarandus granti*)

E. Wolf (*Canis lupus*)

F. Wolverine (*Gulo gulo*)

G.
(i) Dall Sheep (*Ovis dalli*)

(ii) Mountain Goat (*Oreamnos americanus*)

H. Waterfowl

I.
(i) Coyote (*Canis latrans*)

(ii) Red fox (*Vulpes vulpes*)

J. Lynx (*Felis lynx*)

K.
(i) Marten (*Martes americana*)

(ii) Mink (*Mustela vison*)

L.
(i) Short-tailed weasel (*Mustela erminea*)

(ii) Least Weasel (*Mustela nivalis*)

M. Land Otter (*Lutra canadensis*)

N.
(i) Beaver (*Castor canadensis*)

(ii) Muskrat (*Ondatra zibethicus*)

O.
(i) Hoary Marmot (*Marmota caligata*)

(ii) Arctic Ground Squirrel (*Spermophilus parryii*)

I. Wildlife Resources (continued)

P.
(i) Red Squirrel (Tamiasciurus hudsonicus)
(ii) Northern Flying Squirrel (Glaucomys sabrinus)

Q. Porcupine (Erethizon dorsatum)

R. Snowshoe Hare (Lepus americanus)

S.
(i) Willow Ptarmigan (Lagopus lagopus)
(ii) Rock Ptarmigan (Lagopus mutus)
(iii) White-tailed Ptarmigan (Lagopus leucurus)

T.
(i) Ruffed Grouse (Bonasa umbellus)
(ii) Sharp-tailed Grouse (Pediocetes phasianellus)
(iii) Spruce Grouse (Canachites canadensis)

U. Harbor Seal (Phoca vitulina)

V. Seabirds
(i) Gull spp. (Larus spp.)

II. Habitat Usage

1. Spring/Summer Range
2. Fall
3. Winter
4. Calving
5. Denning
6. Feeding
7. Migration
8. Nesting/Molting
9. Staging
10. Hauling-out Area
11. Mineral Licks