Fish and Wildlife Resources Element for the Susitna Area Planning Study

prepared by

The Alaska Department of Fish & Game

Habitat Division

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INTRODUCTION

Historical Perspective

Until a few years ago, balance between public need and land capability was a goal that was only implicitly part of a statewide management policy rather than being explicitly stated and planned. It was a time when supply appeared to exceed demand. Because of apparent abundance, there were few conflicts over the proper uses of land and water resources. Now, during a period of rapid land use change and accelerated resource development, the public is becoming more aware of the limited availability of our natural resources; and diverse demands far exceed supply. Conflict can also be expected to increase among resource users as well as among local, regional, state, and national interests over the use of state lands and resources. Decision-makers must balance the demands of the public against a limited supply of resources, and land managers must attempt to fulfill their responsibility to maintain the integrity of natural resources.

Purpose of a Comprehensive Land-Use Plan

The Alaska Departments of Natural Resources (ADNR), Fish and Game (ADF&G), and the Kenai and Matanuska-Susitna Boroughs are preparing a comprehensive land-use plan for a study area encompassing the Matanuska-Susitna Borough and parts of the Kenai Borough. Decision-makers must combine variables, often difficult to quantify, from several different points of view, reflecting varied and often conflicting interests. The plan attempts to represent these viewpoints and arrive at the best decisions for present and future generations. The plan, in short, addresses the relationship between demands for resources and the capability of the land to meet those demands.

Goal

The goal of the Alaska Department of Fish and Game and the purpose of this Fish and Wildlife Element is sound management of fish and wildlife habitat capable of perpetuating fish and wildlife resources at levels necessary to accommodate existing and future demands for their use and enjoyment by people. These uses can be nonconsumptive as well as consumptive and are of national and statewide significance. Use of fish and wildlife by Alaskans and non-residents has constituted the largest major long-term economic and developmental interest in the state. Alaska's two largest renewable resource industries, the commercial fishing industry, which boasts the world's largest multi-species fishery, and the tourism industry are dependent on the continued well-being of fish and wildlife habitats. These resources are also essential to the lifestyles of many Alaskan residents.

Scope of this study. More comprehensive characterizations of various uses of fish and wildlife resources occurring in the study area are presented in Chapter I of the Element "Fish and Wildlife: Human Use and Economic Value." Chapter II, "Fish and Wildlife Resource Supply," discusses the abundance and distribution of fish and wildlife species in the study area and provides an evaluation of the relative capability of land units to produce these resources. A "Fish and Wildlife Resource Atlas of the Susitna Basin," a companion document included in the Element, provides a geographical portrayal in map form of fish and wildlife resources, their uses, and their habitats.

Evolving Habitat Management Problems

One of the basic habitat management problems in Alaska is that while demands for use of fish and wildlife increase, the amount of land in public ownership is decreasing. In some of the newly established federal conservation units, wildlife uses such as hunting and trapping have been curtailed or prohibited, although there is still opportunity for nonconsumptive use in these areas. Loss or severe restriction of consumptive uses in large areas of federal domain leads to increasing use of other areas still open to hunting and trapping.

Land disposals. State and municipal land disposal programs will continue to place large amounts of land into private control through sale or lease. This also will reduce the opportunity for public use of fish and wildlife resources.

Habitat losses. Fish and wildlife populations and habitats are reduced in quantity and quality as habitats are changed by uses incompatible with them. Some land use activities can lead to significant loss or relocation of fish and wildlife through disturbance, alteration, or destruction of important habitat. Some habitat loss or alteration is inevitable when development occurs, and little can be done to prevent it. However, major habitat losses can sometimes be avoided or minimized by proper planning and execution of developmental projects.

Importance of the Study Area

In no other region of Alaska do the often competing demands for land and natural resources intensify to the degree found in the study area. Nearly three-fourths of the state's population is concentrated in this region. Their needs for land and resources for settlement, resource development, and recreation will largely be focused on the Susitna-Beluga basins.

In order to ensure future use and enjoyment of fish and wildlife resources in the study area, the department recommends that a suitable land and water base be established to provide for the habitat needs of fish and wildlife and to extend the opportunities of the public to use and enjoy them. In addition, an attempt should be made to maintain as much fish and wildlife habitat as possible in conjunction with any developmental project undertaken. To accomplish these objectives it is recommended that the state reserve instream flows (that is, the amount of water necessary to maintain and protect aquatic habitats for fish and wildlife resources); classify lands valuable for wildlife habitat; and, where possible, establish legislative or administrative special management areas for the purpose of protecting and enhancing fish and wildlife populations and providing opportunities for their continued public use. The state should also maintain or improve public use opportunities by retaining access rights when lands are leased or sold and, where possible, establish public use corridors that would perpetuate use of trails and shorelines. Detailed recommendations for land allocation, public access, and developmental guidelines are presented in Chapter III, "Resource Management Recommendations."

CHAPTER I

DEMAND

CHAPTER I. FISH AND WILDLIFE: HUMAN USE AND ECONOMIC VALUE

Introduction

Human use and enjoyment of fish and wildlife has been steadily increasing in Alaska. This use is often termed "demand" for fish and wildlife. This demand is important for Alaskan residents and non-residents alike because Alaska is one of the few remaining places in the world where fish and wildlife are abundant and fairly accessible. Likewise, human use and enjoyment of the state's fish and wildlife resources are important to the Alaskan economy and essential to lifestyles of many Alaskan residents. In the Matanuska-Susitna (Mat-Su) Borough alone, more than $70 million annually are contributed by people who directly or indirectly use its fish and wildlife resources.

The Susitna-Beluga basins contain a variety and abundance of fish and wildlife resources for which there is substantial human demand. Uses of, and demands for, fish and wildlife resources are as varied as the individuals who engage in fish and wildlife-related activities, including commercial, recreational, and subsistence hunting, fishing, and trapping; conservation activities; scientific study; photography; nature viewing; and other such activities. Few of these uses or demands can be adequately quantified. About some of these activities no information is available, or there may not be a good method for evaluating the use or its value. As a result, this chapter deals only with uses of and demands for big game, furbearers, selected species of commercial and sport fish, and some nonconsumptive uses of other wildlife. An analysis of economic values, summarizing the overall contributions of specific user groups, is also in this chapter. Appendixes A and B discuss, respectively, the contribution of sport fishing and sport hunting to the economy of the study area.

Chapter I summarizes the human use of fish and wildlife for both consumptive users (hunters, fishermen, trappers) and nonconsumptive users (photographers, nature viewers, birdwatchers, school classes, researchers). It attempts to quantify data on fish and wildlife harvested from the study area and highlights the more important areas for consumptive and nonconsumptive human use, emphasizing access. The Department of Fish and Game compiled information from harvest tickets, hunting licenses, subsistence use surveys, trapping licenses, creel surveys, bear kill locations, and sealing forms for bears and furbearers. The department then estimated the user days and numbers of harvested animals for chum, chinook, pink, sockeye, and coho salmon, brown and black bears, moose, caribou, sheep, and furbearers (lynx, wolves, beavers, wolverines, and land otters).

The department has compiled all angler day sport fish information and commercial fish harvest data and summarized in map and outline forms the most intensively used areas and important access points such as trails, stream corridors, and lakes. From the harvest ticket information, the department identified the areas used by most sheep, caribou, and moose hunters according to the kind of transportation they used to attain access to their hunting sites. Information was obtained on nonconsumptive use from the United States Fish and Wildlife Service's 1980 National Survey of Fishing, Hunting and Wildlife Associated Recreation (USFWS 1982).

Sport Hunting

Moose. Moose are probably the most heavily utilized wildlife species in the Susitna-Beluga basin planning area. Not only do they occur in large numbers, but they are also highly visible and accessible for nonconsumptive and consumptive uses.

The moose taken in the Matanuska-Susitna Borough make up 41% of the total moose harvest effort statewide[1]. The harvest statistics derive from two sources: 1) the general hunt harvest ticket information (reported by harvest code units) and 2) special-permit hunt information. By far the greatest consumptive use of moose occurs during the general hunts.

There were over 18,100 people in 1981 obtaining harvest tickets for moose in the Matanuska-Susitna planning area for the general hunts, compared to 44,087 statewide. Of the former, approximately 12,200, or 67.5%, actually hunted[1] moose. This means that over 41% of all moose hunters hunted in a region that constitutes only 4% (the area of the Susitna-Beluga basins) of the total area of the state. The reason for this imbalance in hunter effort and land area is twofold: 1) the majority of the state's population live in or within commuting distance of the Matanuska-Susitna Borough, and 2) there is better road and other kinds of inexpensive access to prime hunting areas in the Matanuska-Susitna Borough. Other areas of the state are more costly for Matanuska-Susitna and Anchorage residents to reach and the access modes are generally not road-based.

Interestingly enough, the proportion of Alaska residents hunting in the planning area was similar to that of Alaska residents hunting statewide: 96.3% Alaska residents in the planning area and 93.8% Alaska residents statewide (Table 1). There were 20.2% successful and 79.7% unsuccessful moose hunters reporting from the Matanuska-Susitna Borough in 1981, which is similar to the success rate of hunters statewide: 26.0% success. The majority of hunters came from the Anchorage, Girdwood area (65.3%), with the next greatest number coming from the Palmer-Skwentna area (23.9%), indicating that most moose hunters in this highly popular area hunted close to home. The remainder of the hunters in the planning area came from other parts of Alaska (7.1%) or from out of state or foreign countries (3.8%) (These data are displayed by Harvest Report Code Unit in Data supplement A, B, and C, Sport Hunting Harvest Ticket Data.).

[1]Extrapolated estimate based on ratio of hunters reporting and not reporting statewide.

TABLE 1. Numbers of Reporting Moose Hunters, by Residency and Success, in the General Hunts in the Matanuska-Susitna Planning Area, 1981[1]

Residence of Hunter	Total Hunters #	%[1]	Successful Hunters #	%[2]	Unsuccessful Hunters #	%[2]
Anchorage-Girdwood	3,298	65.3%	609	12.0%	2,689	53.2%
Palmer-Skwentna	1,208	23.9%	265	5.2%	943	18.7%
Kenai-Homer	87	1.7%	20	0.4%	67	1.3%
Kodiak-AK. Peninsula	8	0.2%	2	0.1%	6	0.1%
Cordova-Tok	133	2.6%	19	0.4%	114	2.3%
Fairbanks-Delta	106	2.1%	18	0.4%	88	1.7%
Southeast	19	0.4%	7	0.1%	12	0.2%
Other Alaskan	5	0.1%	2	0.1%	3	0.1%
Out of state	170	3.4%	72	1.4%	98	1.9%
Foreign	20	0.4%	12	0.2%	8	0.2%
Total Known	5,054	100.0%	1,026	20.3%	4,028	79.7%

1 Adjusted for unknown residency
2 Percent of total reporting

Certain locations in the Matanuska-Susitna Borough are more heavily utilized than others by moose hunters. These are usually the more accessible areas. They are displayed by Harvest Report Code Unit, a tabulating system created by the Game Division in order to quantify moose statistics (Atlas Map C2a and Table 2). Atlas Map C2a and Table 2 show areas supporting most days of use. These areas were also used by the majority of hunters. The average number of user days (average days per hunter) for a report code unit overall was 5.4 days per hunter, ranging from a low of 3.6 days to a high of 7.8 days within the top 5% most used areas. The total number of reported user days (adjusted for unknown units) was 24,785 (User days are the number of days on which individual hunters hunted for at least a portion of a day.). Estimated total user-days (for hunters returning harvest tickets and those that do not) equals 65,880 days of use (12,200 hunters X 5.4 days/hunter).

The use of the land for hunting in the Susitna-Beluga basin is disproportionate to the size of the area. Seventy percent of the moose hunting (user days) occurred on 19% of the coding units; 80% occurred on 20% of the units; and 90% of the hunting occurred on 39% of the units. This pattern of use generally reflected the relative ease of access to the units.

The Petersville Road-Peters Hills area (Unit 16-1-002) had the highest reported hunter use, with 3,937 user days, and the Lake Louise/Tyone River area (Unit 13-10) had the next highest use, with 1,766 user days. The Little Nelchina/Horn Mountain area (Unit 13-12) was third highest, with 1,202 user days. The Alexander Creek-Mount Susitna area (16-2-012) had 1,185 user days, and the fifth-ranked area in the 70% use category was the Moose Creek-Montana Peak area, with 1,090 user days.

TABLE 2. Harvest Report Code Units in the Upper 70%, 80% and 90% Use Categories, Moose General Hunts, Susitna Planning Area, 1981[1]

Rank	Harvest Report Code Unit[2]	Description of Area	Days[3]
	70% Use Category		
1.	16 1-002	Petersville Rd/Peters Hills	3,937
2.	13-10	Lake Louise/Tyone River	1,766
3.	13-12	Little Nelchina River/Horn Mt.	1,202
4.	16 2-012	Alexander Creek/Mt. Susitna	1,185
5.	14 1-017	Moose Creek/Montana Peak	1,090
6.	16 2-004	Yenlo Hills/Willow Mt.	1,085
7.	16 2-013	Beluga Lake	1,080
8.	16 1-003	Lower Yentna/Lower Susitna	1,059
9.	14 2-020	Talkeetna	892
10.	13 2-127	Maclaren River (south of Denali Highway)	557
11.	14 1-011	Sutton	513
12.	14 2-014	South & Middle Forks Montana Creek	472
13.	14 1-022	Palmer	465
14.	14 1-024	Knik River	442
15.	13-14	Oshetna River	402
16.	14 2-019	Question, Fish, Talkeetna Lake	400
17.	16 2-017	Tyonek/Chuitna River	381
18.	16 2-007	Shell Hills	366
19.	16 2-003	Fairview Mt./Chelatna Lake	359
	80% Use Category		
20.	14 1-016	Friday Creek	354
21.	14 2-009	Caswell Lake	352
22.	13-13	Anthracite Ridge/Caribou & Boulder Creek	332
23.	14 1-013	Seventeen Mile Lake	305
24.	16 2-011	Talachulitna River/Judd Lake	293
25.	16 1-004	Deshka River/Cache Creek	270
26.	16 2-006	Rainy Pass/Happy River	263
27.	14 2-021	Talkeetna River	240
	90% Use Category		
28.	13 2-132	Denali Hwy./Clearwater Cr. to Susitna Bridge	232
29.	14 1-005	Kings River	227
30.	14 2-011	Sheep Creek	224
31.	14 1-015	Wolverine Creek	218
32.	13 2-122	Susitna Lodge/Denali Highway	201
33.	16 2-001	Midway Lake/West & East Fork Yentna	186
34.	14 2-008	Kashwitna River	184
35.	13 5-023	Fog Creek/Susitna River	168
36.	14 2-023	Sheep River	168
37.	14 1-001	Chickaloon River	163
38.	13 2-130	Denali Highway/Clearwater Creek	159
39.	13 5-044	Seattle Creek	153
	TOTAL		22,437

[1] Total days in the Planning Area = 24,785

[2] Harvest Report Code Units (HRCU's) are related to Game Management Units (GMU's) in the following way: the first 3 digits of the HRCU indicate its GMU e.g. 16-1-002 = 16-A-002 = GMU 16 A; 13-5-023 = 13-E-023 = GMU 13 E.

[3] Adjusted for unknown HRCU's

Other areas of importance to the majority of moose hunters (upper 70% of user days) in the planning area in 1981 were the Yenlo Hills/Beluga Lake areas (16 B-004, 16 B-013) and locations near road access along the Glenn, Denali, and Parks highways, areas near Sutton, and a few aircraft-accessible areas such as Talkeetna Lake, Tyonek, Shell Hills, and Chelatna Lake. Areas with another 10% and 20% of the user days (bringing the cumulative totals now to 80% and 90%) are also identified. These areas are depicted on Atlas Map C2a .

The demand for moose hunting is so high in the planning area that in addition to the general hunts there are also special lottery and registration permit hunts for selected areas (Figure 1). Demand for special lottery hunts is high, with the number of applications exceeding available permits issued by a factor ranging from 6.9 to 17.2. In 1982, the number of applications increased an average of 55% from 1981, while the number of available permits remained at 1981 levels (Table 3). Demand for special lottery hunts in the area is increasing faster than the borough, Anchorage, or state populations.

These hunts occur in game management units 16A, 14A, and 14B. The greatest increase from 1981 to 1982 in the number of permits issued in the drawing hunts (80%) occurred in area 910 (game management unit 14A), which was just recently divided into a west and east area. Hunt #913 (game management unit 14B) likewise had a large increase in numbers of applicants, (57% increase). Area 14A extends roughly from Anchorage north to Willow and east to Chickaloon and the Chickaloon River. Area 14B extends from Willow to Talkeetna; Area 16A extends northwest from Talkeetna to Petersville and the Kahiltna River.

An average of 87% of those who obtained permits in 1981 engaged in hunting. Approximately 50% of all special permit lottery moose hunters were successful (Table 3), with the greatest success occurring in Hunt #913 (Game Management Unit 14B)(98% success). The success ratio in the permit hunts is higher overall than that in the general hunts. In the Matanuska-Susitna Borough, this may be because the permit hunts are for cow moose, which are more abundant by a factor of 4:1. The average($\bar{x}$) number of days hunted by permit hunters for all areas in the planning area was 5.19 days, which is similar to the average for the general hunt.

Table 4 displays residence for all hunters in each permit area hunt in 1981. As in the general hunts, in the lottery hunts the majority of hunters resided in the Anchorage-Girdwood area ($\bar{x}$ = 69%), with the Palmer-Skwentna area contributing the next largest percentage of hunters ($\bar{x}$ = 25%). For all other areas of the state and of the "Lower 48" the average contribution was only 6% of the total permit hunter population, and this percentage is spread fairly evenly through these areas. As in the general hunts, the people in these lottery hunts do not travel far for their moose.

TABLE 3. Summary of Demand and Success in Moose Drawing Permit Hunts, 1981[1]

	Hunt#	GMU	Number of Applicants	Number of Permits	Total Hunters	Successful Hunters	Unsuccessful Hunters
1981	908	16A	1036	150	121(81%)	28 (23%)	93(77%)
1982			1056				
1981	910	14A	2582	150	129(91%)[4]	67 (52%)	62(48%)
1982			4658				
1981	911[2]	14B	720	100	85(88%)[4]	21 (25%)	64(75%)
1982			660				
1981	913[3]	14B	413	50	43(86%)	42 (98%)	1(2%)
1982			649				

1 Information from File Data, Game Division
2 Cow moose hunt
3 Late winter hunt
4 Percentage of respondents

TABLE 4. Residence of Hunters in the Moose Special Permit Hunts, 1981[1]

Residence	Hunt 908	Hunt 910W	Hunt 910E	Hunt 911	Hunt 913	Total
Anch.-Girdwood	121(80.1%)	127(64.5%)	128(64.0%)	71(67.6%)	31(62%)	478(68%)
Palmer-Skwentna	20(13.2%)	60(30.5%)	62(31.0%)	28(26.7%)	6(12%)	176(25%)
Kenai-Homer	2(1.3%)	2(1.0%)	4(2.0%)	1(1.0%)	2(4%)	11(2%)
Kodiak-AK Pen.	1(1.0%)	-	2(1.0%)	-	-	3(1%)
Cordova-Tok	1(1.0%)	-	1(1.0%)	1(1.0%)	3(6%)	6(1%)
Fairbanks-Delta	6(4.0%)	5(2.5%)	3(1.5%)	2(1.9%)	7(14%)	23(3%)
Southeast	-	5(2.5%)	-	1(1.0%)	-	6(1%)
Other Alaskan	-	-	-	-	1(2%)	1(1%)
Out of state	-	-	-	1(1.0%)		1(1%)
Total	151	199	200	105	50	705

1 Information from File Data, Game Division.

To briefly summarize the modes of transportation, highway vehicles provided access in the majority of the general hunts in 1981 (41.3%), with airplanes (22.2%) and off-road vehicles (20.2%) providing the second and third most used form of access (Table 5). For permit hunts, the highway vehicle was still most important (56.2%), followed by off-road vehicles (23.1%) and boats (13%) (Table 5).

FIGURE 1. Area of Special Permit Moose Hunt

TABLE 5. Modes of Transportation Used for Moose Hunting, 1981[1]

Transportation Mode	General Hunt Frequency of Use Number	General Hunt Frequency of Use Percent	Permit Hunts Frequency of Use Number	Permit Hunts Frequency of Use Permit
Highway Vehicle	2,725	41.3%	173	56.2%
Airplane	1,462	22.2%	20	6.5%
Off-Road Vehicle	1,333	20.2%	71	23.1%
Boat	869	13.2%	40	13.0%
Horse	139	2.1%	2	0.6%
Motor Bike	66	1.0%	2	0.6%
Snowmachines	3	1.0%	-	-
Total	6,597[2]		281	

[1] Based on known modes of transportation
[2] Some hunters had multiple modes of transportation

Moose are also important for nonconsumptive uses. Because there are many roads and other forms of access into the planning area, the public has excellent opportunities to view or photograph these animals without traveling very far from home. Access into the area is also important for field trips by schools and conservation organizations.

Nonconsumptive users of wildlife spent over 900,000 days in 1978 at photography, nature viewing, etc., and the majority of these users passed through the Susitna-Beluga basins planning area (Jack Wiles pers. comm.). Moose are one of the more visible and readily accessible forms of wildlife for nonconsumptive users and are often seen along the major road systems in the planning area. As a result, families and tourists alike are able to come in close contact with Alaskan wildlife relatively close to home or close to the major urban and cultural center of the state, and they are thus able to enjoy wildlife at a relatively low cost.

Caribou. Caribou are another wildlife species in the Susitna-Beluga basin planning area important to consumptive and nonconsumptive users. Bands of the Nelchina herd are occasionally visible along the Glenn Highway near Eureka. This large herd is the nearest to a major population center like Anchorage. The Mulchatna herd of 20,000 animals, whose range extends into a portion of the planning area, is well over 70 miles from Anchorage, west of Lake Iliamna and Rainy Pass, and is relatively inaccessible to most people.

Caribou are often considered an Arctic tundra species, and it is valuable to have a large herd near the major population center and crossroads of Alaska. The majority of the state's caribou herds are in inaccessible areas that incur much expense to reach. The Nelchina caribou herd is a highlight to people who travel the Glenn Highway during the winter and early spring. The majority of caribou hunting in the planning area occurs in the special Nelchina permit hunt area (Figure 2).

There were 6,819 people who applied for 1,300 caribou permits (Game Division File Data) for the Nelchina hunt in 1981. Of these, an estimated 943 actually hunted. Success for these hunters was 65%, which is similar to the 70% success rate statewide. The caribou hunters in the planning area made up 23.4% of the reporting statewide caribou hunters and took 15.7% of the state's harvested caribou.

The residency distribution of caribou hunters for the Nelchina hunt in 1981 was similar to that of moose hunters in the Matanuska-Susitna Borough, with the majority being Alaskans from the Anchorage-Girdwood, Palmer-Skwentna regions (Table 6). However, 14.5% of the caribou hunters came from the Fairbanks - Delta region (versus 2.1% of the moose hunters), indicating that people travel farther for caribou than for moose, probably because moose are more available near the major urban population centers. For an additional description of Nelchina caribou hunting, refer to Appendix B. Any differences in numbers between these two sections are based on different interpretations and analyses of the data set.

TABLE 6. Residency of Caribou Hunters by User Days in the Nelchina Caribou Hunt, 1981[1]

	No. Hunters	Percent	No. Days	Percent
Anchorage - Girdwood	424	53.1	1,279	45.1
Palmer - Skwentna	156	19.6	615	21.7
Kenai - Homer	18	2.3	56	2.0
Cordova - Tok	37	4.6	132	4.7
Fairbanks - Delta	116	14.5	411	14.5
Southeast	8	1.0	18	1.0
Other Alaska	2	1.0	88	3.1
Out of state	34	4.3	215	7.6
Foreign	3	1.0	24	1.0
Total	798		2,838	

[1] Does not include deletions of units partially outside the planning area

The Nelchina permit hunt in the planning area is divided into 23 game management units encompassing an area of over 15,000 square miles. Of these units, 22% constitute 70% of the user days (Atlas Map C2b; Table 7). Fifty percent of the use occurs in only three management units, units 13-10, 13-12, and 13-14, which are located near Lake Louise, the Little Nelchina River, and the Oshetna River, respectively. With the addition of two more areas, Deadman Creek and Indian/Moose Creek, user days increased to 70% of the use. Access is gained by aircraft most of the time (31%), followed by off-road vehicles (28%) and highway vehicles/foot (26%) (Table 8). Other methods of transportation had relatively low use. The average number of

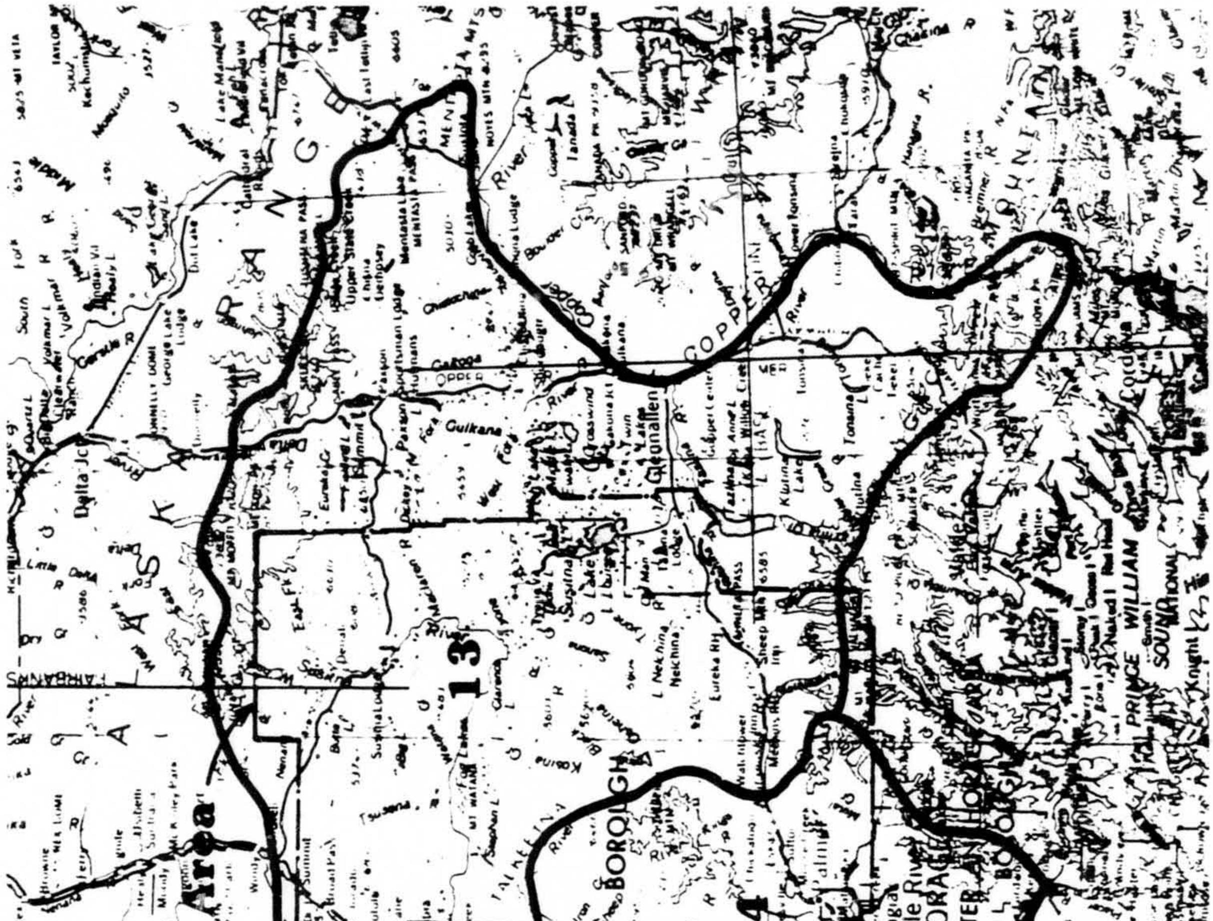

FIGURE 2. Area of the Special Nelchina Permit Caribou Hunt

user days per hunter spent in a caribou management unit was 3.6, ranging from a low of 2.8 days to a high of 8.1 days.

TABLE 7. Caribou Game Management Units Important for Human Use within the Susitna Planning Area[1]

Level of Use	Unit	Location	No. Days	No. Hunters	$\bar{X}$ Days
70%	13-10	Lake Louise	714	201	3.6
	13-12	Little Nelchina River	540	188	2.9
	13-14	Oshetna River	247	82	3.0
	13-21	Deadman Creek	162	58	2.8
	16-203	Indian, Moose, and Johnson Creek	137	16	8.6
80%	13-22	Nenana River	122	19	6.4
	16-101	Dutch and Peters Hills	102	15	6.8
	13-13	Anthracite Ridge	97	21	5.0
90%	13-16	Tsisi Creek/Fog Lake	91	27	3.4
	13-20	Caribou Pass	64	18	3.6
	13-23[2]	Maclaren River	62	12	5.3
	13-15	Clarence Lake, Clear Creek	61	17	3.6

1 Corrected for unknown areas
2 Fifty percent of hunting in this unit was in the study area

TABLE 8. Modes of Transportation Used in the Nelchina Caribou Hunt, 1981

Mode of Transportation	Total No. of Hunters	Number of Successful Hunters	Number of Unsuccessful Hunters
Airplane	302 (31%)	241 (81%)	57 (19%)
Off-road Vehicle	276 (28%)	188 (68%)	88 (32%)
Highway Vehicle & on foot	253 (26%)	110 (43%)	143 (57%)
Boat	71 (7%)	44 (62%)	27 (38%)
Motor Bike	22 (2%)	14 (64%)	8 (36%)
Horse	19 (2%)	13 (68%)	6 (32%)
Total Known Modes	943	614	329

1 Includes multiple modes of transportation

Caribou game management units are large, and user days are not distributed evenly, because specific access points and hunting areas are used (harvest report code units). These access points and hunting areas are listed in Table 9. Code unit numbers are given to each geographical area, although these areas still are general (e.g., complete drainages and access points) and may not represent exactly where the hunting took place. Likewise, a portion of hunters report the wrong unit.

TABLE 9. Specific Caribou Harvest Report Code Units or Access Points with the Greatest Amount of Use (hunter days) in the Susitna Planning Area, 1981

Unit	Location	No. Days	No. Hunters
70% USE			
13-253	Lake Louise	391	106
13-342	Eureka	169	69
13-262	Tyone River	159	46
13-402	Big Oshetna River	111	38
16-203	Happy River/Rainy Pass	97	12
13-191	Nelchina River	87	23
13-260	Tyone Lake	84	24
16-101	Dutch and Peters Hills	72	11
13-531	Coal Creek	68	11
13-420	Clarence Lake	61	17
13-308	Little Nelchina River	59	19
13-524	Butte Lake and Mt.	56	23
13-255	Susitna Lake	55	11
13-273	Gunsight Mountain	53	20
13-385	Little Oshetna River	50	12
13-377	Caribou Creek	50	11
13-320	Kelly Lake	45	5
13-292	Crooked Creek	44	20
13-302	Flat Creek	39	16
13-533	Jay Creek	36	5
13-429	Montana Creek	34	12
13-528	Butte Creek	34	11
80% USE			
13-431	Fog Lakes	34	5
13-294	Old Man Creek	27	8
13-369	Sheep Creek	25	2
16-204	Crystal, Emerald, Portage & Muddy Creeks	24	6
13-663	East & Mid Forks Susitna River	24	6
13-509	Seattle Creek	22	6
13-388	Yacko Creek	21	7
13-486	Tsusena Lake	21	3
13-405	Black Lake	20	7
13-498	Broad Pass	20	4
14-259	Sheep River	20	1
90% USE			
13-181	Monument Creek & Mt.	19	4
13-532	Coal Creek	18	3
13-523	Brushkana Creek	16	8
13-646	Windy Creek	16	8
16-206	Telequana River & Merrill Pass	15	4
13-361	Hicks Creek	14	5
13-519	Deadman Creek	13	4
13-691	Wells Creek	12	6
13-309	Slide Mt. & Fossil Creek	12	3
13-323	Maxon Lake	12	2
13-392	Curtis Lake	12	5

TABLE 9. (Continued)

Unit	Location	No. Days	No. Hunters
13-328	Blue Lake	12	1
13-428	Tsisi Creek	11	5
13-318	Buchia Creek	11	3
13-505	Caribou Lake	10	3
13-404	Crater Lake	10	3
13-272	Sheep Mountain	10	1
13-233	Y Lake	10	1
13-558	Alphabet Hills	10	1

Of the 216 units, only 12 (5%) made up 50% of the effort (days); 25 (12%) made up 70% of the effort; and 17 and 28 constituted 80% and 90% of the effort, respectively. These figures illustrate that access plays an important role in hunter distribution (Table 10).

TABLE 10. Caribou Harvest Report Code Unit Distribution, by Effort, 1981[1]

Use Category	Number of Units	Percent of Total
50%	12	5%
70%	25	12%
80%	37	17%
90%	60	28%

1 Total of 216 units

The ten units most heavily used are Lake Louise, Eureka, Tyone River, Big Oshetna River, Happy River/Rainy Pass, Nelchina River, Tyone Lake, Dutch and Peters hills, Coal Creek, and Clarence Lake.

Sheep. Sheep are the wildlife species in third highest demand for hunting in the planning area. They also attract many hikers, photographers, and nature viewers to peaks easily accessible from nearby major population centers of the state. In the basin, more than 1,170 people were estimated to have applied for sheep harvest tickets in 1981, and of these 370 actually hunted sheep. The residency of these hunters was similar to that of moose and caribou hunters in the planning area, with the exception of out of state and foreign hunters, who make up 17.6% of the total of sheep hunters (3.8% for moose, 8.6% for caribou) (Table 11). All sheep hunters spent an average of 4.6 days and took 146 animals, 16.2% of the sheep killed statewide. Their overall success was 38.7%, versus 42.4% statewide.

TABLE 11. Residency of Sheep Hunters in the Susitna Planning Area, 1981[1]

Residence	Number of Hunters	Percent
Anchorage-Girdwood	195	52.7
Palmer-Skwentna	88	23.8
Kenai-Homer	6	1.6
Kodiak-Alaska Peninsula	0	0
Cordova-Tok	3	1.0
Fairbanks-Delta	9	2.4
Southeast	4	1.0
Other Alaska	0	0
Out of state	58	15.7
Foreigners	7	1.9
TOTAL	370	

[1] Adjusted for unknown residency

There are 15 code units, which constitute 70% of the total user days. An additional four code units bring the total use to 80% of the days (Atlas Map C2c, Table 12). With an additional eight code units (a total of 27 units), 90% of the use is represented. The majority of these 27 important units are near road and airstrip access points. The ten locations most heavily used were Boulder Creek, Chickaloon River, Friday Creek, Pavell Glacier Area, Caribou Creek, Ship Creek, Honolulu Creek, and Coal Creek (Table 12). Transportation modes most frequently used in the planning area were airplanes (41.9%) and highway vehicles (34.3%) (Table 13).

TABLE 12. Sheep Harvest Report Code Units Important for Human Use in the Susitna Planning Area, 1981

Use Category	Unit Code	Location	No. Days	No. Hunters
70% USE	13-18	Boulder Creek	162	42
	13-19	Boulder-Chickaloon	123	27
	14-28	Friday Creek	108	19
	13-25	South Fork Pavell Glacier	91	13
	13-15	Caribou Creek	72	16
	14-02	Sheep Creek	70	10
	14-11	Chickaloon River	65	18
	13-02	Honolulu Creek	54	10
	13-22	Coal Creek	53	7
	13-05	Jay Creek	48	11
	13-17	Hicks Creek	47	12
	13-26	Nelchina Glacier	44	10
	14-30	Wolverine Creek	43	14
	13-24	Matanuska Glacier	43	9
	16-04	Happy River/Rainy Pass	42	5
80% USE	14-09	Kings Creek	41	9
	14-29	Jim Creek	34	8
	14-31	Pinnacle Mountain	33	4
	16-03	Johnson Creek	32	4
90% USE	14-01	Iron Creek	29	4
	16-01	Yentna River	23	6
	13-01	Brushkana Creek/Caribou Pass	22	8
	13-14	Horn Mountains	21	6
	13-23	Glacier/Monument Creek	20	4
	13-20	Talkeetna River	19	6
	13-12	Little Oshetna River	19	4
	14-07	Jonesville/Moose Creek	5	19

TABLE 13. Known Modes of Transportation for Sheep Hunters in the Susitna Planning Area[1]

Mode	Frequency of Use: Number of Hunters	Frequency of Use: Percent Use
Airplane	144	41.9
Highway Vehicle	118	34.3
Off-Road Vehicle	34	9.9
Horse	29	8.4
Boat	15	4.4
Motor Bike	4	1.1
Total	344	

[1] Includes multiple modes of transportation

Black and Brown Bears. Both black and brown bears inhabit the Susitna-Beluga basins and are eagerly sought after by wildlife photographers, nature viewers, and sportsmen, who often travel many miles to reach these animals. Bears are readily seen along the hiking and canoe trails. Many bears, especially brown bears, are found in more remote, inaccessible areas. However, people are still attracted to these remote areas to view and to hunt them.

Black bear tags are issued only to non-residents of the state of Alaska. Thus it is difficult to determine the number of resident hunters who hunted bears. Statewide, there were 1,247 tags issued to non-residents, and their success rate was 18.8% (235 bears harvested). Both resident and non-resident hunters are required to report and seal bears that are harvested only if they take the skull and hide. Therefore, the numbers of bears taken by each group is not known. The success rate of residents, of course, is not known. Assuming that the success rate in the planning area is similar to that statewide, we can extrapolate to estimate the total number of bear hunters, both resident and non-resident, in the area.

In the planning area in 1982, 159 black bears were harvested. Of these, 136 were killed by residents and 23 by non-residents (Table 14). A total of 122 non-residents purchased tags and hunted in the planning area, assuming one tag per hunter. The resident kill of 136 black bears is a minimum figure, since residents are not required to seal black bears if they salvage only the meat. An estimate of the number of residents hunting bears, assuming an 18.8% success rate, is 723.

The department maintains records which show the approximate kill sites for black bears in the planning area. Most of these sites are near road or airplane access points. Game management units 13-E (Cantwell Area), 14-A (Anchorage-Wasilla), and 16-B (Tyonek-Skwentna) had the most black bears taken.

TABLE 14. Number of Black Bears Sealed per Game Management Unit, 1981[1]

Sub-Unit	Total Animals Killed
13-A	12
13-B	3
13-D	5
13-E	20
13 unk	1
14-A	30
14-B	13
14 unk	1
16-A	19
16-B	52
16 unk	3
Total	159

1 Does not include bears taken in defense of life and property

Tags are necessary for all hunters of brown bears. Statewide, 813 non-resident and 5,049 resident tags were issued. A total of 811 brown bears were killed statewide, 435 by non-residents (success rate = 53.5%) and 376 by residents (success rate = 7.4%). The success rate for non-residents may be higher because many non-residents employ professional guides. In the planning area, 89 brown bears were harvested, 28 by non-residents, 61 by residents (Table 15). Assuming the success rate for non-residents and resident brown bear hunters in the planning area to be the same as the statewide success rates for non-residents and residents, respectively, there were an estimated 52 non-resident and 824 resident brown bear hunters in the planning area in 1982. Game management units 16-B and 13-E accounted for most brown bears harvested.

TABLE 15. Number of Brown Bears Sealed per Game Management Unit, 1981[1]

Sub-Unit	Total Animals Killed
13-A	14
13-B	11
13-D	8
13-E	28
14-A	1
14-B	1
16-A	1
16-B	25
Total	89

[1]Does not include bears taken in defense of life and property.

Furbearers. Furbearers is the term given to a variety of unrelated species pursued by humans for their pelts rather than for their meat. Occasionally, a furbearer will be eaten; but generally only their pelts are used. Furbearers in the study area for which data are available are lynx, wolves, land otters, wolverines, and beavers. They are usually trapped by local trappers. Therefore, the potential demand for trapping in the planning area can be extrapolated from the number of trapping licenses issued to people who live in the communities in the planning area. Table 16 lists the communities with the number of trapping licenses issued for each.

Table 17 presents the numbers of trappers and mean trapline length in selected locations of the planning area during 1981, and Table 18 gives, by game management unit, a sample of number of furbearers trapped (File Data, Statistics Division, ADF&G). The statistics presented are only a minimum of the number of animals trapped. Probably many more were trapped but not recorded.

TABLE 16. Trapping Licenses Issued to Residents in or near the Planning Area 1982[3]

Community	Number of Licenses
Anchorage	3,031
Eagle River	233
Chugiak	111
SUBTOTAL	3,375[1]
Palmer	306
Wasilla	246
Willow	55
Talkeetna	56
Trapper Creek	17
Big Lake	10
Sutton	11
Alexander Creek	6
Beluga	3
Cantwell	34
Tyonek	7
Gold Creek	1
SUBTOTAL	768[2]
Paxson	15
Gakona	43
Glennallen	91
Copper Center	40
SUBTOTAL	189
Kenai	312
Soldotna	393
Sterling	54
SUBTOTAL	759
TOTAL	5,091

[1]Does not include Indian, Girdwood, Bird Creek

[2]Does not include McKinley Park

[3]Information from File Data, Game Division, Alaska Department of Fish and Game

TABLE 17. Numbers of Trappers and Mean Trapline Length, 1981[1]

Area	Game Management Unit	Number Trappers	Mean Length Trapline Miles
Glennallen, Paxson			
Lake Louise	13-01	20	81.6
Skwentna	16-01	8	61.8
Cantwell, Denali	13-05	5	35.6
Talkeetna, Petersville	14-02	6	19.2
Palmer, Wasilla	14-01	9	29.1

[1]File Data, Game Division

TABLE 18. Numbers of Animals Trapped, 1981[1]

Game Management Subunit	Lynx	Wolf	Wolverine	River Otter	Total	Rank
13-01	22	13	12	5	52	3
13-02	6	9	11	5	31	6
13-05	40	18	15	0	73	2
14-01	7	4	5	28	44	4
14-02	0	1	4	4	9	7
16-01	1	7	6	18	32	5
16-02	1	13	39	30	83	1

[1]File Data, Statistics Division

Subsistence

The subsistence life style is important for many residents in the planning area. This use of resources, for example, is very important to the way of life of residents of the Tyonek and Upper Yentna areas (Atlas Map C5), as demonstrated by research conducted by the Division of Subsistence (Fall et al. 1983). In 1982 and 1983, about 52% of the households in the village of Tyonek and 82% of the households in the Upper Yentna area participated in a survey of their uses of fish and wildlife. Some of the results of this survey are summarized in Table 19.

The available data suggest that salmon are one of the most widely used resources in both communities. Over 90% of the households in Tyonek participated in salmon fishing in 1982, similarly 67-78% of the Upper Yentna households fished for chinook, sockeye, and coho salmon in that same year. In addition, over 90% of the households in Tyonek harvested moose in the last five years. In 1982, 83% of the Upper Yentna households harvested moose. Freshwater fish, eulachon, small game and furbearers were the major groups harvested by Upper Yentna residents, and chinook salmon and shell fish appear to have constituted most of the harvest by Tyonek residents in 1982.

TABLE 19. Subsistence Use of Fish and Wildlife 1982

Species Taken	TYONEK (N=39) # animals	% of households[2]	UPPER YENTNA (N=38) # animals	% of households
Chinook (king) salmon	1565[1]	97%	151	67%
Sockeye (red) salmon	209[1]	94%	470	78%
Pink (humpback) salmon	32[1]	75%	531	44%
Chum (dog) salmon	13[1]	72%	127	22%
Coho (silver) salmon	63[1]	91%	351	75%
Freshwater fish (except eulachon)	N/A	3-50%	1805	14-72%
Eulachon (Hooligan)	N/A	34%	5929	36%
Waterfowl	N/A	69%	152	42%
Spruce grouse	N/A	56%	171	50%
Small game/furbearers	N/A	3-53%	1181	11-36%
Moose	15	91%	30	83%
Black Bear	1-3	22%	13	44%
Brown Bear	1	6%	1	11%
Caribou	---	---	1	6%
Sheep	---	---	1	3%
Shellfish	1056-3300	34%	1481	19%
Harbor seals/ Belukha whales	(1 belukha harvested) (3 struck animals)	21-37%	---	---

[1] These harvest numbers do not include additional salmon removed from commercial harvest for home consumption.

[2] Percent of households harvesting these species within the last five years (1978-1982)

Source: Fall, Foster, and Stanek 1983

Sport Fish

Sport fishing is one of the most important recreational activities in the planning area in terms of numbers of individuals participating, total user days, and number of fish caught. A total of 225,345 days of fishing were spent by reporting sport fishermen in 1981 in the planning area, and 218,264 fish were harvested. This constitutes 15.9% of the effort and 17.9% of the sport fish harvest statewide.

Table 20 displays the sport fish harvest by species and drainage for 1981. The location of these lakes and streams can be found in Atlas Maps B7 and B8. The rivers in the planning area contributed approximately 8% to the total harvest statewide. From 1977 to 1981, the recreational harvest in the planning area ranged from 6.0% to 9.3% of the statewide harvest (Table 21).

TABLE 20. Alaska Sport Fish Harvest by Species and Drainage, 1981[1, 3]

Species	Glennallen	East Susitna	West Susitna	Total[2]	Total State
Chinook (King)	87	881	3,582	4,550 (7.7%)	58,997
Imm. Chinook	--	736	1,466	2,202 (18.5%)	11,908
Sea-run Coho (silver)	--	5,817	7,033	12,850 (10.2%)	125,666
Sockeye (red)	27	739	1,476	2,242 (2.8%)	79,823
Pink (humpback)	--	4,742	660	5,402 (5.3%)	100,998
Chum (dog)	--	2,424	317	2,741 (19.5%)	14,057
Land-locked Coho	57	287	--	335 (0.3%)	97,224
Steelhead	27	--	--	27 (0.1%)	3,264
Rainbow Trout	896	6,964	13,030	20,890 (11.7%)	178,613
Lake Trout	4,675	287	297	5,259 (28.7%)	18,316
Dolly Varden/ Arctic Char	858	2,577	3,037	6,472 (3.4%)	191,689
Arctic Grayling	10,547	10,049	5,250	25,846 (16.2%)	159,924
Northern Pike	--	--	125	125 (0.8%)	16,536
Whitefish	1,625	--	--	1,625 (17.6%)	9,251
Burbot	6,192	172	211	6,575 (45.8%)	14,342
Other fish[4]	183	268	201	652 (1.1%)	
60,881					
TOTAL CONTRIBUTION	25,174	35,934	35,934	97,766 (8.0%)	1,216,712

[1]Includes a few streams and lakes outside of planning area

[2]Percentage contribution to statewide fish harvest of each species

[3]Does not include smelt, halibut, rockfish, clams

[4]Misidentified fish

TABLE 21. Total Sport Fish Harvest, Susitna Basin, 1977-1981

Stream or Lake Fished	1977	1978	1979	1980	1981
Glennallen Area					
Lake Louise, Lake Susitna & Tyone Lake	10,624	8,419	8,953	15,386	15,941
Other waters x 35%	10,308	7,914	11,909	9,191	9,231
TOTAL	20,932	16,333	20,862	24,577	25,172
Eastside Susitna Drainage					
Caswell Creek	---	---	1,643	3,740	2,127
Montana Creek	8,351	25,812	8,564	14,003	7,952
Sunshine Creek	---	---	2,660	4,567	2,759
Clear (Chunilna) Creek	4,227	10,430	5,909	4,959	4,578
Sheep Creek	6,464	10,492	5,203	8,723	3,870
Others	14,121	20,864	14,582	18,348	14,598
TOTAL	33,163	67,598	38,561	54,340	35,884
Westside Susitna Drainage					
Deshka River (Kroto Creek)	4,225	7,630	8,929	13,079	8,431
Lake Creek	11,202	11,738	12,970	9,903	7,109
Alexander Creek	5,667	9,542	4,922	6,862	5,882
Polly Creek	---	---	---	---	326
Talachulitna River	2,687	840	1,484	4,091	987
Chuit River	1,993	1,744	1,465	791	2,280
Theodore River	1,309	1,187	861	998	1,351
Lewis River	208	139	107	9	---
Other rivers	9,391	11,332	15,078	11,581	6,609
Shell Lake	199	100	203	370	---
Whiskey Lake	144	28	252	---	---
Hewitt Lake	171	129	191	---	---
Judd Lake	340	44	938	1,308	---
Other lakes	2,070	3,439	1,972	3,271	3,135
TOTAL	39,606	48,287	49,392	52,272	36,110
TOTAL ALL DRAINAGES IN STUDY AREA	93,701	132,218	108,815	131,189	97,166
Alaskan Total	1,336,237	1,418,361	1,443,244	1,758,245	1,611,585
% of Statewide Total	6.9%	9.3%	7.5%	7.5%	6.0%

If the total sport fish harvest is looked at over a period of time, it will be seen that certain rivers and lakes in the planning area consistently contribute more fish than others (Table 21). Eastside and westside Susitna drainages appear to contribute equally large percentages, and within these drainages certain rivers stand out as important contributors. Montana, Clear, and Sheep creeks in the eastside and the Deshka, Lake Creek, and Alexander Creek in the westside are important contributors. The west and eastside Susitna drainages contribute the largest average percentage of fish, approximately 40% each of the planning area and 3% each of the statewide catch, during the five years of record.

During 1981, the fish contributing the largest percentage of the catch to the statewide total were burbot (45.8%), lake trout (28.7%), chum salmon (19.5%), immature chinook salmon (18.5%), and white fish (17.6%).

From 1977 through 1981, streams near Glennallen, the east and west sides of the Susitna River, and the west side of Cook Inlet supported a total of 92,635 to 123,326 angler-days (Table 22) (Mills 1979-1981). Most Susitna basin angling effort in the planning area was concentrated on the eastside Susitna drainage ($\bar{x}$ = 44.2%). The rivers used most by fishermen in the Susitna basin are Sheep Creek, the Deshka (Kroto Creek), Alexander Creek, Montana Creek, Lake Creek, and Clear Creek (Atlas Fig. C4). The number of angler days in the area increased 18% between 1981 and 1982, which is faster than the human population growth.

Following is a summary of the important sportfish species, their contribution to the total harvest, and the most popular places where they are fished.

Chinook (king) salmon. King salmon are one of the most popular species for sport fishing in Southcentral Alaska. For many years rivers were closed to sport fishing of this species because of their low stocks. Recently their populations have increased and they can now be fished.

In the Susitna-Beluga planning area 4,550 adult and 2,202 immature king salmon were reported caught in 1981, and the majority (74.8%) of these were taken from the west Susitna drainages. The Deshka River (Kroto Creek) had the most fish taken (16.2%) out of all other surveyed streams and lakes in the study area.

King salmon harvest in the Susitna basin in 1981 constituted 9.5% of the statewide total of king salmon harvest.

Coho (silver) salmon. Silver salmon are another popular sportfish in the Susitna basin. Both sea-run and land-locked coho are taken by anglers. The number of sea-run and land-locked silvers make up 10.2% and 0.3% of the total statewide harvest of these species, respectively. The majority of sea-run coho (54.7%) are caught in rivers of west Cook Inlet. Montana Creek provided a large harvest also (17.6%). The majority of land-locked coho are caught in the eastside drainages.

TABLE 22. Angler-days Fished by Stream, 1977-1981, and Percent Contribution to Statewide Totals

Stream Fished	1977	1978	1979	1980	1981
Lake Louise					
Lake Susitna &					
Tyone Lake	14,899	13,161	12,199	10,539	14,397
Other Waters x 35%	7,746	4,667	6,613	5,823	5,354
Glennallen Area Total	22,645	17,828	18,812	16,362	19,751
	(1.9%)	(1.4%)	(1.4%)	(1.1%)	(1.4%)
Caswell Creek	-	-	3,710	4,963	3,860
Montana Creek	14,268	25,762	22,621	19,287	16,657
Sunshine Creek	-	-	3,317	5,208	3,062
Clear (Chunilna) Creek	3,163	5,040	5,125	4,388	3,584
Sheep Creek	8,112	11,869	6,728	8,041	6,936
Others	12,501	14,970	12,639	12,216	7,850
East Side Susitna					
Drainage Total	38,044	57,641	54,140	54,103	41,949
	(3.2%)	(4.8%)	(3.9%)	(3.6%)	(2.9%)
Deshka River					
(Kroto Creek)	3,852	9,111	13,236	19,364	13,248
Lake Creek	6,946	8,767	13,881	8,325	6,471
Alexander Creek	5,991	6,914	8,284	6,812	6,892
Polly Creek	-	-	-	-	377
Talachulitna River	1,342	732	2,185	2,542	1,378
Chuit River	1,355	1,185	1,069	614	1,364
Theodore River	1,037	905	912	700	899
Lewis River	343	172	31	43	---
Other Rivers	7,269	6,011	7,577	4,998	4,586
Other Lakes	2,205	3,420	1,615	2,999	2,120
Shell Lake	566	302	263	414	-
Whiskey Lake	287	129	189	29	-
Hewitt Lake	436	172	613	471	-
Judd Lake	317	151	519	814	-
West Side Cook Inlet					
West Side Susitna					
Drainage Total	31,946	37,971	50,374	48,125	37,335
	(2.7%)	(3.0%)	(3.7%)	(3.2%)	(2.6%)
Total Contribution	92,635	113,440	123,326	118,590	99,035
	(7.7%)	(8.8%)	(9.0%)	(7.9%)	(6.9%)
Total Alaska	1,197,590	1,285,063	1,364,729	1,488,962	1,420,172

[1]M.J. Mills 1979, 1980, 1981, and 1982

[2]Low year for pink salmon run

Sockeye (red) salmon. Sockeye salmon harvested in the planning area make up 2.3% of the total sportfish harvest. The majority of sockeyes (65.8%) are caught in the west Susitna drainages, and in this area, most are caught in Lake Creek. In the planning area, their total contribution to the statewide harvest is only 2.8%.

Pink (humpback) salmon. The eastside Susitna drainages contribute the majority (87.8%) of the pink harvest in the planning area. Montana and Sheep creeks had the highest catch in 1981, contributing 33.0% and 22.9% of the pinks in the planning area, respectively.

Chum (dog) salmon. Chum salmon harvest in the planning area constitutes 19.5% of the statewide sportfish catch of this species, and the majority (88.4%) of these chum are caught in rivers on the eastside Susitna drainages. The creeks in this area with the largest sportfish harvest are Sheep (18.3%) and Montana (14.9%) creeks.

Rainbow trout. Rainbow trout constitute the second largest contribution to numbers of fish caught in the planning area. They are second (21.4%) only to grayling (26.4%) with respect to numbers caught. This harvest makes up 11.7% of the total statewide harvest for rainbows. The majority of these fish (62.4%) are caught in westside Susitna River tributaries. The stream contributing the largest catch is the Deshka (17.4%), followed in order by Lake Creek (13.8%), Alexander Creek (11.0%), and the Theodore River (5.2%).

Lake trout. Lake trout caught in the planning area represent 28.7% of the statewide harvest for lake trout. The majority were caught in the Glennallen area (88.9%). Most are found in the Lake Louise, Lake Susitna, and Tyone Lake areas.

Arctic grayling. The Arctic grayling catch in the planning area contributed the greatest number of fish to the total sportfish caught in the planning area in 1981 (25,846 fish). Approximately equal numbers of grayling came from Glennallen (40.8%) and eastside Susitna (38.9%) drainages. These fish make up 16.2% of all grayling caught in the state.

Whitefish. The whitefish sportfish catch in the planning area contributes 17.6% to the total whitefish catch statewide. All whitefish in this area are caught in the Glennallen area lake system, and most (94.4%) are caught in Lake Louise, Lake Susitna, and Tyone Lake.

Burbot. Of all sportfish species caught in the planning area, burbot contribute the most to the statewide catch of any one species. Of all burbot caught in the state, 45.8% are caught in the planning area, and 43.2% are caught in Lake Louise, Lake Susitna, and Tyone Lake.

Commercial Fish

Currently, all five species of Pacific salmon are harvested commercially in Upper Cook Inlet (UCI). The UCI salmon fishery, although contributing less than a mean 5% of the statewide harvest, generated an average of $21.8 million annually for the years of record 1977-1982 (range = 15-32 million) for 599 drift and 747 set net fishermen. Set gill nets accounted for 40% of the commercial harvest in 1981 (Ruesch 1983). Only set nets are allowed in the Northern District, which includes the immediate area into which rivers of the Susitna basin drain.

The General Subdistrict of the Northern District is the only UCI fishing subdistrict encompassed in the Susitna planning area (Figure 3) and is divided into three areas. Area 247-30 extends from the Chuitna to the Ivan River; area 247-41 extends from the Ivan River to a few miles west of Point McKenzie; and area 247-42 extends from Point McKenzie to the eastern shore of Knik Arm. The commercial harvest in these three areas in 1981 equaled 16% of the total Upper Cook Inlet commercial salmon harvest (Bruce King, pers. comm.). However, the compilation of data for the Northern District only and the General Subdistrict in particular is somewhat misleading because many fish bound for Susitna basin rivers to spawn are caught in the Central District of UCI. Presented here are both detailed data for the Northern District, specifically the General Subdistrict, and also summary data for all districts.

The five species of salmon in UCI are captured as they migrate to their river of origin to spawn. The species that generate the most income for the fishermen are sockeye, followed by chum, pink, and king salmon (Ruesch 1983). The exvessel value of Upper Cook Inlet commercial salmon harvest for 21 years is presented in Table 23. There was a dramatic increase in 1976 in income due to an increase in the price paid for sockeyes and pinks. Cohos had a 362% increase in 1974, and chum had a 384% increase in 1972. All species have remained at or near these higher annual values.

Table 24 presents the 1981 commercial catch by species in the General District. Based on average prices per species, the total dollar amount brought in by commercial fishermen in the General District is over $2 million. However, we cannot look at only General District data, as explained previously. Ninety percent of the chum harvest is attributed to the drift gill net fleet in the Central District. The majority of these fish are bound for Northern District streams, especially the Susitna River, believed to be the foremost contributor to the commercial chum salmon harvest (Ruesch 1983).

It is a difficult, if not impossible, task at this time to separate out commercial catches by river of origin. Thus we have used catch in the Northern District only as an indicator of importance of the UCI commercial fish catch. These figures underestimate the numbers and value of fish contributed by the Susitna basin. The total commercial catch in Upper Cook Inlet for the period 1954-1981 is displayed in Table 25. The catch for 1981, divided into area, gear type, and species, is displayed in Table 26. Biologists from the Commercial Fish Division have estimated that the contribution by salmon populations from Susitna basin rivers to the total UCI catch in 1981 was 56.6%. They also estimate that these rivers contribute 90% of the chum catch, 75% of the pink, 75% of the coho catch, and 30% of the sockeye catch. Table 27 displays the contribution of Susitna basin rivers to the catch in 1981.

Figure 3

Upper Cook Inlet Management Area, Adult Anadromous Investigations, 1982

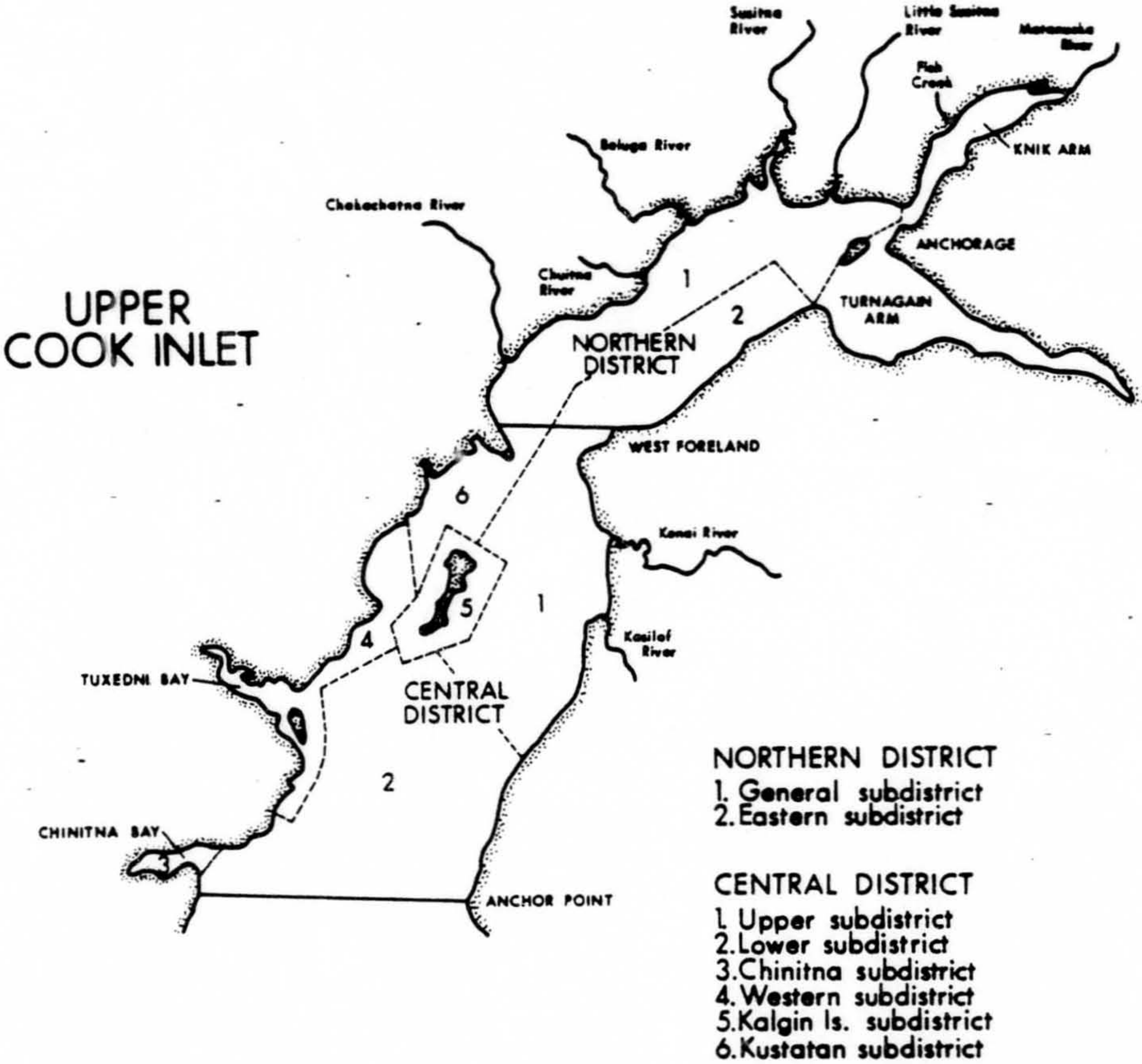

TABLE 23. Exvessel Value of Upper Cook Inlet Commercial Salmon Harvest in Thousands of Dollars by Species, 1960-1981[1]

Year	King	Sockeye	Coho	Pink	Chum	Total
1960	140	1,334	307	663	343	2,787
1961	100	1,687	118	16	204	2,125
1962	100	1,683	342	1,274	582	3,981
1963	89	1,388	193	13	236	1,919
1964	20	1,430	451	1,131	646	3,678
1965	50	2,099	109	70	230	2,558
1966	50	2,727	295	823	338	4,233
1967	49	2,135	187	13	202	2,586
1968	30	1,758	515	1,209	843	4,355
1969	70	1,231	109	23	204	1,637
1970	49	1,135	354	387	745	2,670
1971	189	1,102	143	22	316	1,772
1972	179	1,980	224	478	1,214	4,075
1973	97	2,587	255	330	1,449	4,718
1974	194	2,987	923	955	1,583	6,642
1975	68	2,680	847	418	2,747	6,760
1976	269	8,648	837	1,876	1,985	13,615
1977	463	13,292	857	786	5,187	20,585
1978	418	20,592	935	1,332	2,367	25,644
1979	596	7,935	1,853	96	3,944	14,424
1980	455	9,123	1,194	2,634	1,612	15,018
1981	479	11,546	2,435	184	4,218	18,862
1982	831	24,216	3,614	600	5,657	34,918

[1] 1979-1981; Preliminary data, Annual Management Rept. 1981, UCI Region II

TABLE 24. 1981 Commercial Catch by Period and Species, Set Gill Nets, General Subdistrict

Date	King	Red	Coho	Pink	Chum
6/26	86	508	2	1	23
6/29	58	1,516	1	9	110
7/03	130	1,192	8	9	23
7/06	109	7,517	333	385	7,351
7/10	65	52,334	4,181	875	1,190
7/12	42	30,990	10,015	1,016	3,181
7/14	53	16,684	5,561	4,305	905
7/17	12	1,998	723	1,054	107
7/19	19	18,061	51,738	9,522	14,367
7/20	14	8,583	12,419	4,660	3,294
7/24	14	3,075	4,452	8,709	568
7/27	7	2,417	6,263	9,211	490
7/29	11	2,250	14,636	2,400	5,173
7/31	4	696	3,052	1,170	876
8/03	8	800	3,210	2,191	3,530
8/07	1	113	1,146	227	226
8/10	1	61	615	197	153
8/14	0	2	112	0	5
8/17	0	1	163	7	98
8/21	0	6	133	3	103
8/31	0	2	29	0	16
Total	634	148,806	118,792	45,951	41,789

TABLE 25. Commercial Catch of Upper Cook Inlet Salmon in Numbers of Fish by Species, 1954-1981

Year	King	Sockeye	Coho	Pink	Chum	Total
1954	63,780	1,207,046	321,525	2,189,307	510,068	4,291,726
1955	45,926	1,027,528	170,777	101,680	248,343	1,594,254
1956	64,977	1,258,789	198,189	1,595,375	782,051	3,899,381
1957	42,158	643,712	125,434	21,228	1,001,470	1,834,002
1958	22,727	477,392	239,765	1,648,548	471,697	2,860,129
1959	32,651	612,676	106,312	12,527	300,319	1,064,485
1960	27,512	923,314	311,461	1,411,605	659,997	3,333,889
1961	19,737	1,162,303	117,778	34,017	349,628	1,683,463
1962	20,210	1,147,573	350,324	2,711,689	970,582	5,200,378
1963	17,536	942,980	197,140	30,436	387,027	1,575,119
1964	4,531	970,055	452,654	3,231,961	1,079,084	5,738,285
1965	9,741	1,412,350	153,619	23,963	316,444	1,916,117
1966	9,541	1,851,990	289,690	2,006,580	531,825	4,689,626
1967	7,859	1,380,062	177,729	32,229	269,037	1,894,716
1968	4,536	1,104,904	470,450	2,278,197	1,119,114	4,977,201
1969	12,398	692,254	100,952	33,422	269,855	1,108,881
1970	8,348	731,214	275,296	813,895	775,167	2,603,920
1971	19,765	636,303	100,636	35,624	327,029	1,119,357
1972	16,086	879,824	80,933	628,580	630,148	2,235,571
1973	5,194	670,025	104,420	326,184	667,573	1,773,396
1974	6,596	497,185	200,125	483,730	396,840	1,584,476
1975	4,790	684,818	227,372	336,359	951,796	2,205,135
1976	10,867	1,664,150	208,710	1,256,744	469,807	3,610,278
1977	14,792	2,054,020	192,975	554,184	1,233,733	4,049,704
1978	17,302	2,621,667	219,360	1,689,098	571,959	5,119,386
1979	13,738	924,415	265,166	72,983	650,357	1,926,658
1980	13,798	1,573,597	271,418	1,786,430	389,113	4,034,356
1981	12,240	1,439,235	485,148	127,169	833,549	2,897,341

TABLE 26. Commercial Salmon Harvest by Area, Gear Type and Species Upper Cook Inlet, 1981

Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Drift Gillnet	2,319	633,145	226,257	53,888	756,848	1,672,457
Set Gillnet						
Upper Subdistrict	8,359	496,196	36,133	15,659	2,467	558,814
Kalgin Subdistrict	175	33,945	46,173	2,093	2,009	84,395
Western Subdistrict	624	21,739	29,629	939	21,110	74,041
Kustatan Subdistrict	38	3,995	10,804	1,077	455	16,369
Chinitna Subdistrict	0	538	1,784	167	2,887	5,376
Central District Total	9,196	556,413	124,523	19,935	28,928	738,995
Eastern Subdistrict	91	100,856	15,570	7,374	4,419	128,310
General Subdistrict	634	148,806	118,792	45,951	41,789	355,972
Northern District Total	725	249,662	134,362	53,325	46,208	484,282
Seine	0	15	6	21	1,565	1,607
Grand Total	12,240	1,439,235	485,148	127,169	833,548	2,895,596

TABLE 27. Commercial Salmon Catch Upper Cook Inlet, 1981-1982, and the Susitna Basin Contribution, 1981[1]

	Chinook	Sockeye	Coho	Pink	Chum	Total
1981 Cook Inlet	11,500	1,443,000	494,000	128,000	843,000	2,919,500
Susitna basin	unknown	425,000	371,000	96,000	759,000	1,651,000
		(29.5%)	(75.0%)[2]	(75.0%)[2]	(90.0%)[2]	(56.6%)[2]
1982 Cook Inlet	21,000	3,237,000	777,000	789,000	1,429,000	6,253,000

[1]Information from K. Florey, B. Cross, A. Kingsbury

[2]Estimates

Nonconsumptive Uses of Fish and Wildlife

Nonconsumptive use of fish and wildlife (e.g., nature viewing, birdwatching, photography, research, etc.) has been shown to contribute up to 30% of the total use of fish and wildlife in the southeastern United States. In Alaska it may be even higher. It is an important activity in the planning area, but is not yet quantified as to its percentage contribution. The United States Fish and Wildlife Service conducted a survey on nonconsumptive use of fish and wildlife by Alaskans (1982). According to this study, there were 286,500 people (69%) that used wildlife nonconsumptively, and of these 121,900, or 29%, of all Alaskans did not fish or hunt. Overall in Alaska the percentage contribution to nonconsumptive use was 900,000 user days in 1978 (USFWS 1982).

Many tourists travel to and through the planning area, and 12% of all visitors who travel through Anchorage travel through the Matanuska-Susitna Borough, which constitutes a large part of the planning area (pers. comm., Anchorage Convention and Visitors Bureau). During these travels, tourists often view nature, photograph wildlife, birdwatch, or use recreational facilities where wildlife are known to be.

In 1981, the total number traveling through the borough was 87,993 (Table 28). These tourists spend money on equipment, services, food, and lodging. Many Alaskans and borough residents especially are benefitted by this activity.

Table 28. Visitors to the Matanuska-Susitna Borough in 1982 and the Nature of Their Visits (From In-Flight Survey, Anchorage Convention and Visitors Bureau)

	Anchorage Visitors	Mat-Su Visitors
Year Total	733,300	87,933(12%)
Non-Residents	578,500	
Residents	154,800	
Spring	84,500	7,605(9%)
Non-Residents	62,600	
Residents	21,900	
Summer	387,700	54,278(14%)
Non-Residents	329,200	
Residents	58,500	
Fall	173,800	17,380(10%)
Non-Residents	125,700	
Residents	48,100	
Winter	87,300	8,730(10%)
Non-Residents	61,200	
Residents	26,100	

Spring - April, May
Summer - June, July, August, September (in part)
Fall - September (in part), October, November, December
Winter - January, February, March

Public Attitudes

An extensive outdoor recreation survey conducted in 1979 reported that the top six activities rated as "favorite" by adults in Southcentral Alaska, with the exception of "walking and running for pleasure," which was third, were activities that generally take place on public land (Alaska State Parks). Table 29 summarizes the findings of the survey. Fishing and camping were "most preferred," followed fourth by hunting, then motorboating and beachcombing. The top five activities in which adults "preferred to participate" were usually dependent on public land: fishing, camping, hunting, motorboating, and hiking. Fishing was the third activity in which adults "participated most frequently" (first and second were driving and walking/running). The reason most frequently given by people for not participating in more preferred activities was lack of time (72%).

TABLE 29. Southcentral Alaska Resident Outdoor Recreation Data

A. Activities in which adults most frequently participate (analysis by Clark and Johnson)

- driving for pleasure	- walking/running for pleasure
- fishing	- audience for outdoor sports
- tent camping	- motorboating
- bicycling	- cross-country skiing
- target shooting	- recreational vehicle camping

B. Activities in which adults would like to participate more often (analysis by Clark and Johnson)

- fishing	- camping (general, tent)
- hunting	- motorboating
- hiking	- alpine skiing
- flying	- driving for pleasure
- bicycling	- recreational vehicle camping

C. Activities rated as favorite by adults (analysis by Alaska Division of Parks)

- fishing	- tent camping
- hunting	- walking/running for pleasure
- beachcombing	- motorboating
- cross-country skiing	- playing softball/baseball
- bicycling	- alpine skiing

NOTE: Based on responses by adults participating in the 1979 Alaska Public Survey

The Kellert Survey (Kellert 1980) was a study of American attitudes and behavior towards wildlife and natural habitats. The results of this survey (of 3,107 Americans, including 350 Alaskans) indicated that the respondents supported protection of wildlife habitat.

Fifty-seven percent of the people surveyed, for example, disapproved of building houses on wetlands needed by waterfowl; a significant 51% opposed (44% approved of) natural resource development in wilderness areas if it meant much smaller wildlife populations; 60% favored restricting livestock grazing on public lands to protect vegetation needed by wildlife, despite higher beef prices. At a more significant level, 76% favored forestry cutting practices that helped wildlife even if higher lumber prices resulted, and 66% disapproved of oil development if discovered in Yellowstone Park if it harmed the park's wildlife. An overwhelming 86% of the national sample favored restrictions on off-road vehicle use if it harmed wild animals (moreover, a significant 79% of frequent off-road vehicle users also supported this restriction).

In Alaska, the most outstanding result was the greater knowledge of, appreciation for, and protectionist sentiment toward wildlife on the part of

Alaskans as compared to other regions of the country. Most respondents from this state were strongly inclined toward maintaining healthy and abundant wildlife populations despite the loss of various material benefits. This pattern was revealed on the attitude scales as well as on various habitat protection and endangered species questions. On the other hand, Alaskans had quite low moralistic and high dominionistic scores[1] (attitude scales developed as part of the study) in addition to including far more hunters, fishermen, and trappers than found in other regions. The protectionist sentiment of Alaskans, thus, was not related to an ethical antipathy toward the consumptive use of animals.

"Considerable appreciation of wildlife, the out-of-doors, and general interest in animals were found among Alaska, Pacific Coast and the Rocky Mountain states. Alaska, in fact, had the second highest naturalistic and lowest negativistic scale scores of all demographic groups in the entire study. Additionally, Alaskans participated far more often in almost all consumptive and nonconsumptive wildlife-related activities..."

"Very significant regional differences also occurred on the knowledge of animals scale. Alaskans had, by far, the highest scores, ranking only behind respondents with a graduate education among all demographic groups."

Specifically, Alaskans expressed far greater willingness than any other region to forsake a diversity of human benefits in order to protect wildlife and natural habitats, and this tendency was reflected in both very low utilitarian and extremely high ecologistic scores -- in fact, among the most exceptional of any demographic group on these two scales. Additionally, Alaskans, in response to a number of habitat preservation questions, indicated a definite willingness to render substantial sacrifice to protect wildlife and natural environments.

Economic Valuation Summary

Indicators of wildlife resource value can be associated with the magnitude of goods and services, employment, or revenues attributable to a wildlife-related activity. The use and enjoyment of fish and wildlife resources in the planning area contribute significant benefits to local and state residents. Adequate measures of the benefits provided consumers of these resources can be difficult to obtain, however; commercial fishing, guiding, taxidermy, air taxi and commercial boat operations, outfitting, or sale of fur contribute direct benefits in terms of market transactions that can be quantified. Other important activities such as photography, sportfishing, viewing, nature study, sport hunting, or subsistence use are more difficult to evaluate directly because market transactions do not generally apply, and indirect methods are required to assess them.

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1 Attitude scales from Kellert 1982
- Moralistic = primary concern for the right and wrong treatment of animals.
- Dominionistic = primary interest in the mastery and control over animals, typically in sporting situations.
- Naturalistic = primary interest and affection for wildlife and the outdoors.
- Negativistic = avoidance of animals due to fear.

The following summary of social/economic values resulted from a survey of available information on fish and wildlife resource use in the planning area. The information is admittedly incomplete but does demonstrate that these resources are of considerable economic value. As reported in an earlier section, the Upper Cook Inlet fishing industry supports 1,346 fishermen with an average total value to fishermen per year of $2.0 million. Total expenditures by sport fishermen for the planning area for 1980 were estimated at $29,500,000[1] (USFWS 1982). Estimates of net economic value of sport fishing 1980 (Willow not included), using "willingness to pay" and "willingness to sell" methodologies, were $6,750,000 and $15,400,000 respectively. Estimates of net values are discussed in Appendix A. Sport fishing activities have increased dramatically in the planning area since 1980; an 18% increase in user days was reported between 1981 and 1982.

Estimates of total expenditures by sport hunters in the planning area during 1980 included $5,591,000 by big game hunters, $1,400,000 by small game hunters, and $664,000 by waterfowl hunters (USFWS 1982). These estimates included the Willow Subbasin area. Independent estimates of total expenditures by hunters during 1981 is presented in Appendix B in addition to a comparison of economic values associated with three important hunting areas. Expenditures for big game hunting (Willow Subbasin not included) and waterfowl hunting were respectively $4,239,000[1] and $1,379,000[1].

Most non-residents hunting in the planning area must use guiding services when they hunt Dall sheep and brown bears in Alaska. A survey from the Alaska Professional Hunters Association (140 respondents) noted that each guide averaged 13.5 clients per hunting season, with each client spending an average of $7,077. This provides a total of $95,550 gross average income per guide operation. Seventy-five guiding operations were active during 1982 in the study area. Each operation employs an average of 7.3 Alaskans per year. The average client also spends an additional $2,830 on other activities or purchases while in the state.

A telephone survey was made of ten of the larger air taxi services that operate in the Matanuska-Susitna Borough. A major portion of their business consists of air charters within the planning area by hunters, fishermen, and wildlife photographers. Each of the larger operators grossed in excess of $300,000 during the 1982 season.

An additional benefit can be estimated in terms of the nutritional replacement value of wild game and fish harvested by sportsmen. The following Tables 30 and 31 summarize data used to estimate food replacement values for moose, caribou, bear, and common sport fish species harvested in the planning area (John O'Neil, pers. comm.).

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[1] This figure includes the economic values for the Willow Subbasin, because those values are not able to be isolated from the rest of the study area values in the USFWS report.

Table 30. Susitna Sports Fishing Salmon Harvest Values, 1981

(1) Species	(2) Number Harvested	(3) Average Weight (lbs.)[1]	(4) Average Cleaned Weight (lbs.)[2]	(5) Value Per Pound (Wet Weight)[3]	(6) Total Harvest Value [(2)x(4)x(5)]
Chinook	7,579	26.8	21.4	$4.12	$ 668,225
Coho	32,609	6.3	5.0	4.37	712,507
Sockeye	9,912	6.2	5.0	4.27	211,621
Pink	24,870	3.4	2.7	4.31	289,412
Chum	4,892	7.5	6.0	4.52	132,671
Totals	79,862				$2,014,436

1 Statewide Harvest Study, 1981 - Michael J. Mills
2 Assumed to be approximately 80% of round weight
3 Based on protein cost of 23 selected food items found in 1974 USDA Yearbook of Agriculture

Table 31. Fish and Game Values, 1981[1]

Food Item	Number Harvested	Average Weight Per Animal	Percent Useable[2]	2nd Quarter 1982 Projected Projected Price Base	Total Harvest Value
Black Bear	236	150	50	$3.16	$ 55,932
Caribou	920	250	45	4.21	435,755
Moose	2,155	800	55	4.21	3,991,922
Total					$4,483,609

1 Values were based on costs of protein provided from retail prices of 23 specified meats and meat alternatives. Wild game has a protein per unit weight ratio several times greater than pork or beef.

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CHAPTER II

SUPPLY

CHAPTER II. FISH AND WILDLIFE SUPPLY

Overview

This chapter presents a description of the supply of fish and wildlife resources in the planning area. This supply, or number of animals, is related to the capability of the land to support them. Generally, the capability of an area to support selected species must be assessed indirectly, by examining the quality, abundance, and seasonal distribution of food, water, cover, breeding environments, winter habitats, and other necessary elements required by each species. More direct species data (for example, population size, natality and mortality rates, seasonal movements and concentrations) can be valuable in determining the suitability of an area to support a given population, but such data are available for only a few species and in only a few areas. Moreover, because environments are always changing, either naturally or as a result of human activities, current population data may not be a good index of suitability for future decades. The information in this chapter on supply is based in part on quantitative and qualitative information on fish and wildlife species abundance and distribution. It also is based on known wildlife-habitat associations and the subsequent computer modeling of these associations. "Supply" refers to the amount of fish and wildlife supported by the habitat, and since populations fluctuate from year to year, "supply" for our purposes represents the overall average numbers of fish and wildlife currently supported in the planning area.

The planning area supports a variety and abundance of wildlife. One hundred and fifty-four species of birds, 30 species of freshwater and anadromous fishes, and 38 mammal species (not including belukha whales and harbor seals, which occur in Cook Inlet waters) are likely to be regular breeders or migrants in the study area (Tables 32, 33, and 34). The diversity and abundance of study area fish and wildlife reflect the variety and productivity of available habitats that provide food, cover, water, and reproductive areas for these species. Basin habitats include tidelands, estuaries, river floodplains, deciduous and coniferous forests and woodlands, shrublands, grasslands, muskegs, freshwater marshes, and a variety of tundra plan communities (Atlas Map B15). Table 35 indicates acreages of 33 plant communities in the Beluga and Talkeetna subbasins (areas for which such data are available). Table 36 combines vegetation into 13 categories (plus water and non-vegetated areas) for these two subbasins plus the upper Susitna. Table 37 lists some of the bird and mammal species that may occur in 7 particular plant communities. The modeling descriptions found in Part II of this chapter are based on these wildlife-habitat relationships.

In this chapter we present, by selected species groups, the habitat requirements of each, with estimated population numbers. The estimate of the number of animals living in the planning area and the description of where they live are based on a variety of sources. Most life history and ecology information on the various species derive from assessments of some of the area's populations conducted during coastal zone management projects and from other assessments, including Alaska's Wildlife and Habitat (ADF&G 1974), Alaska's Fisheries Atlas (ADF&G 1976a), and personal communications from researchers. Much ecological information likewise was gleaned from the Susitna-Hydroelectric studies for a portion of the planning area (ADF&G 1982). All the above information appears in Part I.

The specific associations of habitats and wildlife in the planning area generated for this chapter comes from computer modeling. The United States Soil Conservation Service (USDA-SCS) and United States Forest Service (USFS) mapped and inventoried the majority of the habitat (vegetation) cover in the planning area, both by aerial photography and by field assessment. These data were combined with the United States Fish and Wildlife Service's (USFWS) Habitat Evaluation Procedures to generate models that predicted the relative values of wildlife habitat. These included good, moderate, and poor: 1) winter and 2) spring, summer, and fall habitat for moose, the most wide-ranging visible large mammal in the area. Similar procedures were used to categorize poorly, moderately, and highly theoretical existing and enhancible habitats for moose, based upon preliminary information from SCS forage production and a literature review on moose carrying capacity related to vegetation type. The "Species Diversity Model" addressed species other than moose, and the SCS-ADF&G "General Habitat Synthesis Model" addressed all species and habitat and mapped vegetation with respect to certain habitat criteria: scarcity of habitat, use of summer and winter habitats by moose, proximity of riparian zones, and habitats with the greatest number of wildlife species types (species richness). From all of these models, the ADF&G was able to construct maps of the Talkeetna and Beluga subbasins and parts of the upper Susitna subbasin, demarcating lands important for fish and wildlife. This informations appears in Part II and in the Atlas.

TABLE 32. List of Mammals of the Planning Area

Insectivora
- Masked (common) shrew
- Dusky shrew
- Northern water shrew
- Pygmy shrew

Chiroptera
- Little brown bat

Carnivora
- Coyote
- Grey wolf
- Red fox
- Pika
- Black bear
- Brown bear
- Marten
- Short-tailed weasel
- Least weasel
- Mink
- Wolverine
- Land otter
- Lynx

Pinnipedia
- Harbor seal

Cetacea
- Belukha whale

Lagomorpha
- Collared pika
- Snowshoe hare

Rodentia
- Arctic ground squirrel
- Red squirrel
- Northern flying squirrel
- Hoary marmot
- Beaver
- Northern red-backed vole
- Meadow vole
- Tundra (Northern) vole
- Singing vole
- Northern bog lemming
- Brown lemming
- Muskrat
- Meadow jumping mouse
- Porcupine

Artiodactyla
- Moose
- Caribou
- Mountain goat
- Dall sheep

TABLE 33. List of Birds of the Matanuska Valley[1]

R = resident S = summer W = winter M = migrant A = accidental E = escapees

Common loon S
Arctic loon S
Red-throated loon
Red-necked grebe S

Fork-tailed storm-petrel A

Great blue heron S

Tundra swan M
Trumpeter swan S
Canada goose M
Greater white-fronted goose M
Snow goose M
Mallard R
Gadwall S
Northern Pintail S
Blue-winged teal M*
Green-winged teal C*
Eurasian wigeon A
American wigeon S
Northern shoveler S
Redhead M
Ring-necked duck M
Canvasback S or M?
Greater scaup S
Lesser scaup S
Common goldeneye S
Barrow's goldeneye S
Bufflehead S
Oldsquaw M
Harlequin duck S
White-winged scoter M
Surf scoter M
Black scoter M*
Hooded merganser A*
Common merganser S
Red-breasted merganser S

Northern goshawk R
Sharp-shinned hawk S
Red-tailed hawk S
(Harlan's hawk S)
Swainson's hawk M
Rough-legged hawk M
Golden eagle R
Bald eagle R
Northern harrier S
Osprey M

Gyrfalcon R
Peregrine falcon M
Merlin S
American kestrel S

Spruce grouse R
Willow ptarmigan R
Rock ptarmigan R
White-tailed ptarmigan R

(Bobwhite quail E)
(Ring-necked pheasant E)

Sandhill crane S

Lesser golden plover S
Black-bellied plover M*
Surfbird M*
Hudsonian godwit S*
Semipalmated sandpiper M*
Common snipe S
Long-billed curlew S
Whimbrel M
Upland plover M or S?
Spotted sandpiper S
Solitary sandpiper S
Wandering tattler S
Greater yellowlegs S
Lesser yellowlegs S
Least sandpiper S
Pectoral sandpiper S
Western sandpiper M*
Dunlin M*
Short-billed Dowitcher S*
Long-billed dowitcher M*
Semiplamated dowitcher M*
Red-necked phalarope M?
Long-tailed jaeger S
Glaucous-winged gull S
Herring gull S
Mew gull S
Bonaparte's gull S
Arctic tern S

Rock dove R

Golden-crowned kinglet S
Ruby crowned kinglet S

TABLE 33. (continued)

R = resident S = summer W = winter M = migrant A = accidental E = escapees

	Water pipit S
Rufous hummingbird S	
Belted kingfisher S	Bohemian waxwing R
Northern flicker S	Northern shrike R
Hairy woodpecker R	European starling R
Downy woodpecker R	
Black-backed woodpecker R?	Great horned owl R
Three-toed woodpecker R	Snowy owl A
	Northern hawk owl R
Alder flycatcher S	Northern pygmy owl A?
Western wood peewee M	Great gray owl R
Olive-sided flycatcher S*	Short-eared owl M
	Boreal owl R
Horned lark S	
	Arctic warbler A
Violet-green swallow S	Wilson's warbler S
Tree-swallow S	Blackpoll warbler S
Bank swallow S	Orange-crowned warbler S
Cliff swallow S	Yellow warbler S
	Yellow-rumped warbler S
Gray jay R	Blackpoll warbler S
Steller's jay A	Northern waterthrush S
Black-billed magpie R	Rusty blackbird S
Common raven R	
	Pine grosbeak R
Black-capped chickadee R	Rosy finch S or R?
Boreal chickadee R	Hoary redpoll R
Red-breasted nuthatch A	Common redpoll R
Brown creeper R*	Pine siskin R
	White-winged crossbill R
Dipper R	Savannah sparrow S
	Dark-eyed junco R or S?
Winter wren R*	Tree sparrow S
	White-crowned sparrow S
American robin S	Golden-crowned sparrow S
Varied thrush S	Fox sparrow S
Hermit thrush S	Lincoln's sparrow S*
Swainson's thrush S	Song sparrow S
Gray-cheeked thrush S	Lapland longspur R, S, or M?
Townsend's solitaire S	Smith's Longspur *
	Snow bunting W

[1] Michael T. Bronson, Matanuska Audubon Society pers. comm., Gabrielson and Lincoln (1959), Kessel and Gibson (1978), P. Arneson (ADF&G pers. comm.).

[2] The phylogenetic order has been changed on some of these species (AOU 1983).

TABLE 34. List of Fishes in the Planning Area Streams[1]

Pacific lamprey
Arctic lamprey
Pacific herring
Chinook salmon
Coho salmon
Sockeye salmon
Kokanee salmon
Pink salmon
Chum salmon
Steelhead
Rainbow trout
Lake trout
Dolly Varden
Arctic char
Arctic grayling
Northern pike
Round whitefish
Blackfish
Burbot
Pond smelt
Surf smelt
Euclachon (Hooligan)
Longnose sucker
Three spine stickleback
Nine spine stickleback
Slimy sculpin
Coast range sculpin
Pacific staghorn sculpin
Sharpnose sculpin
Starry flounder

[1]Morrow 1980

TABLE 35. Acreages of Cover Types in the Talkeetna and Beluga Subbasins in the Susitna Planning Area

SCS NO.[1]	VEGETATION TYPE[2]	TOTAL ACRES IN TALKEETNA	(%)	TOTAL ACRES IN BELUGA	(%)	TOTAL ACRES	(%)
21.	Short closed white spruce	3,590	(1.0%)[3]	740	(1.0%)	4,330	(1.0%)
22.	Young closed mixed deciduous	6,810	(1.0%)	20	(1.0%)	6,830	(1.0%)
24.	Med. aged closed mixed deciduous	154,450	(6.7%)	59,090	(4.1%)	213,540	(5.7%)
25.	Tall closed white spruce	11,870	(0.5%)	13,200	(1.0%)	25,070	(1.0%)
26.	Old closed mixed deciduous	474,350	(20.5%)	143,950	(9.9%)	618,300	(16.4%)
27.	Young closed cottonwood	1,050	(1.0%)	1,480	(1.0%)	2,530	(1.0%)
28.	Medium closed cottonwood	3,530	(1.0%)	4,220	(1.0%)	7,750	(1.0%)
29.	Old closed cottonwood	1,300	(1.0%)	430	(1.0%)	1,730	(1.0%)
31.	Short open white spruce	59,450	(2.6%)	2,400	(1.0%)	61,850	(1.6%)
32.	Med. aged open mixed deciduous	41,820	(1.8%)	14,920	(1.0%)	56,740	(1.5%)
33.	Tall open white spruce	7,090	(1.0%)	2,810	(1.0%)	9,900	(1.0%)
34.	Old open mixed deciduous	15,940	(1.0%)	140,890	(9.7%)	156,830	(4.2%)
35.	Medium aged open cottonwoods	1,210	(1.0%)	5,080	(1.0%)	6,290	(1.0%)
36.	Old open cottonwoods	530	(1.0%)	690	(1.0%)	1,220	(1.0%)
41.	Short closed black spruce	96,860	(4.2%)	23,340	(1.6%)	120,200	(3.2%)
42.	Tall closed black spruce	41,590	(1.8%)	11,670	(1.0%)	53,260	(1.4%)
43.	Short open black spruce	5,290	(1.0%)	2,860	(1.0%)	8,150	(1.0%)
46.	Tall closed hemlock	0	0	460	(1.0%)	460	(1.0%)
50.	Saltwater grasslands	4,110	(1.0%)	9,250	(1.0%)	13,360	(1.0%)
51.	Saltwater low shrub	2,510	(1.0%)	1,790	(1.0%)	4,300	(1.0%)
52.	Tidal marsh	4,760	(1.0%)	7,900	(1.0%)	12,660	(1.0%)
60.	Tall shrub alder	487,650	(21.0%)	435,000	(30.0%)	922,650	(24.5%)
61.	Tall alder-willow-streamside	135,850	(5.9%)	59,420	(4.1%)	195,270	(5.2%)
62.	Low shrub-willow-resin birch	13,250	(1.0%)	16,280	(1.1%)	29,530	(1.0%)
63.	Grassland	29,130	(1.3%)	25,650	(1.8%)	54,780	(1.5%)
64.	Sedge-grass tundra	4,200	(1.0%)	1,940	(1.0%)	6,140	(1.0%)
65.	Herbaceous tundra	46,600	(2.0%)	113,470	(7.8%)	160,070	(4.2%)
66.	Shrub tundra	3,700	(1.0%)	13,770	(1.0%)	17,470	(1.0%)
67.	Mat-cushion tundra	13,660	(1.0%)	31,070	(2.1%)	44,730	(1.2%)
68.	Sphagnum bog	51,250	(2.2%)	72,140	(5.0%)	123,390	(3.3%)
69.	Sphagnum-shrub bog	472,640	(20.4%)	143,150	(9.9%)	615,790	(16.3%)
70.	Culturally influenced	6,720	(1.0%)	1,650	(1.0%)	8,370	(1.0%)
80.	Mud flats	14,660	(1.0%)	20,600	(1.4%)	35,160	(1.0%)
81.	Rock	2,000	(1.0%)	17,690	(1.2%)	19,690	(1.0%)
82.	Snow fields	0		10	(1.0%)	210	(1.0%)
83.	Glacier	0		17,200	(1.2%)	17,200	(1.0%)
91.	40 acre lakes	18,380	(1.0%)	19,640	(1.4%)	38,020	(1.0%)
92.	10-40 acre lakes	9,850	(1.0%)	3,720	(1.0%)	13,570	(1.0%)
96.	Streams 165-660 ft. wide	2,930	(1.0%)	1,670	(1.0%)	4,600	(1.0%)
97.	River > 660 ft. wide	68,670	(3.0%)	8,960	(1.0%)	77,630	(2.1%)
TOTAL		2,319,200		1,450,420		3,769,620	

[1] SCS NO. = code assigned to a cover type by the Soil Conservation Service (SCS)
[2] Descriptions of each vegetation type are in the supplement to this chapter.
[3] 1% means less than or equal to 1%

TABLE 36. Bird, Mammal, and Plant Associations in the Susitna Planning Area

A. Coniferous Forest

Great blue heron	Winter wren
Goshawk	American robin
Sharp-shinned hawk	Varied thrush
Bald eagle	Hermit thrush
Merlin	Swainson's thrush
Spruce grouse	Gray-cheeked thrush
Willow ptarmigan (?)	Golden-crowned kinglet
Rock ptarmigan (?)	Ruby-crowned kinglet
Great horned owl	Bohemian waxwing
Northern hawk owl	Orange-crowned warbler
Boreal owl	Yellow-rumped warbler
Rufous hummingbird	Blackpoll warbler
Hairy woodpecker	Wilson's warbler
Downy woodpecker	Pine grosbeak
Olive-sided flycatcher	Common redpoll
Tree swallow	Pine siskin
Gray jay	White-winged crossbill
Steller's jay	Savannah sparrow
Black-billed magpie	Dark-eyed junco
Common raven	White-crowned sparrow
Black-capped chickadee	Song sparrow
Boreal chickadee	
Red-breasted nuthatch	
Brown creeper	

Masked shrew	Black bear
Dusky shrew	Brown bear
Northern water shrew	Marten
Pigmy shrew	Short-tailed weasel
Snowshoe hare	Least weasel
Red squirrel	Mink
Northern flying squirrel	Wolverine
Northern red-backed vole	Lynx
Meadow vole	Moose
Tundra vole	Caribou
Muskrat	
Northern bog lemming	
Meadow jumping mouse	
Porcupine	
Coyote	
Grey wolf	
Red fox	

TABLE 36. (continued)

B. Mixed Forest

All species of birds found in coniferous and deciduous forests.

Mammals

Masked shrew	Wolverine
Northern Water shrew	Land otter
Pygmy shrew	Lynx
Little brown bat	Moose
Snowshoe hare	
Northern flying squirrel	
Red squirrel	
Beaver	
Northern red-backed vole	
Meadow vole	
Muskrat	
Northern bog lemming	
Meadow jumping mouse	
Porcupine	
Coyote	
Grey wolf	
Red fox	
Black bear	
Brown bear	
Marten	
Short-tailed weasel	
Least weasel	
Mink	

TABLE 36. (continued)

C. Deciduous Forest

Goshawk	Orange-crowned warbler
Sharp-shinned hawk	Yellow warbler
Merlin	Yellow-rumped warbler
Spruce grouse	Blackpoll warbler
Willow ptarmigan	Townsend's warbler
Great horned owl	Northern waterthrush
Northern hawk owl	Wilson's warbler
Rufous hummingbird	Pine grosbeak
Hairy woodpecker	Rosy finch
Downy woodpecker	Common redpoll
Tree swallow	Pine siskin
Gray jay	Savannah sparrow
Steller's jay	White-crowned sparrow
Black-billed magpie	Common raven
Black-capped chickadee	
Boreal chickadee	
Brown creeper	
Winter wren	
American robin	
Varied thrush	
Hermit thrush	
Swainson's thrush	
Gray-cheeked thrush	
Ruby-crowned kinglet	

Masked shrew	Wolverine
Dusky shrew	Land otter
Northern water shrew	Lynx
Pygmy shrew	Moose
Little brown bat	
Snowshoe hare	
Red squirrel	
Beaver	
Northern red-backed vole	
Meadow vole	
Muskrat	
Northern bog lemming	
Meadow jumping mouse	
Porcupine	
Coyote	
Grey wolf	
Red fox	
Black bear	
Brown bear	
Short-tailed weasel	
Least weasel	
Mink	

TABLE 36. (continued)

D. Shrubland

Sharp-shinned hawk
Rough-legged hawk
Northern harrier
Merlin

Spruce grouse
Willow ptarmigan
Rock ptarmigan
Short-eared owl

Rufous hummingbird
Downy woodpecker
Alder flycatcher
Black-billed magpie
Common raven
Black-capped chickadee
Winter wren
American robin
Varied thrush
Hermit thrush
Swainson's thrush
Gray-cheeked thrush
Ruby-crowned kinglet
Bohemian waxwing
Orange-crowned warbler
Yellow warbler
Yellow-rumped warbler
Blackpoll warbler
Wilson's warbler
Pine grosbeak
Common redpoll
Pine siskin
Dark-eyed junco

Tree sparrow
White-crowned sparrow
Golden-crowned sparrow
Fox sparrow
Lincoln's sparrow
Song sparrow

Masked shrew
Dusky shrew
Pika
Snowshoe hare
Beaver
Northern red-backed vole
Meadow vole
Tundra vole
Singing vole
Muskrat
Brown lemming
Coyote
Grey wolf
Red fox
Black bear
Brown bear
Short-tailed weasel
Least weasel
Mink
Wolverine
Land otter
Lynx
Moose
Caribou
Mountain goat
Dall sheep

TABLE 36. (continued)

E. Grasslands

Sharp-shinned hawk Rough-legged hawk Northern harrier Merlin Spruce grouse Willow ptarmigan Rock ptarmigan Short-eared owl Rufous hummingbird Downy woodpecker Alder flycatcher Black-billed magpie Common raven Black-capped chickadee Winter wren American robin Varied thrush Hermit thrush Swainson's thrush Gray-cheeked thrush Ruby-crowned kinglet Bohemian waxwing Orange-crowned warbler Yellow warbler Yellow-rumped warbler	Blackpoll warbler Wilson's warbler Pine grosbeak Common redpoll Pine siskin Dark-eyed junco Tree sparrow White-crowned sparrow Golden-crowned sparrow Fox sparrow Lincoln's sparrow Song sparrow
Masked shrew Northern water shrew Pygmy shrew Pika Hoary marmot Arctic ground squirrel Northern red-backed vole Meadow vole Tundra vole Singing vole Muskrat Northern bog lemming Brown lemming Meadow jumping mouse Porcupine Coyote Grey wolf Red fox Black bear Brown bear Short-tailed weasel	Least weasel Mink Wolverine Land otter Moose Caribou Mountain goat Dall sheep

TABLE 36. (continued)

F. Alpine Tundra

Rough-legged hawk
Northern harrier
Merlin
Willow ptarmigan
White-tailed ptarmigan
Rock ptarmigan
Short-eared owl
Violet-green swallow
Common raven
American robin
Varied thrush
Hermit thrush
Water pipit
Horned lark
Rosy finch
Common redpoll
Savannah sparrow
Tree sparrow
Fox sparrow
Lincoln's sparrow
Lapland longspur
Snow bunting

Masked shrew
Dusky Shrew
Northern water shrew
Pika
Hoary marmot
Arctic ground squirrel
Northern red-backed vole
Tundra vole
Singing vole
Muskrat
Northern bog lemming
Brown lemming
Porcupine
Coyote
Grey wolf
Red fox
Black bear
Brown bear
Short-tailed weasel
Least weasel
Mink
Wolverine
Land otter
Moose
Caribou
Mountain goat
Dall sheep

TABLE 36. (continued)

G. Tidelands/Marshes/Wetlands

Common loon	Sandhill crane
Arctic loon	Semipalmated plover
Red-throated loon	Lesser golden plover
Red-necked grebe	Black-bellied plover
Horned grebe	Hudsonian godwit
Great blue heron	Whimbrel
Tundra swan	Greater yellowlegs
Trumpeter swan	Lesser yellowlegs
Canada goose	Solitary sandpiper
Brant	Spotted sandpiper
Greater White-fronted goose	Wandering tattler
Snow goose	Ruddy turnstone
Mallard	Red-necked phalarope
Gadwall	Common snipe
Northern Pintail	Short-billed dowitcher
Green-winged teal	Long-billed dowitcher
Blue-winged teal	Surfbird
Northern shoveler	Sanderling
Eurasian wigeon	Semipalmated plover
American wigeon	Western sandpiper
Canvasback	Least sandpiper
Redhead	Pectoral sandpiper
Ring-necked duck	Dunlin
Bufflehead	Glaucous-winged gull
Greater scaup	Herring gull
Lesser scaup	Mew gull
Common goldeneye	Bonaparte's gull
Barrow's goldeneye	Arctic tern
Oldsquaw	
Harlequin duck	
White-winged scoter	
Surf scoter	
Black scoter	
Hooded merganser	
Common merganser	
Red-breasted merganser	
Northern harrier	

Harbor seal
Red fox
Coyote
Red-backed vole
Water shrew
Bog lemming
Muskrat
Least weasel
Short-tailed weasel
Mink
Land otter
Moose

PART I. EXISTING FAUNA AND THEIR HABITATS

Mammals

Moose. Some of Alaska's highest density moose populations occur in the Susitna River valley and in valleys formed by its major tributaries. Moose populations in this area are thought to account for 25-50% of the state total (Reardon 1981). Suitable moose habitat is widespread in the Susitna-Beluga basins and includes early birch, aspen, and white spruce woodlands and forests, riparian alder-willow shrublands, high elevation willow/resin birch shrublands, shrub tundra, and sphagnum-shrub bogs. These habitats occur in a variety of environments, from alpine mountain slopes to lowland valleys, and provide habitats for many other forms of wildlife.

Moose are generally found in all areas of suitable plant composition except steep rocky alpine slopes and, during severe winters, in north-facing deep snowfall areas. Moose concentration areas are located along river and stream valleys from alpine areas to the outlets of the waterways. Most south-facing foothills, lowlands, and mountainous areas at and below treeline are also important.

Important moose concentration areas within the planning area are the Sunflower Basin, Yenlo Hills, Kahiltna flats, Petersville Road, Buffalo Mine area, Moose Creek Bear and Peters creeks, Little Peters Hills, Peters-Dutch hills, Twentymile Creek, Deshka River, Kroto Slough, Talachulitna River basin, the lower Susitna basin, Beluga-Susitna mountains, Yentna-Susitna river delta, Alexander Creek, Susitna River floodplain, Skwentna River floodplain, Bald Mountain, Matanuska River Valley, Big Bones Ridge, Oshetna-Nelchina watersheds, Jim/Swan lakes area, Knik River floodplain, Peter/Purches creeks area, and Deception Creek (Atlas Map B1).

Moose-calving takes place in lowland bogs (Atlas Map B1), beginning in late May and extending through June. Wet marshy lowlands consisting of open areas interspersed with dense stands of shrubs and trees are preferred calving grounds. Important habitats are tidal flats, bogs created by fire or by flooding by beavers, lowland areas associated with major rivers, and shallow, partially filled lakes. These aquatic areas are interspersed with elevated areas with better drainage and with trees 10-60 feet (3.0-18.2 m) tall.

Some important calving areas in Game Management Unit 14 are Nancy Lake, Palmer Hayflats, Knik River flats, Little Susitna River flats, and areas along the Little Susitna River. In Game Management Unit 16A, calving probably occurs along the Tokositna and Kahiltna river flats and in bogs below Little Peters Hills. In Game Management Unit 16B the calving grounds are the Susitna flats, Bachatna flats, Fox flats and bogs below 1,000 feet (305 m) between the Alaska Range and Cook Inlet.

Moose lowland summer habitat occurs throughout the basin. Summer feeding habitats consist of willow, birch, aspen, spruce, grass, aquatic plants, and alder plant communities. These communities may occur in widely distributed stands, isolated patches, or in large concentrated stands. Alpine shrub areas are also important for summer feeding and for breeding areas. See Atlas Map B9a for identification of moose summer habitat suitability (HEP see Part II) for areas in the Talkeetna, Beluga, and upper Susitna subbasins.

Winter habitats occur primarily within riparian and wetland zones in the lowlands, and on south-facing slopes and other upland areas supporting preferred browse species. Winter habitats used during periods of unusually high snow accumulation can include young stands of cottonwood and streamside willow. Moose may become very concentrated in these areas because often they provide the only available food during severe winter conditions (D. Bader pers. comm.). Although winter habitat is necessary for supporting moose through the winter, it can do so effectively only if all moose populations have attained adequate energy reserves while on summer range. Winter habitat then provides adequate energy sources for body maintenance during winters of average snowfall. See Atlas Map B9b for an identification of winter moose habitat suitability in the Talkeetna, Beluga, and Susitna subbasins. Browse consisting mainly of willow, with the addition of birch, aspen, cottonwood, and alder, comprises up to 80% of the winter diet.

Moose densities in summer and winter habitat are generally similar, except during severe, high snowfall winters, when higher densities occur on the more restricted winter range as moose become concentrated in areas where browse remains available. Summer range is considered extremely important for calf survival and moose reproductive success and for providing the nutritional requirements of moose populations in preparation for breeding and winter survival (see Atlas Map B9a for summer range suitability). The amount of fat and muscle tissue produced by moose is directly related to the amount and quality of moose summer habitat available (D. Bader pers. comm.). High quality and wide distribution of forage are of primary importance in providing the moose with its nutritional requirements. See Atlas Map B14a for an identification of theoretical moose-carrying capacity related to moose browse forage in the Talkeetna, Beluga, and upper Susitna subbasins. By late summer the moose return to the uplands and remain there until heavy snows and lack of available food force them back to the lowlands.

The highest moose densities occur where disturbance by fire, flooding, or timber cutting has kept the vegetation in an early seral form, predominantly paper birch with willow and aspen. Summer diet, in addition to the above browse species, includes a variety of terrestrial and herbaceous plants, sedges, and pondweed occurring in bogs and lakes. Density, height, and distribution of forage species affect the intensity with which moose will utilize a particular vegetation type.

Cover is important for moose. In summer they feed in open areas and utilize the bordering shrub and forest areas for cover. They usually bed down near cover. Winter cover needs are generally determined by the influence of climate, food availability, and animal mobility. Mature forest stands with dense canopies provide cover for escape, relief from deep snow conditions, and perhaps protection from wind. Suitable winter range is critical, and its availability is often restricted by snowfall, which can decrease food accessibility and limit mobility. Moose generally prefer the more open shrub-dominated areas and sedge meadows in early winter, when snow depth is minimal, shifting in late winter to closed canopy coniferous and deciduous habitats, where snow accumulation is less and ground vegetation more visible than in the shrub and open meadow habitats (Atlas Map B13).

The majority of moose are migratory and show preferences for traditional migratory routes to winter and summer ranges. Barriers across or elimination of traditional ranges could significantly reduce numbers of moose in an area. Disturbance or destruction of winter range or calving areas, for example, could result in serious interference with the life cycles of thousands of moose over a large area.

Numerous reports have documented the Susitna valley as sustaining the highest moose population in the state (LeResche 1970). Estimates from area biologists for parts of the study area are 11,000 moose in the summer for Game Management Units 14, 16A, and 16B. A conservative estimate of the total population of moose in the planning area, based on annual surveys and correlation with habitat types, may be as high as 49,000 animals (D. Bader pers. comm.). Another means of estimating moose is described below and in Part II, and this estimate yields 17,000 existing and 70,000 potential moose on the summer range (Table 37).

The number of moose the habitat can support is called its "carrying capacity," and theoretical estimates for this, shown in Table 37, have been derived from quantitative and qualitative measurements of their forage species in the study area (Atlas Maps B14a and B14b, Part II).

TABLE 37. Average Theoretical Existing and Potential Carrying Capacity of Moose in the Talkeetna and Beluga Subbasins[1]

	Talkeetna	Beluga	TOTAL
Existing Summer	11,000	6,000	17,000
Existing Winter	2,000	1,000	3,000
Potential Summer	51,000	19,000	70,000
Potential Winter	8,000	3,000	11,000

[1]Extrapolation from SCS forage production and moose browse requirements (ADF&G)

Black bear. Black bears are found throughout the planning area. The black bear is a forest species, and its distribution coincides closely with the distribution of forests. Black bears prefer open forests and mixed habitat types. Semi-open forest areas composed primarily of fruit-bearing shrubs and herbs, lush grasses, and succulent forbs are particularly favored. Black bears avoid expansive open areas (ADF&G 1976b). During spring, summer, and fall, bear distribution is largely determined by food availability. Black bears are opportunistic feeders, eating both plant and animal foods. Upon emergence from winter sleep, they eat mainly new green vegetation or roots, but bears will eat carrion. Newborn moose are frequently consumed later in the spring and early summer (late May through June), although animal food comprises less than 15% of the annual diet (Hatler 1972). Salmon are often utilized heavily during the spawning season, and berries are the most important food item in late summer and fall. To determine what habitats the bears utilize, one must also take into account what habitats their prey utilize.

Black bears emerge from their dens in May and migrate to available food areas in lowlands, to south-facing slopes, and sometimes to local dumps. Later in the season, bears concentrate on salmon streams, moose calving grounds, and berry patches, usually below 2,000 feet (610 m).

Black bear populations have been estimated at 2,000 animals in the Mat-Su Borough, based on annual surveys and population-habitat relationships. This has been estimated at 10% of Alaska's black bear population (Reardon 1981).

Important black bear habitats are located along the Susitna and Little Susitna rivers in spring, and in the Hunter Creek drainage (south of Knik flats) in August. Other bear concentration areas are depicted on Atlas Map B5.

Brown Bear. Brown bears are relatively common throughout the study area. Their feeding habits and distribution are generally similar to those of black bears. However, they are more commonly found at higher elevations ations than are black bears and in more remote mountainous areas. The alpine-subalpine zone is important for summer and fall feeding, as well as for denning. In the spring they also prefer sedge meadows, grass flats, and potholes and especially south-facing slopes and river valleys. In summer and fall, they become more ubiquitous. Denning areas are commonly alder-willow thickets at levels above 1,300 feet (396 m) elevation.

Isolation from human disturbance is important for brown bears. Bear populations may be markedly reduced where substantial and sustained human activities occur.

The Knik River flats region is an important area for brown bears, as are the headwater areas of the Talkeetna, Hayes, Kichatna, Yentna, Oshetna, Susitna, and Johnson rivers (Atlas Map B4). During the July salmon spawning season, Prairie Creek, which flows from Stephan Lake into the Talkeetna River, has higher known concentrations of brown bears than any other portion of the planning area. Specific salmon-spawning slough areas of the Susitna River between Talkeetna and Devils Canyon are known brown bear concentration areas, as are the Lewis River, Talachulitna Creek, Fish Lake Creek, Alexander Creek, and Coal Creek.

The population of brown bears in Game Management Unit 14 is small, probably less than 100 bears. They are found in moderate-to-high densities in Game Management Unit 16. The population there is approximately 100 bears in 16A and 300 bears in 16B. The Talkeetna Mountains have relatively large numbers of brown bears. Overall in the study area, based on annual surveys and brown bear-habitat relationships, the population of brown bears is estimated to be 1,000 (ADF&G 1982), which is approximately 10-20% of the state's total population (Reardon 1981).

Caribou. Three caribou herds occur in the planning area: the Nelchina, Mulchatna, and McKinley herds. Of these, the Nelchina is the largest in the area. The Nelchina caribou herd ranges through the Talkeetna Mountains, Jack River Mountains, Watana Hills, and the foothills adjacent to the Oshetna, Nelchina, Tyone, Maclaren, and Gulkana rivers, and in the upper Susitna River. This herd calves exclusively on the eastern slopes of the Talkeetna Mountains. Ninety percent of its calving occurs in the southeastern region crossed by the Oshetna and Black rivers. Six percent occurs in the northernmost region reeding/rutting (north of the Susitna River and west of the Oshetna River), and 2% in other small areas to the southwest (Figure 4). Two main areas have been identified -- one north of the Susitna River and one in the Lake Louise - John Lake - Slide Mountain area (Atlas Map B2).

The Nelchina herd constitutes one of the most significant big game populations in Southcentral Alaska. There are approximately 24,500 animals in this herd. This is nearly 3% of all the caribou in the state (ADF&G 1976). The vast majority of the caribou in the study area are associated with this herd. Other caribou populations frequent the northern and western edges of the basin. Caribou from the Mulchatna herd range through the Alaska Range from Chakachamna Lake to Rainy Pass. Portions of the McKinley Park caribou herd are sometimes found in the Broad Pass - Cantwell area.

Caribou depend largely on climax vegetation for population maintenance. They utilize coniferous forest, sedge-grass tundra, tussock tundra, mat and cushion tundra, tall and low shrub, tall and mid-grass, herbaceous sedge-grass, and freshwater aquatic habitat types.

In summer, caribou consume a wide variety of plants, apparently favoring the leaves of willow and dwarf birch, grasses, sedges, and succulent plants (ADF&G 1976b). In the winter they switch to lichens and dried sedges. Caribou usually inhabit areas at or above timberline in summer.

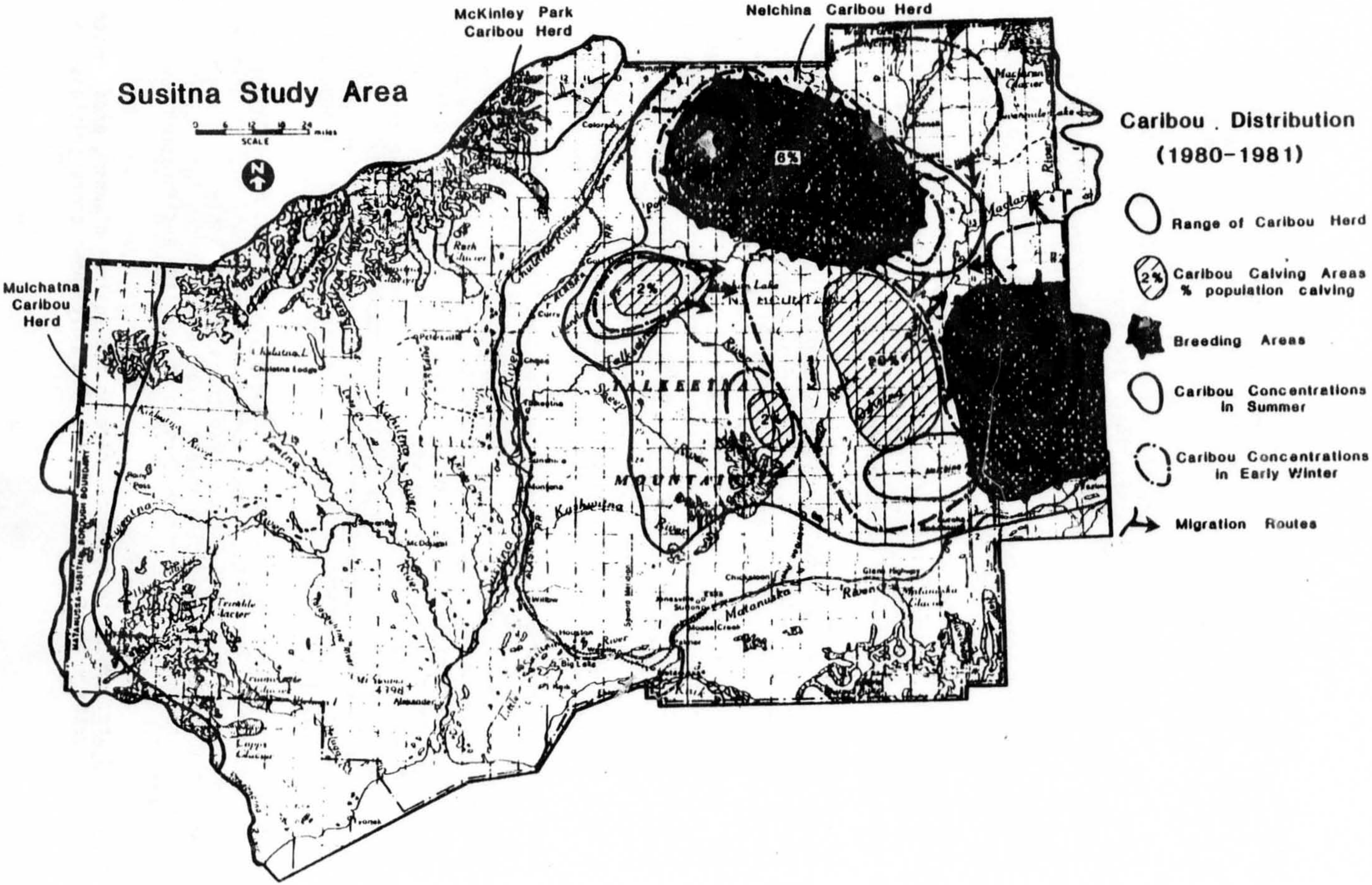
The calving areas is the focal point of the caribou herd's yearly movements. The calving grounds are usually gently sloping hills dominated by herbaceous vegetation and small shrubs. The Nelchina herd's calving ground lies between 2,600 and 4,600 feet (792 and 1,400 m) and has primarily shrub birch, meadow and dwarf heath types. One characteristic of the Nelchina calving grounds makes it highly suitable for caribou is its lower snow pack retention relation to other areas of comparable elevation in the region.

Snow depth and hardness of the crust are important factors for winter habitat suitability for caribou. Likewise, the calving areas are very important for the maintenance of the caribou populations, and these areas should be protected from disruption. Developments inhibiting or disrupting movement to these areas must be avoided. Human presence and activity on the calving grounds during the calving season can result in abandonment and subsequent mortality of calves. The key to maintaining a viable caribou population is to retain very large areas of suitable habitat that allow unrestricted movement, because caribou often degrade their winter habitat and must shift to a new winter range each year to maintain stable population levels (Hemming 1971).

Some habitats used by caribou overlap those of Dall sheep, mountain goats, moose, and bears. During the summer months, caribou occupy high mountainous slopes where alpine grasses, sedges, and forbs are available. Winds are important to caribou in reducing insect harassment. During late fall and winter, caribou occupy and migrate throughout the lake and forested lowland and foothill areas.

Mountain goats. Mountain goats are rare in the Susitna planning area, which is at the northern limit of their range. The only known concentrations are

Figure 4. Seasonal distribution of the Nelchina Caribou Herd



in the Chugach Mountains and to a lesser extend in the Talkeetna Mountains. The total goat population in the area is about 300 (D. Bader pers. comm.).

Mountain goats are both grazing and browsing animals. They normally summer in high alpine meadows where they graze on grasses, herbs and ground-growing shrubs. As winter advances and the more succulent plant species die, the mountain goats shift to browsing (ADF&G 1976b).

Most goats migrate from alpine summer ranges to winter ranges at or below tree line, but some may remain on windswept ledges. Severe winters can have a detrimental effect on goat populations.

Dall sheep. Dall sheep normally inhabit the mountainous alpine regions of the planning area, at approximately 2,000-6,000 feet elevations (610-1,829 m). Habitat is typically steep open grasslands interspersed with broken cliffs and talus slopes on recently glaciated mountains. Vegetation consists largely of sedges, bunch grasses, mosses, lichens, and low shrubs such as blueberry, crowberry, dwarf willow, and birch interspersed with larger willows and dense alder. In some areas, sheep may range into the brush or timbered areas.

Short vertical migrations correlated with seasonal food availability are typical for Dall sheep. In winter they retreat into snow-free areas. These areas are on upper windblown ridges and steep slopes. With the spring thaw, sheep move to the lower slopes, where early green vegetation is available and then follow the retreating snow line, becoming more dispersed as spring progresses. Winter food availability is apparently the limiting factor for Dall sheep populations. The number of lambs born, as well as the number of lambs surviving to yearling age, are positively correlated with forage production on winter range.

Cliffs, deep canyons, rock outcroppings, and steep slopes are important to Dall sheep for escape terrain. The intensity of use of feeding areas is determined by proximity of escape terrain and preferred bedding sites.

Summer distribution of Dall sheep is strongly influenced by the presence of mineral licks. Licks satisfy not only a nutritional requirement but also a social requirement for mixing of ram and ewe bands.

Human disturbance can cause sheep to desert traditional home ranges. Utilization by sheep of their winter range, lambing areas, and mineral licks can be affected by intensive recreational use, low flying aircraft, or by mining or construction activities. There may be future conflicts between mining claims and traditional sheep mineral licks.

Roads may disrupt sheep habitat. In addition to possible disturbances during construction, roads improve access and thus increase the potential for other disturbances. In nearly all instances in Alaska where roads have been built through or near sheep habitat it has been necessary to stop or closely restrict Dall sheep hunting (Summerfield 1974). Frequent disturbance when lambs are young may cause ewes to become separated from lambs, which can result in higher lamb mortalities due to predation.

Sheep in the planning area number about 6,000 to 8,000 animals, based on surveys and habitat-population relationships (D. Bader pers. comm.). This makes up approximately 12-16% of Alaska's sheep population (Reardon 1981).

Important concentrations of sheep are located in the Talkeetna Mountains, Chugach Mountains, Alaska Range, Watana Hills, Clear Water Mountains, and Jack River areas (Atlas Map B3).

Furbearers and small game. There are no census data for furbearers in the planning area. Furbearers such as beavers, muskrats, mink, and river otters are abundant along stream corridors and around ponds and lakes. Furbearers may be found in nearly all habitat types, although most species occur in riparian, wetland, or forested areas. The following 15 species of furbearers range from moderate to very abundant in the study area: Hoary marmot, Arctic ground squirrel, red squirrel, northern flying squirrel, beaver, muskrat, coyote, wolf, red fox, marten, short-tailed weasel, mink, wolverine, land otter, and lynx.

Snowshoe hares, while not abundant, are ubiquitous in the planning area. They dwell in coniferous, deciduous, and mixed forests and in tall shrub habitats, especially those in early successional stages (Terrestrial Environmental Specialists 1982). They prefer a winter habitat with cover (dense black spruce or willow-alder thickets) and summer habitat with more open cover types. Their food includes spruce, willow, alder, and birch. Their tremendous population fluctuations can influence habitat use, with more marginal habitats being used during periods of high population numbers. The most important factors affecting habitat suitability are browse availability and density of cover.

Hoary marmots are usually found above treeline in alpine areas. They are an ecotone species, sheltering in rocky habitats and foraging in tundra habitats.

Arctic ground squirrels prefer alpine shrublands and usually avoid vegetation taller than 8 inches (20 cm) that obscures their vision.

Red squirrels are residents of mature coniferous and mixed coniferous-deciduous forests. Mature deciduous forests provide marginal habitat during emigration or population expansion, but these forests cannot support permanent overwintering populations. The seeds of white and black spruce are the most important components of red squirrels' diet.

Beavers are limited to freshwater aquatic habitats bordered by subclimax stages of low and tall shrub, deciduous forest, and mixed forest habitats. They are found from sea level to 4,000 feet (1,219 m). The most productive beaver habitat is characterized by a dependable water supply with little fluctuation in stream flow and by willow, aspen, cottonwood, or birch vegetation. Quality and quantity of food are two of the major factors determining whether beavers will settle and remain in an area. Their primary foods include bark, leaves and buds of aspen, willow, cottonwood, poplar, birch, and alder. However, willow, because of its resiliency to browsing, is the most reliable food source. Eroding streams and lakes are highly unsuitable for beavers. Beavers prefer water bodies with shorelines that are 75% or more vegetated with perennials such as willow and alders.

Human disturbance along shorelines can render beavers' feeding habitats unsuitable. Road and railway corridors or land clearings can limit habitat suitability for beavers.

Beavers are unique in the degree to which their activities modify riparian habitats. Beaver dams stabilize watersheds, reducing flooding and silting (ADF&G 1980). Raising of water tables and impoundment of water alters vegetative cover and provides aquatic and riparian habitat for many species of wildlife. Although some species of fish benefit by increased production of fish food and rearing areas for young fish, dams often create serious barriers to migrating anadromous fish.

In the absence of human disturbance, wolves can be expected to occupy all habitat types that support their primary prey of moose and caribou. They also occupy habitats where other prey species such as microtine rodents, ground squirrels, marmots, beavers, and snowshoe hares are found. Dens are usually placed near open water. Drainage channels, lakes, and game trails, as well as roads and railways, are important travel corridors for wolves, especially in winter when snow depth can limit mobility.

Human settlement is generally detrimental to wolf populations. It can often disrupt normal wolf behavior, because wolves are attracted to garbage and/or hand-outs and may become malnourished or remain longer in an area than they normally would. Wolves can also contract diseases and parasitic infections from domestic canids, and this not only injures the wolf but also could render the fur unsuitable.

It has been suggested (Chapman 1977) that human activity be restricted to a minimum of 1.5 miles (2.4 km) from established wolf dens and rendezvous sites. These areas should be closed to human activity four to five weeks prior to whelping (early April - October). The wolf population in the planning area has been estimated at 800 (D. Bader pers. comm.).

Red foxes are found from 1,000 feet to 3,500 feet elevation (305-1,067 m), although they generally range between 2,200 and 3,100 (671-945 m) elevation (Terrestrial Environmental Specialists 1982). The arctic ground squirrel is their principal food in spring and summer; other preferred prey include ptarmigans, muskrats, and marmots. Red foxes often hunt around lakes and riparian areas. They often den in the alpine habitat between 1,000 and approximately 1,160 feet, and they are often near large lakes (Hobgood 1983).

Martens are one of the more economically important furbearers in the study area. They are dependent on a well-developed understory and prefer mature coniferous and mixed deciduous forests below 3,000 feet (914 m). Because of this dependence they are particularly susceptible to forest fires and clear-cut logging practices. Cover for martens is best in dense climax spruce forests with greater than 30% cover. In summer and fall, open areas are also used. Enhanced habitat that has been logged or burned is good for martens, who frequently used downed timber or stumps for cover and as nesting areas during their reproductive period (Koehler and Hornocker 1977). Martens often use red squirrel middens as resting sites, especially in winter (Buskirk 1982).

Short-tailed weasels occupy a variety of habitat types, from low elevation riparian zones to elevations over 4,500 feet (1,372 m). They prefer open black and white spruce forests and medium-height birch-shrub communities.

Mink are most commonly found near streams, ponds, marshes, beaches, or muskegs, and their diet reflects the variety of prey species available there. Mink are opportunistic feeders and eat a variety of prey, including small rodents, fish, and aquatic invertebrates. Mink summer along rivers, streams, and in upland muskegs and often spend time in the winter along narrow beach zones.

Mink generally travel along the edges of lakes, ponds, sloughs, and rivers. Mink will travel overland from one slough system to another if the systems are close to one another.

Disturbance by heavy machinery decreases the population of mink within an area (Burns 1964). This disturbance can cause compression of the ground, producing cavities that fill with water and subsequently constitute a barrier to these burrowing animals. Disturbance next to a lake or stream bank is highly disruptive to mink habitat. Heavy equipment should be used only during the winter, and all use should avoid shorelines wherever possible. Habitat suitability for mink is dependent on the relative proportion of riparian habitat. Winter food is probably the primary limiting factor in noncoastal areas.

Land otters generally occur at the interface between water bodies and vegetation edges. Because they are adaptable, otters occur in almost every vegetation type and at elevations up to 400 feet (122 m) and occasionally as high as 2,500 feet (762 m). They have been found in the following habitats: coniferous, deciduous, and mixed forests; low and tall shrub communities; tall grass areas; saltwater and freshwater areas; and in shrub, tussock, and sedge-grass tundra (Konkel et al. 1980). Land otters sometimes range away from water. They have been observed to travel long distances between river drainages, often four to five miles, although they will travel over 12 miles to find suitable access to water. During high hare populations, land otters are seen further away from lakes and rivers. Otter food includes a variety of fish (salmonids, halibut, sculpins), marine invertebrates (crustaceans, urchins, crabs, shellfish) and seabirds, frogs, and small mammals. Land otters often hunt and travel along the marine shore zone, lake shores, and riparian corridors. The amount of oxygen in these water bodies indirectly affects the otters by influencing the abundance of food sources (aquatic plants) of their prey.

Lynx have a limited distribution in the planning area. They are primarily residents of the northern boreal forest where they feed primarily on snowshoe hares. Lynx are, in fact, largely dependent on snowshoe hares. As snowshoe hare densities decline, lynx home range increases; home range overlap declines; lynx population densities decline; and long distance dispersal increases (Ward 1983). Lynx may prey on red foxes when hare populations are low. Lynx occasionally occur on the tundra beyond the treeline, and in years of severe food shortages individuals may venture far out onto the tundra in search of hares, lemmings, and ptarmigan (ADF&G 1980).

Birds

The planning area supports a rich variety of avifauna. A diversity of habitats ranging from saltwater marshes to alpine tundra provides a myriad of nesting and foraging areas. One hundred and fifty-four species have been identified in the study area, including migrants, residents, visitors, accidentals, and escapees. Table 33 lists all species occurring in the Matanuska Valley and their known status (M. Bronson pers. comm.). Species noted as year-round or summer residents are known to breed in the planning area and are more susceptible to year-round development in their breeding habitats than birds that migrate through twice a year or arrive accidentally, out of their usual range. The latter species, however, can be very important in generating money for the local economy, as did a Ross's gull in Massachusetts a few years ago. Up to 10,000 people thronged the shoreline to observe this rare bird, producing thousands of dollars for the local economy (Massachusetts Audubon Society pers. comm.).

Waterfowl

Waterfowl populations are most abundant along Cook Inlet coastal marshes. During spring and fall migrations, the number of waterfowl may range from 50,000 to 100,000 birds. Although inland lakes and wetlands have fewer birds per square mile than do coastal areas, the total number of birds inhabiting inland environments may equal and even exceed coastal population numbers because of the large areas involved (Terrestrial Environmental Specialists 1982). Tundra and trumpeter swans, tule, white-fronted, Canada, and snow geese are some of the more numerous waterfowl in the area.

Trumpeter swans. Trumpeter swan summer habitat is widespread throughout the planning area. Swans nest along marshy lakes, where they also raise their broods. Breeding swans molt in the vicinity of the nesting territory, and young pre-breeders concentrate in flocks on large shallow lakes. Concealing vegetation and food must be present. Suitable breeding habitat consists of stable shallow water with no marked seasonal fluctuations, or marshes and sloughs not subject to an obvious current. Emergent and floating mat vegetation are important, and these generally occur in smaller lakes, where erosive wave action and currents do not occur. A recent study in the planning area found 80% of swan nesting areas to be lakes less than 35 acres (141,645 m^2) (Terrestrial Environmental Specialists 1982). These studies found a close association between trumpeter swans and beavers; nearly 75% of the trumpeter swan nesting ponds had water levels regulated through beaver action. The shorelines of many trumpeter swan lakes are devoid of closely-surrounding timber. Lakes suitable for nesting by more than one pair are not common. Only the largest lakes contain more than one breeding pair.

Nests are usually built near shore or near small islets on the larger lakes. Muskrat houses and beaver lodges sometimes are used as nest sites. The greatest factor in cygnet mortality is their forced rapid movement from one water body to another because of human intrusion (Terrestrial Environmental Specialists 1982). Banko (1960) and Hansen et. al. (1971) recommend that human disturbance during the brood season be kept to a minimum. Areas known to support trumpeter swan nesting are depicted on Atlas Maps B6 and C6.

Canada geese. Canada geese breed in association with herbaceous sedge-grass and aquatic habitats. Except during brooding and molting, when aquatic vegetation is utilized more extensively, geese are primarily grazers preferring sedges and grasses including fescue and carex spp. This general grassland habitat seems to be the factor determining where the geese are found (Williams 1967). Cultivated fields, aquatic habitats, marshes, seeps, wet meadows, mud flats, and upland banks and high beaches are preferred. Feeding areas are usually near habitats that provide suitable resting, escape, and breeding locations. Geese always remain relatively close to fresh water. For breeding pairs, this is up to 16 miles (26 km) from the nest site. Canada geese utilize water bodies ranging from deep oligotrophic lakes, rivers, ponds, and potholes to temporary lakes.

Cover is important in the prenesting and nesting seasons when goslings and adults are flightless. Open water is also necessary for escape. Sand bars and peninsulas are used as refuges, during migration, and slough banks, islands, etc., are favorite nesting places. Dense bottomland vegetation is seldom used (Williams 1967). Geese need ample bank roosting and resting areas and prefer level or sloped shorelines at least approximately 330 feet (100 m) long. Prime breeding habitat consists of extensive areas of shallow open water, with an abundance of aquatic foods growing throughout the littoral zone, or waterbodies that are fringed with emergent or meadow plants. Likewise, marshes or wet meadows and lakes with islands near wet meadows or grain-producing areas are preferred. Isolation is needed to raise young most successfully, Muskrat lodges provide 76% of all nest sites (Terrestrial Environmental Specialists 1982). Muskrats also aid geese by retarding dense emergent growth and by providing the important "interspersion" or edge effect.

After hatching, broods move to riparian habitats consisting of gently sloping shorelines free from boat traffic or with escape cover and with abundant plant food such as semi-aquatic plants or pasture grasses. Other kinds of escape cover besides emergents or meadows are weedy river banks, isolated sand bars, and islands. Sites chosen are usually close to open water deep enough for diving. Human harassment can increase brood desertion and decrease production (Michelson 1975).

Raptors

Goshawks. The northern goshawk is a resident of the forested region of the planning area. It prefers to nest in coniferous and mixed forests but also utilizes shrub thicket, marsh, tidal flat, and beach habitats. The goshawk preys primarily on snowshoe hares, ptarmigans, grouse, and red squirrels, and thus is found in habitats where these species live.

Goshawks may hunt regularly over 1¼ miles (2.0 km) from their nests, which occur in the coniferous, deciduous, or mixed forests. The majority of nests are usually found in paper birch of 7.5-20 inch (19-51 cm) Diameter Breast Height (DBH). These trees tend to have large forks, required for stability for nesting platforms. In other states and, we assume, also in Alaska, goshawk nests are often built within 500 feet (152 m) of water. Goshawks demonstrate a high fidelity to nest sites from year to year, and the defended area around the nest is 328-646 feet (100-200 m) in diameter (Terrestrial Environmental Specialists 1982). Breeding densities are one pair per 16-144 mi^2 (41.4-373 km^2). Goshawk nests are often placed near tracks, dirt roads, edges of meadow, and other clearings. They frequently hunt in ecotones along timberline, watercourses, tidal sloughs, and inlets (Terrestrial Environmental Specialists 1982).

Deforestation destroys the suitability of an area for goshawk nesting until the trees can regenerate to a size adequate to support a nest. Nesting goshawks will be disturbed when humans approach within half a mile (0.8 km) of the nest (Beebe and Webster 1964). Jones (1979) recommended that in areas that will be developed, riparian habitats and adjacent lands up to 1,312 feet (400 m) on either side should be left undisturbed. Likewise there should be a 1,640 feet (500 m) radius left undisturbed around the nest. Important areas for goshawks are shown in Atlas Map B6.

Bald eagles. Bald eagles prefer to nest and perch close to open water in large trees offering them the cover of overhead and surrounding vegetation. Bald eagles eat fish, waterfowl, or seabirds and are therefore restricted to nesting near water bodies. In the planning area, bald eagles usually select old growth timber in which to construct their nests and prefer tall spruce trees, although nests have also been found in cottonwoods growing adjacent to rivers and lakes.

Most breeding bald eagles prefer isolation from other nesting bald eagles. Territories range in size from 28 to 112 acres (0.11-0.45 km^2), averaging 57 acres (0.23 km^2). The average distance between nest sites have been found to be 1.1-4 miles in other parts of Alaska (Robards and King 1966, Robards and Hodges 1976).

Bald eagles prefer various degrees of isolation from humans. They are vulnerable to disturbance during egg laying, incubation, and the hatchling stages (Mathisen 1968). Human invasion of a nest during incubation causes abandonment of the eggs and disturbance of the nest during the hatchling stage may result in a relocation of the nest during the next breeding season. Various degrees of tolerance of disturbance by humans have been reported. Juneman (1973) observed that disturbance from logging within 0.75-0.8 mile (1.2-1.3 km) caused abandonment of the nest site. Stalmaster and Newman (1978) found that the following kinds of disturbance, which can be applied to eagles in all seasons were beyond the tolerance limits of wintering eagles: high recreational use, heavily traversed roads along a river without a vegetation buffer, alteration of habitat by human development, and human activity close enough to make eagles fly. Time of disturbance may be critical, with less effect or less abandonment occurring during the hatchling stage than during other stages of the breeding cycle.

A buffer zone of trees should be left around the nest tree, so that if the adjacent area is logged there will be a windbreak. Large tall trees must also be left, if an area is logged, in order to support nests and to provide potential nest and perching trees. Known important areas for bald eagles in the planning area are shown in Atlas Map B6.

Gyrfalcons. Gyrfalcons are not common residents of the planning area. Their distribution is closely associated with the occurrence of cliffs and bluffs and open landscapes. They usually occur in foothills, tundra, and in Arctic-alpine areas during the breeding season. The Talkeetna and Chugach mountains are important areas for gyrfalcons, and their nest sites in the planning area are also shown in Atlas Map B6.

Gyrfalcons eat seabirds, gulls, and small mammals, and their distribution is closely tied to distribution of their prey. In interior areas, gyrfalcons eat ptarmigan, grouse, and small mammals such as lemmings and red squirrels. Ptarmigan seem to be the most important prey species. Since ptarmigan are associated with willow communities, the majority of gyrfalcon sitings have been near willow communities. Cade and White (1976) suggest that the distance from the nest the gyrfalcon travels in order to obtain food may exceed ten miles.

Gyrfalcon eyries are usually located on cliff faces and rock outcroppings. They also use cliffs as winter roosts and plucking platforms, preferring areas where snowfall is not dense. Gyrfalcons typically use old stick nests of other birds, usually ravens, and thus ravens can be considered an important factor for gyrfalcon nesting.

The effects of human disturbance are variable. Human disturbance within a few hundred meters of eyries can cause abandonment (Cade 1960). Airplanes flying over nests should maintain altitudes greater than 300 feet (91.4 m), for even at these altitudes gyrfalcons will assume a stress posture (Platt 1976).

Habitat suitability for gyrfalcons can be determined from habitat suitability of their prey within a certain radius of nest sites.

Peregrine falcons. Peregrine falcons prefer nest sites offering protective cover. Their cliff nests will often have an overhang of a dense shrub thicket. They hunt in various habitats, including open areas within the boreal forest zone, above muskegs, and over large watercourses. Rivers are of particular importance for peregrines. They provide open country in the boreal forest and in some areas provide cliffs for nesting. Rivers create habitat, such as gravel bars and willow stands, required by some of the peregrines' more important prey species.

Peregrines can be disturbed by human activity. The direct interference by humans in some areas of their range has hastened the decline of populations already weakened by other detrimental factors (Haugh 1976). The idea that falcons will move away from disturbing factors is erroneous (Haugh 1976). They usually will not move to areas in which they historically have not occurred. Thus the major rivers that form a "core" for regional populations take on added importance for the survival of these species. White and Cade (1975) recommend that certain river corridors be given special consideration as falcon habitat and be designated "birds of prey areas," following the example of the Snake River Birds of Prey Area in Idaho, established a few years ago by order of the secretary of the interior.

Any disturbance during the sensitive period of egg-laying and incubation should be prevented. Once the eggs have hatched, the birds can tolerate considerably more activity around their nests without adverse effects (White and Cade 1975). Peregrines traditionally use the same nest sites year after year and apparently do not seek new nesting habitat even if the traditional site is threatened. Projects like road or bridge construction, gravel removal, or pipeline or powerline installation should be avoided near nesting sites.

Upland Birds

Spruce grouse. The spruce grouse inhabits the late successional stage of the boreal coniferous and mixed forests. They prefer upland habitats with 30-90% of the forest stand composed of black and white spruce. Understories in preferred white spruce-birch habitats are usually grasses, blueberry, cranberry, and *Spirea* sp. In black spruce, understories are blueberry, cranberry, and lichen. Blueberry and cranberry bushes are indicators of good habitat because they provide spring, summer and fall foods; they also provide display areas for males and cover for broods and nests (Ellison and Weeden 1968).

During winter, habitats they usually avoid are open spruce-birch stands with trees 65-95 feet (20-30 m) apart, and sometimes dense black spruce. Most nests are at the base of spruce trees, but once the clutches hatch, the broods frequent stands predominated by birch and dense ground cover of blueberry or other low ground cover.

In the fall, birds of all age and sex classes are attracted to places with grit at the bases of uprooted trees, along lake shores, stream banks, and gravel roads.

White spruce needles are the preferred food items in the winter, although grouse will also eat black spruce needles. As the snow recedes, spruce needles are taken in decreasing amounts, while blueberry and cranberries are eaten more. These berries make up the majority of their diet until fall, when they commence relying on spruce needles again.

Willow ptarmigan. Willow ptarmigan occur throughout the planning area in shrublands and shrubby openings in coniferous forests at or below timberline. In the winter, the females remain below timberline, while the males stay at or above timberline. Burns, river courses, and disturbed areas provide their preferred shrubby areas below timberline. They may, during the winter, roost in small clearings within dense thickets. They also occupy the shrubby interface between woods and tundra.

Summer habitat consists of shrubby tundra at the upper edge of timber in widely scattered trees or below timberline in treeless areas. The shrubs in these preferred areas are three to eight feet (0.9-2.4 m) high, with a ground cover of grasses, sedges, and mosses. The thick cover of willow often offers escape from goshawks and other predators. Ptarmigan prefer moist areas. Older flying broods prefer tall dense stands of willow or birch along stream or shrub-sedge tundra banks for escape cover.

During the breeding season, willow ptarmigan prefer mesic mature communities of the lower alpine zone or low-arctic tundra. They nest on the ground on hummocky or slightly sloping ground. Their nests are often along river banks, gullies, roadside ditches, or under isolated tundra conifers. Shrubs around the nesting sites are normally three to six feet (0.9-1.8 m) high, alternating with open vegetation less than one foot (0.3 m) tall, with high species diversity.

Ptarmigan avoid dry savannahs on level tablelands and plateaus (Weeden 1960). They also avoid dense brush and wet shrubless marshes or wet tundra areas devoid of taller shrubs.

Other Species

Sandhill cranes. The lesser sandhill cranes roost in wetlands, gravel beaches and sand-covered or alkali beaches, often on peninsulas and islands. They prefer shallow water in sedge grass and rush communities and often flock in grain fields and pastures up to a third of a mile from their roosting sites.

Preferred nesting habitats of cranes are grassy flats with dry knolls, on mounds in wet marsh tundra, raised mounds in meadows, isthmuses between ponds, low wet islands, slough banks, islands in marshes, or dry islands in ponds. Nests are in dry, well-drained areas but near to standing water. Cranes spend much time along slough banks where vegetation is often taller than adults.

Sandhill cranes are opportunistic feeders, subsisting on croberry salmonberry, microtine rodents, small fish, flying insects, and snails. In late summer they become more herbivorous, preferring crowberries.

Fish

Fish are one of the more important resources in the planning area. An estimated 5.7 million salmon alone were produced in 1981 in the streams and rivers of the area. There are many suitable habitats for migration, spawning, and rearing of chinook, pink, sockeye, coho, and chum salmon, steelhead, grayling, rainbow trout, and Dolly Varden.

Tables 38 through 42 list the important spawning streams for five species of salmon. Most of these streams and lakes are located in the Susitna lowlands (Atlas Map B7). For a general description of the distribution of resident freshwater fish species in the planning area, see Atlas Map B8.

TABLE 38. Chinook (King) Salmon Spawning Streams

Little Susitna	Twentymile Creek
Willow Creek	Creek near Burro Lake
Deception Creek	Byers Creek
Moose Creek	Troublesome Creek
Granite Creek	Whiskers Creek
Chickaloon River	Sunshine Creek
Theodore River	North Fork Kashwitna
Lewis River	Sheep Creek
Alexander Creek	North, Middle, South, and main stem Montana Creek
Fish Creek (off the Susitna River)	Chunilpack Creek
Deshka River (Kroto Creek)	Creek near Sherman
Trapper Creek	Indian River
Little Willow Creek	Portage Creek off Devils Canyon
Talachulitna River	Prairie Creek
Kichatna River	Lower Mendeltna
Nakochna River	Lower Tolsona Creek
Happy River near Rainy Pass	Middle Fork Gulkana
Yentna near Youngstown Bend	Hungry Hollow Creek
Donkey Creek near Youngstown Bend	Gulkana River
Home Creek	Lower Twelvemile River
Canyon Creek	Lower Sinona Creek
Sunflower Creek	Lower Indian Creek near Indian River
Cache Creek	Lower Ashley Creek
Peters Creek south of Petersville near Peters Hills	Goose Creek
East Fork Chistochina	Middle and East Forks of Chulitna River
Bunco Creek	Honolulu Creek
Lake Creek	

TABLE 39. Sockeye (Red) Salmon Spawning Streams and Lakes

Nancy Lake
Meadow Creek
Wasilla Lake
Cottonwood Lake
Lower Sucker Lake
Fish Lake
Alexander Lake
Shell Lake
Shell Creek
Hewitt Lake
Hewitt Creek
Camp Creek
Sunflower Creek
Upper Deshka (near Kroto Lake)
Upper Moose Creek (near Scotty Lake)
Byers Lake
Fish Creek (Big Lake)
Birch Creek
Chelatna Lake
Coffee Creek, Cripple Creek
Larson Lake
Mendeltna Creek
Keg Creek
Link Lake
Middle Fork of the Gulkana River (near Twelvemile)
Eagle Creek
Big Lake
Herkimer Lake
Corcoran Lake
Lilly Lake
Blodget Lake
Mama Bear Lake
Papa Bear Lake
Sockeye Lake
Redshirt Lake
Fish Creek (off the Susitna River)

TABLE 40. Coho (Silver) Salmon Spawning Streams

Little Susitna
Fish Creek (Big Lake)
Granite Creek
Wasilla Creek
Meadow Creek
Little Willow Creek
Jim Creek
Alexander Creek
Lower Sucker Creek
Fish Creek (off Susitna River)
Trapper Creek
Creeks north of Willow Mountain
Middle and Upper Camp Creek (near Collinsville)
Sunflower Creek
Peters Creek (near Little Peters Hills)
Lower Deshka (near Parker Lake)
Moose Creek
Rabideaux Creek
Lower Trapper Creek
Lower Whiskers Creek
Lower Troublesome Creek
Sunshine Creek
Birch Creek
North Fork Kashwitna
Chunilna Creek
Creek near Sherman
Upper Indian Creek
Portage Creek
Cottonwood Creek
Question Creek
Birch Creek

TABLE 41. Pink (Humpback) Salmon Spawning Streams

Fish Creek (off the Susitna River)
Little Susitna
Alexander Creek
Deshka River (Kroto Creek)
Lake Creek
Shell Creek
Cache Creek
Montana Creek
Birch Creek
Sheep Creek
Chunilna Creek
Creeks near Shannon
Gold Creek
Goose Creek
Little Willow Creek
Kashwitna River
Sunshine Creek
Deception Creek
Byers Creek
Troublesome Creek

TABLE 42. Chum (Dog) Salmon Spawning Streams

Little Susitna
Kashwitna
Wasilla Creek
Tributaries of the Skwentna
Lake Creek
Delta Islands to Caswell on the Susitna River
Susitna River (Trapper Lake to Curry)
Lower Troublesome Creek
Byers Creek
Talkeetna River
Birch Creek
Montana Creek
Goose Creek
Middle of Sheep Creek
Middle of the Talkeetna River
Lower to middle Chunilna Creek
Creeks near Sherman
Willow Creek
Little Willow Creek
Knik River
Matanuska River

In addition to these salmon species, eight other important species of freshwater game fish can be found in the study area: landlocked coho, rainbow trout, Dolly Varden, lake trout, grayling, northern pike, burbot, and whitefish. Nongame fish species present in Susitna basin rivers are blackfish, pond and smurf smelt eulachon (hooligan), longnose sucker, three and nine spine stickleback, slimy, coast range, Pacific staghorn, and sharp nose sculpin, starry flounder, Pacific and Arctic lampreys, and Pacific herring.

Freshwater systems to which salmon return and in which resident fish live are critical to the maintenance of their populations. Salmon and other species utilize freshwater habitat for migration, spawning, and rearing of young. Disturbances that degrade habitat, water quality, water flow, or fish migration routes may adversely affect population numbers of salmon or other species in the disturbed area, or of those that migrate beyond the disturbed area. Overstory vegetation along streams is very important to keep streams cool. Silt and low oxygen are detrimental to all young alevins. During incubation, substantial mortality of the embryos may occur due to disturbances from fluctuating flows, dewatering, freezing, suffocation, and microbial infestation.

Coho (silver) salmon. Coho salmon usually enter their natal streams during periods when the water temperature begins to drop, from midsummer to early winter. They usually spawn at the head of riffle areas in narrow side channels and tributaries of mainstream rivers (Morrow 1980, McLean et al. 1977). Preferred substrate diameters range from 0.75 to 10.0 cm, temperatures from 4.4 to 9.0°C, and water velocities from 0.1 to 1.0 m/s (Smith 1973, Bell 1973). Conditions outside this range severely reduce egg survivability. Fry emerge in May or June, although some have been observed as early as March and as late as July. Juvenile fish establish territories in slow-moving water along stream margins, in ponds and lakes, in pools behind logs or boulders, and in backwater sloughs, and generally they avoid riffles. In late fall, juvenile coho salmon inhabiting widely distributed summer rearing areas (often small and intermittent ponds, sloughs and tributaries), migrate to larger lakes and streams, where ice and water conditions are more favorable for winter survival. Juveniles may remain in freshwater systems from one to three years. They feed mainly on terrestrial insects and often swim near the shore and along stream banks.

Pink (humpback) salmon. Pink salmon occupy a wide range of habitats and tolerate a wide range of environmental conditions, depending on the time of year and the stage of their life cycle. They move from the sea into streams from late June to September. They often enter short coastal streams and sometimes spawn in tidal areas. Their eggs and alevins are more euryhaline than other species of salmon.

Preferred spawning habitats are found at depths of at least six inches, with current velocities of 0.7-5.6 feet (2.1-1.7 m), and where the substrate is 0.5-4 inches (1.2-10.1 cm) in diameter, although pink salmon are so adaptable they can spawn over fractured bedrock with no gravel. Spawning usually takes place when the temperature is declining after reaching the summer maximum. However, temperatures greater than 4.5°C are necessary for initial development. If spawning habitat is destroyed and adults are forced into more crowded situations in order to spawn, they may dig up previously spawned eggs in the process of building their own redd.

Eggs hatch from December through February. Fry emerge from the gravel in the spring. The fry then migrate to sea, usually at night. During the day, they require streamside vegetative cover or overhanging stream banks along the migration path.

Sockeye (red) salmon. Adult sockeye salmon return to their natal streams and lakes during the summer and fall from July to October, sometimes as late as December. The majority of the spawning occurs in streams that connect with lakes and along lake shorelines. Hatching occurs mid-winter to early spring, and the young emerge from April to June. Fry usually go to sea after one or two years in a lake. Once in the lake they hug the shoreline, feeding on insect larvae and water fleas. They later move offshore and feed on zooplankton consisting predominately of copepods and cladocerans.

The adults prefer a spawning substrate of gravel between 0.5 and 4 inches (1.3-10.2 cm) in diameter, water velocities between 8.3 and 38 in/s (21 and 101 cm/s) and water temperatures between 4.4 and 10.0°C. If water flow drops below critical levels, egg and alevin mortality becomes high. Silt deposition is also detrimental to productivity.

Sockeye salmon are unique among salmon in their dependence on lakes. The growth of fry in these lakes is correlated with water temperature and an abundant food supply (Nelson 1964, Narver 1968, Rogers 1973).

Chinook (king) salmon. Adult chinook salmon enter their natal rivers as early as May in Susitna basin streams, but most appear in June and July. Those that enter earliest are usually those that travel farthest. Spawning takes place from July to early September.

Preferred spawning locations for chinook have water depths ranging from 10 to 80 inches (25-150 cm), stream flow velocities from 1.0 to 4.9 ft/s (0.3-1.5 m/s), and temperatures from 4.4 to 18°C (Major et al. 1978). They prefer greater than 55% medium to fine gravel, with less than 8% silt and sand. Water flow must remain above critical levels or high egg and alevin mortality will result. They are very sensitive to low oxygen content.

Young fry prefer cool clear streams. Warm shallow lakes are generally unsuitable rearing habitat. Juvenile chinook usually remain in freshwater systems for a year, although it is possible for some to remain as long as three years. Juveniles feed on insect larvae and terrestrial insects that fall into streams and rivers. Thus the maintenance of healthy streamside vegetation is necessary for the growth and survival of the salmon.

In British Columbia, 78% of the chinook salmon migrate to sea as fry while the remainder overwinter in freshwater streams. The same pattern may be true of some Susitna basin chinook. Some chinook young feed and migrate downstream gradually, rather than living in distinct reaches of the river for extended periods of time. Spring chinooks from upper reaches of the larger rivers exhibit the more familiar year-long freshwater rearing stage. The young shift to faster, deeper water as they mature. They often overwinter in larger streams with temperatures ranging from 4.4 to 5.5°C. Cover, especially large rocks, is important fish.

Chum (dog) salmon. Chum salmon are typically fall spawners, with the greatest spawning activity occurring in August and September. Spawning usually occurs over gravel 0.8 to 1.2 inches (2.0-3.0 cm) in diameter, although chums are known to pick even bedrock as a substrate. They sometimes use sites in springs and ground-water seepages that may prevent the redds from freezing. Water temperatures range from 0 to 14°C; water depths are 2 to 48 inches (5.0-122 cm); and stream flows range from 12.1 to 15.7 yd^3/sec (9.3-12 m^3/sec) at spawning sites (ADF&G 1982).

As soon as the alevins make their way up through the gravel, they begin to migrate. The young can tolerate temperatures up to 23.8°C but are the least resistant of all Pacific salmon to exposure to high temperatures.

Arctic grayling. The Arctic grayling is abundant in the planning area. Grayling spawn early in the spring immediately after breakup and begin to congregate at the mouths of clear water tributaries in April, and in May they start upstream through channels cut in the ice by surface runoff. Spawning takes place from mid-May to June.

Grayling distribution and abundance in a selected section of the Susitna River (ADF&G 19082) appeared to be closely associated with surface water temperatures. As water temperatures in the tributaries increased in the spring, increased numbers of grayling were observed migrating upstream into areas with pool-type habitats. Many fish remained in these pools for rearing during the summer months. As surface water temperatures began to decrease in the late summer and fall, lower numbers of fish were observed in these habitats and many were seen migrating downstream. The main downstream migration occurs in mid-September, and they overwinter in deep water. A few fish stay in the major clear-water streams and apparently overwinter in the deeper pools (Schallock 1966).

During the research studies conducted in 1981 by ADF&G, some limited conclusions were reached about Arctic grayling - habitat relationships in the upper Susitna River. Grayling movements in and out of streams were influenced by water temperature; grayling were more abundant in habitats with streamflow velocities below 2.0 ft/sec (0.6 m/sec); channels with large deep pools and/or cutbanks appeared to provide optimal habitat; availability of spawning substrate did not appear to limit grayling abundance and distribution significantly.

Dolly Varden/Arctic char. Dolly Varden and Arctic char are found in planning area drainages. They are both members of the char family and will be discussed together. They are found in clear and glacial rivers and lakes, and in brackish deltas and lagoons (McLean and Delaney 1978). They overwinter in lakes, deep river pools, and spring-fed streams.

There are resident and anadromous char. Little is known about the life history of resident char. Anadromous char live in freshwater for two to five years before beginning their annual fall migration between marine summer feeding areas and freshwater fall spawning and overwintering areas. Seaward migrations commence around the time of breakup. All char spawn between the end of July and the beginning of December, with most activity in September and October. Water temperatures between 5.5° and 6.5°C are preferred, although char can spawn between 3° and 13°C. Spawning usually occurs over gravel shoals in lakes but sometimes in quiet pools in streams close to a lake. Juveniles consume insects and small crustaceans.

Rainbow trout and steelhead. There are two life history forms of rainbow trout: stream and lake dwelling fish, which can inhabit rivers or streams on a year-round basis or which can move between lakes and streams; and ocean-run rainbows (steelhead), which spend part of their lives in freshwater systems and part in marine systems.

Some stream-dwelling rainbow populations move only limited distances within a river or stream, overwintering in deep river holes, in sloughs and side channels, often in lower stretches of rivers with slow to moderate velocity (ADF&G 1976). Some populations do not remain in open leads and probably use ice as cover. After ice breakup, the trout disperse throughout the river system, usually moving upstream. Juvenile rainbows generally inhabit slow-moving water under tangled roots and along the edge of gravel bars. Adult rainbows prefer riffle areas with gravel substrates and a moderate stream flow and are often found in areas with an upward percolation of water.

Other rainbow populations have highly variable migratory patterns related to stream flow and the availability of food. Usually, these adults overwinter in lakes, spawn in rivers and streams during spring, and return to the lakes during summer and fall, although some may remain in the rivers. Juveniles from these populations may move into the lakes during their first year of life, although they are known to remain in rivers till four or five years of age. Juveniles and adults are found inswift, shallow, gravel-bottomed stretches of streams and rivers, feeding on salmon carcasses and eggs.

The rainbow trout is basically a spring spawner, with the majority breeding between mid-April and late June. Spawning takes place in deep-water tributaries and sidechannels, usually in a riffle above a pool, and at temperatures between 10° and 13°C, although they have been known to spawn at temperatures as low as 5.5°C and as high as 17°C.

Survival of eggs is directly related to the velocity of water passage through the redd and the amount of dissolved oxygen in their water. Wood fibers in the water, (e.g. from logging) do not affect egg survival but have adverse effects on the growth and survival of young fish (Kramer and Smith 1965).

Movement of young rainbows seems to be associated with water temperature. In cold water (less than 13°C), the young are carried downstream, because they remain in the water column, whereas if the temperature is warmer, they remain on the bottom and stay in one reach of the stream. Temperature and population density appear to be major factors affecting growth (Black 1953, Murai and Andrews 1972).

Steelhead undertake the most extensive movements of all Alaskan trout species. After one to four years of stream life they migrate downstream in the spring and summer and enter the sea. They may stay in marine waters a few months to four years before returning to their natal streams to spawn.

Freshwater habitat is critical to rainbow trout. The egg/fry stages of development are sensitive to habitat destruction or disturbance. A reduction in stream flow may decrease the area of suitable spawning habitat by reducing water depth over, and access to spawning areas. It may also increase the deposition of fine sediments, which in turn reduces the intragravel water flow critical to the survival of incubating eggs and alevins. An increase in winter stream flow during the critical period of egg and alevin development may wash away spawning gravels and crush the eggs and alevins. A reduction in streamflow may reduce riffle areas that are important in producing the invertebrate diet of the rainbow. The elimination of natural flooding (e.g. by dam construction) can eliminate the important periodic flushing of fine sediments out of spawning gravels. Any disturbance that degrades rainbow or steelhead spawning, rearing, or feeding habitat, degrades water quality, or blocks fish migration routes, may adversely affect population levels of rainbow and steelhead that inhabit the disturbed system.

For a summary of fish vegetation requirements, refer to Appendix C.

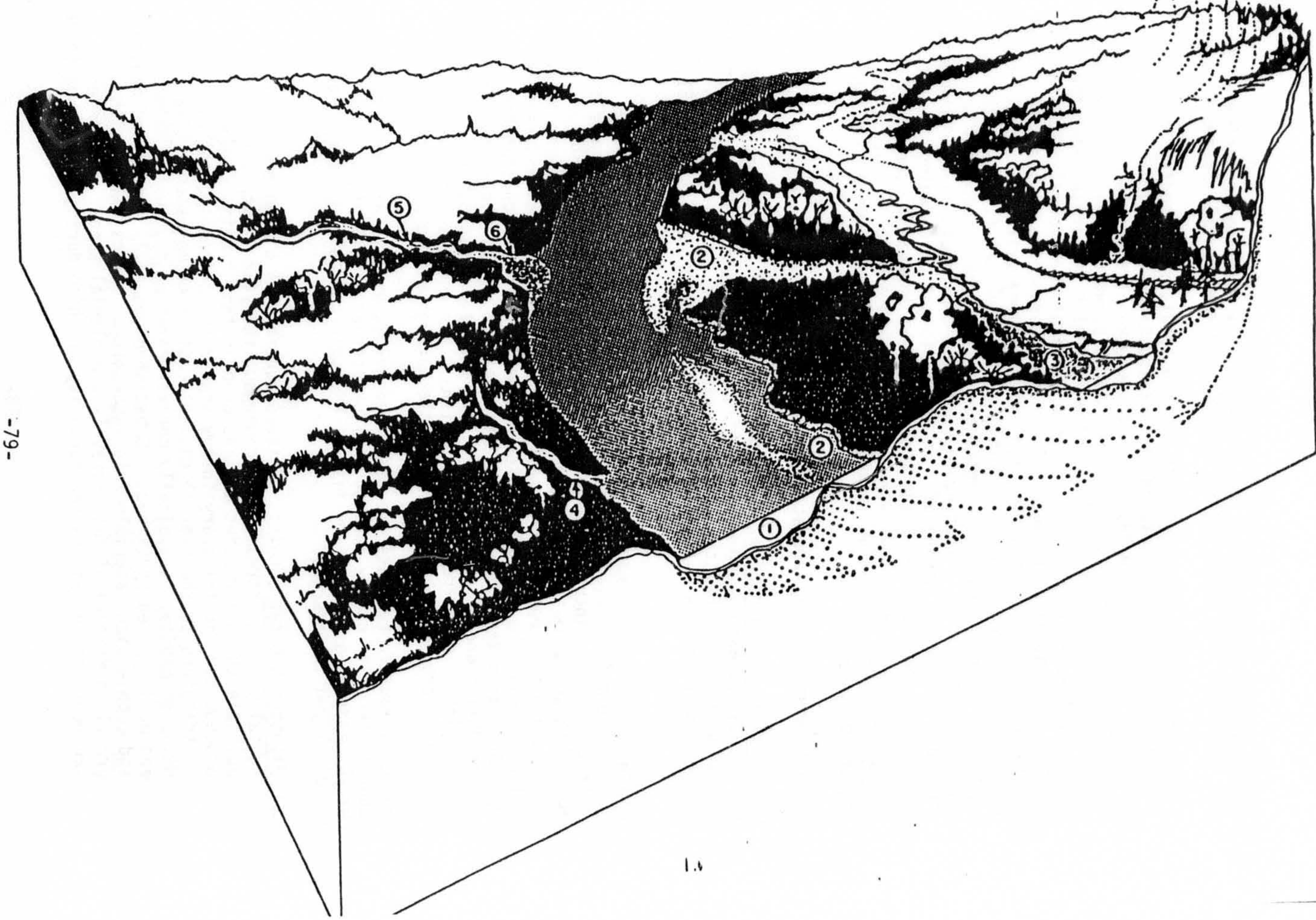
Fish-habitat relationships. Like terrestrial animals, aquatic animals such as fish can be associated with specific habitat types. Presented here is a preliminary Aquatic Habitat Classification System, based in part on research by the members of the Susitna Hydroelectric Project (e.g. ADF&G 1981, 1982, 1983).

Habitat needs of fish vary with season of the year, and with stage of life cycle. The main life stages of fish consist of: upstream migration of adults, spawning, incubation, juvenile rearing, and seaward migration of smolt. It would be beneficial, for land use planning decisions, to be able to correlate fish species and their life stages with certain definable habitat types. The ADF&G's Susitna Hydroelectric research team has described seven major aquatic habitats that are utilized by particular fish species during one or more of their life stages. These habitat categories were originally described for the Susitna River and its tributaries, but they are general enough to be applicable throughout the planning area.

The seven aquatic habitats are described below, and six will be discussed later in terms of use by individual fish species (the Susitna Hydro team has not yet addressed lake use by fish). Pictorial examples of these habitats are displayed in Figure 5.

1. Mainstem habitat consists of those portions of a main river that normally convey stream flow throughout the year. Both single and multiple channel reaches are included in this habitat category. Groundwater and tributary inflow appear to be inconsequential contributors to the overall characteristics of mainstem habitat. Mainstem habitat is typically characterized by high water velocities and well armored streambeds. Substrates generally consist of boulder and cobble size materials with interstitial spaces filled with a groutlike mixture of small gravels and glacial sands. Suspended sediment concentrations and turbidity are high during summer due to the

Figure 5. General habitat categories of the Susitna River - a conceptual diagram (from ADF&G 1983)



influence of glacial melt-water. Streamflows recede in early fall and the mainstem clears appreciably in October. An ice cover forms on the river in late November or December.

2. *Side channel habitat* consists of those portions of a river that normally convey streamflow during the open water season but become appreciably dewatered during periods of low flow. Side channel habitat may exist either in well defined overflow channels, or in poorly defined water courses flowing through partially submerged gravel bars and islands along the margins of the mainstem river. Side channel streambed elevations are typically lower than the mean monthly water surface elevations of most mainstem rivers observed during June, July, and August. Side channel habitats are characterized by shallower depths, lower velocities and smaller streambed materials than the adjacent habitat of the mainstem river.

3. *Side slough habitat* is located in spring fed overflow channels between the edge of the floodplain and the mainstem and side channels of a river and is usually separated from the mainstem and side channels by well vegetated bars. An exposed alluvial berm often separates the head of the slough from mainstem or side channel flows. The controlling streambed/streambank elevations at the upstream end of the side sloughs are slightly less than the water surface elevations of the mean monthly flows of the mainstem Susitna River observed for June, July, and August. At intermediate and low flow periods, the side sloughs convey clear water from small tributaries and/or upwelling groundwater. These clear water inflows are essential contributors to the existence of this habitat type. The water surface elevation of the mainstem river generally causes a backwater to extend well up into the slough from its lower end. Even though this substantial backwater exists, the sloughs function hydraulically very much like small stream systems and several hundred feet of the slough channel often conveys water independent of mainstem backwater effects. At high flows the water surface elevation of the mainstem river is sufficient to overtop the upper end of the slough. Surface water temperatures in the side sloughs during summer months are principally a function of air temperature, solar radiation, and the temperature of the local runoff.

4. *Upland slough habitat* differs from side slough habitat in that the upstream end of the slough is not interconnected with the surface waters of the mainstem river or its side channels at higher flows.

5. *Tributary habitat* consists of the full complement of hydraulic and morphologic conditions that occur in the tributaries. Their seasonal streamflow, sediment, and thermal regimes reflect the integration of the hydrology, geology, and climate of the tributary drainage. The physical attributes of tributary habitat are not dependent on mainstem conditions.

6. *Tributary mouth habitat* is characterized by the downstream portion of the tributary where a) the discharge of the mainstem river influences fish access into the tributary and b) the clear water of the tributary extends as a plume into the turbid waters of the mainstem river.

7. Lake habitat consists of various lentic environments that occur within the river basin drainage. These habitats range from small, shallow isolated lakes on the tundra, to larger, deeper lakes which connect to the mainstem rivers through well-defined tributary systems. The lakes receive their water from springs, surface runoff, and/or tributaries.

"Available habitat" for a species is defined as the area capable of providing direct life support for that particular species (USFWS 1981). Available habitat also includes terrestrial area surrounding described fish habitats. This can be very important to particular fish species. Brna (pers. comm.) has noted (for at least the Kenai River) that aquatic habitats with adjacent wetlands produced more fish than did those without. Wetlands adjacent to waterbodies affect conditions in adjoining rearing habitats. Wetlands may provide: inorganic and organic nutrients, insect drift (fish prey), and detritus on which insects feed. Thus, the wetland surface area bordering a stream should be included in the category of "available habitat" in any aquatic modeling system. Platts (1979) also emphasizes the need to integrate terrestrial ecosystem models and aquatic system models. Suggestions for habitat parameters describing these ecosystems are discussed in the following paragraphs.

After identifying which aquatic habitats are used by particular fish species and life stages, approaches similar to those presented by the USFWS Instream Flow Group (Bouce 1982) or a modification of Habitat Evaluation Procedures (HEP), (Terrell et al. 1982), can be used to identify the physical and chemical variables which limit or support the utilization of these habitats (refer to ADF&G 1980b for an evaluation of HEP and fish). These approaches are similar in concept to the H.E. Procedures developed for moose, described later in this report, and would identify the suitability of a habitat, for a specific species and life stage, with a relative "Suitability Rating."

The range of physical habitat parameters suitable for each fish species addressed in this section, has already been described earlier in this report. Relative capabilities of six of the seven habitats for fish have been suggested, in descriptive form, by the Susitna Hydroelectric research team (ADF&G 1983). Table 43 depicts these relative capabilities of six habitats for five salmonid species, and three important life functions (migration, spawning, rearing). The descriptive values of the various habitats have been translated into a numerical index.

Habitat Suitability models for fish, such as the one suggested, could be used in conjunction with other models (such as fish carrying capacity), with matrix evaluations, or with general descriptions of preferred habitat. Combining such techniques can improve the reliability, applicability, or flexibility of analyses performed.

Once fish species are assigned to one of the seven general habitats, then more specific fish-habitat relationships can be attempted. Correlating fish species with the specific habitats they use, and developing and using Habitat Suitability Index values, however, require a clear understanding of the habitat requirements of fish species being

TABLE 43. Habitat Type - Fish Species - Life Function Matrix, Susitna Planning Area[1] (Information for Susitna River, Sloughs and Side Channels Only)

	Chinook			Coho			Sockeye			Chum			Pink		
	M	S	R[2]	M	S	R	M	S	R	M	S	R	M	S	O[3]
1. Mainstem Habitat	1.0	0	0.5	1.0	0.3	0.5	1.0	0.3	0.3	1.0	0.5	0.5	1.0	0	1.0
2. Side Channel Habitat	1.0	0	0.5	1.0	0.3	0.5	1.0	0.3	0.3	1.0	0.5	0.5	1.0	0	1.0
3. Side Slough Habitat	0	0	0.8	0.3	0.3	0.8	0.8	0.8	0.8	0.8	0.8	0.5	0.3	0.3	0.3
4. Upland Slough Habitat	0	0	0.8	0.3	0.3	0.8	0.3	0.3	0.8	0.3	0.3	0.8	0.3	0.3	0.3
5. Tributary Habitat	1.0	1.0	0.8	0.8	0.8	0.8	0.3	0.3	0.3	0.8	0.8	0.8	0.8	0.8	1.0
6. Tributary Mouth Habitat	1.0	1.0	0.8	0.8	0.8	0.8	0.3	0.3	0.3	0.8	0.8	0.8	0.8	0.8	1.0

[1]Following are suitability index values of the habitat, derived from ADF&G (1983). This interpretation gives the highest suggested value to a given habitat.
1.0 = totally dependent
0.8 = heavy use
0.5 = moderate use
0.3 = rare or little use
0 = no use

[2]M = Migration
S = Spawning and incubation
R = Rearing juveniles, 1st year

[3]Outmigrating - not rearing

evaluated. Where detailed knowledge is lacking on the specific habitat requirements of each fish species of interest, species guilds can be substituted for individual species when determining suitability ratings. In this approach, certain well-studied fish species become representative of a group of species with similar ecological requirements, but about which less is known.

For more detailed analysis of a specific area, stream, or reach of stream variables such as: substrate, water velocity, turbidity, temperature, cover, etc. may be placed in a matrix comparing needs of different fish species. Examples of such matrices can be found in Terrel et al. (1982). Such detailed matrices for a specific habitat, then could be used to classify fish species into guilds and/or to establish more specific fish - habitat relationships. By identifying important habitat parameters, and subsequently associating fish species with these parameters, possible limiting factors to fish populations (e.g. instream flow) could also be described. This identification and association could then help in population management and in resource allocation.

PART II. Modeling of Wildlife-Habitat Relationships

This part of the supply chapter describes general relationships between habitats and wildlife that can be used to identify various categories of wildlife lands. Because it is impossible to sample every hectare to determine the abundance and distributions of important species, the consideration of wildlife-habitat relationships in conjunction with mapped distributions of vegetative cover types represents a useful alternative approach to determining general wildlife distributions. This understanding is needed to represent wildlife management and public use interests during the land allocation negotiation phase of the Susitna area planning process.

As part of the state-federal Cooperative Susitna River Basin Study, the United States Department of Agriculture, Soil Conservation and Forest Services, mapped 33 different cover types plus unvegetated areas for acreage in the Talkeetna, Beluga, and upper Susitna subbasins (USDA 1983). This mapping procedure used aerial photography and subsequent field inventories. Procedures used and data collected are summarized in USDA (1983).

The Environmental Systems Research Institute (ESRI) was then contracted to develop an automated Geographic Information System (GIS) using Susitna River basin data. This GIS represents the culmination of a resource inventory and analysis effort that involved the detailed mapping and field survey of soil and forest resources in the area. All available river basin data were rectified, cross-compared, and composited by ESRI before being entered into the automated GIS. Related area phenomena such as geology, landform, slope, soils, and vegetation were cross-compared and composited on a single map overlay by a process termed "Integrated Terrain Unit Mapping." This process imparted a higher level of spatial resolution, accuracy, and consistency to the mapped data than was generally inherent in the diverse source materials. The terrain unit map was composed of individual units (polygons), each of which encompassed a set of homogeneous environmental characteristics. The numerous data planes represented on the map were individually entered into the automated GIS so that they could be disaggregated for subsequent analysis. Once automated, the mapped data were put in an easily retrievable form. ESRI subsequently employed the GIS during a systematic assessment of environmental opportunities and constraints in the basin and in a structured evaluation of the capability and suitability of basin lands for selected uses. The processing system has been installed on a computer in Alaska that, in the future, can serve both as a structure for the efficient storage and retrieval of environmental data for the area and as a context for its logical and systematic application to land planning and management functions. Development of the GIS is outlined in ESRI (1982).

The computerized data bank was subsequently used to evaluate and assess environmental conditions in the region in relation to certain potential uses. A series of theoretical models was constructed to assess the natural opportunities and constraints in the region and to evaluate the capability and suitability of land for select uses. These models are discussed below.

Because all fish and wildlife species preferentially use habitats in which their needs for food, cover, water, and space can most readily be met, and because these preferred habitats can be generally described in terms of plant community structure and composition, hydrologic conditions, elevation, aspect, etc., a method was sought by which the automated environmental data base could be used to identify basin habitats potentially suitable for wildlife species of interest. The methods selected for wildlife suitability mapping consisted of 1) the Habitat Evaluation Procedures (HEP) developed by the USFWS in consultation with a variety of state and federal agencies and academic institutes (USFWS 1980); 2) a summary analysis of moose carrying capacity, using moose forage values (SCS and ADF&G File Data); 3) the Species Diversity Model; and 4) the General Habitat Synthesis Model.

Estimates of the relative productive capabilities of habitats for moose (Models 1 & 2) served as the basis for evaluating various land ownership/use alternatives for the Talkeetna, Beluga, and upper Susitna subbasins. In addition, a model which provided maintenance and enhancement of moose production potential, as well as protection of important riparian lands, was prepared (Model 4). This system of lands was then compared with available distribution and abundance data for Dall sheep, moose, black bears, brown bears, waterfowl, and raptors and with the results of the species diversity model (Model 3) to determine if the habitat needs of other wildlife species (other than moose and fish species) were being accommodated. Where necessary, modifications were made to protect specific habitat requirements of other species, e.g. tundra areas, wetlands, etc. The resulting depiction represents the needs of a diverse community of fish and wildlife species.

Moose Model

The moose is not only important to humans; it is also one of the more wide-ranging species in the planning area. Therefore, an important objective was to identify habitat suitability for moose. Because moose range so widely, determining habitat suitability for them necessarily involved assessing a large percentage of land in the planning area. Moreover, in as much as many other species of wildlife live in habitats moose occupy, determining preferred habitat for moose serves to determine the preferred habitats for many other species as well. The United States Fish and Wildlife Service's Habitat Evaluation Procedures (HEP 1980) was employed to make some of these determinations. HEP is a method that can be used to document the relative quality and quantity of available habitat for selected wildlife species.

HEP was first applied to the Willow Subbasin, where habitats potentially having high, medium, and low suitability for moose, red squirrel, snowshoe hare, willow ptarmigan, and/or spruce grouse were computer-mapped on the basis of vegetation data. These wildlife suitability maps were then used during development of the Willow Subbasin Land Use Plan (see USDA 1981, USDA 1983, and ADNR et al. 1982). At about the same time, a HEP analysis was also conducted during the Bradley Lake Hydroelectric Project (USFWS 1980). These initial HEP analyses were revised as experience with the procedures improved and as additional environmental data became available. The following description of HEP modeling is based on the most recent HEP analysis of moose habitat conducted in the Talkeetna, Beluga, and upper Susitna subbasins of the Susitna planning area. In addition to using HEP, the ADF&G conducted an alternative analysis of habitat suitability for moose, again based on USDA-SCS vegetation data (Regelin pers. comm.). This independent analysis follows the description of HEP. For explanations and justifications of HEP's use in other studies, see USDA (1983), Konkel et al.

(1979), ADF&G (1980), and USFWS (1978). Basic assumptions underlying HEP analysis are that

1. a definable relationship exists between wildlife species and their living space, and

2. that this relationship for a selected species can be described by a relative index.

The reliability of this procedure is dependent on the habitat biologist's ability to describe accurately and specifically wildlife-habitat relationships for particular species. The relative value of different habitats for a species (Suitability Index) can be indicated by assigning a value of 1.0 to the optimal set of habitat conditions (i.e., conditions characterizing areas with the highest carrying capacity of the particular wildlife species), and comparing all other areas to this standard. Suitability Indices are intended to approximate an expert's assessment of long-term habitat carrying capacity (Chuck Soloman pers. comm.).

Various environmental data were used to assess the habitat suitability of different areas for moose for both the winter and the spring/summer/fall seasons. Combinations of six variables were considered for each of the two general seasons: 1) winter and 2) spring/summer/fall. Formulas for combining variables were determined by known vegetation - moose relationships. The definitions of the variables follow:

V_1 = Deciduous browse quality as indicated by species and percent of total available browse.

V_2 = Deciduous browse quantity as indicated by total available browse of Salix, Betula, and Alnus species.

V_3 = Availability of cover as indicated by canopy type and percentage of tall shrub cover.

V_4 = Presence of Vaccinium-vitis idaea (VAVI) according to percentage of cover: a = 5%, b = 1 to 5%, c = 1%.

Each mapped vegetation type was assigned a relative suitability rating between 0 and 1.0 for each cover type according to equations of the above variables for each general season. High suitability was indicated by values greater or equal to 0.8, medium suitability by values from 0.4 to 0.7, low suitability by values greater than 0 to 0.3, and unsuitable habitat by zero. In the winter, availability of cover was considered very important because of the protection from snow build-up it provides. The presence of Vaccinium was also considered important in winter because this species provides moose winter browse (Atlas Map B9b). The suitability formula determined for moose winter range is

$$\mathrm{SI\ (winter)} = \frac{2(V1) + V2 + V3}{4} + V4$$

(Table 2). Once each cover type was rated for winter suitability, a computer-generated map was developed from the suitability values for each vegetation type displaying four categories of moose winter habitat: high, medium, low, and no suitability (Figure 14).

A similar process was undertaken to map categories for moose spring/summer/fall range (tables 3 and 4). However, instead of variables V_3 and V_4, two new variables were substituted:

V_5 = Availability of cover as indicated by canopy type or distance to forest and to all shrub cover types.

V_6 = Total annual forb production.

These variables were combined, using a different suitability function to determine spring/summer/fall range:

$$SI\ (S/S/F) = \frac{2\ (V1) + V2 + V5 + V6}{5}$$

Again, a relative index between 0 and 1.0 was obtained, and four classes of suitability were determined: high = 0.8; medium = 0.4-0.7; low = 0 to 0.3; unsuitable = 0.

Computer-generated maps portraying categories of moose spring/summer/fall range are shown in Atlas Map B9a. From these two "Moose Model" maps, the department can determine which lands in the planning area are most important for moose (see Chapter III, Resource Allocations).

TABLE 44. Characteristics of Talkeetna and Beluga Subbasin Vegetation Types as Described by Habitat Parameters for Moose Range

	Habitat Parameters			
	V_1	V_2	V_3	V_4
SCS Vegetation Type	Browse Species (percent total)	Production lbs/acre	Canopy Type Cover Class	VAVI Cover Class
21	Al(100)	548	cl CF	c
22	Al(92)Sa(8)	696	cl DF	a
24	Al(77)Sa(13) BP(10)	320	cl MF	a
25	Sa(100)	188	cl CF	a
26	Al(94)BP(4) Sa(2)	403	cl MF	b
27	Al(71)Sa(29)	473	cl DF	c
28	Al(100)	127**	cl DF	c
29	Al(100)	247	cl MF	c
31	Sa/Bn*	393	op CF	a
32	Sa/(100)	456	op MF	c
33	Al(72)Sa(28)	924	op MF	c
34	Sa(58)Al(42)	377	op MF	c
35	Al(100)	31	op DF	c
36	Al(100)	552	op MF	c
41	Al(100)	40	cl CF	a
42	BP(100)	48	cl CF	a
43	Al(100)	40	op CF	b
60	Al(100)	1,082	TS	c
61	Sa(82)Al(18)	2,628	TS	c

Classifications are based on SCS/FS vegetation data for the Talkeetna subbasin.

* not measured in plot of pure type, but mentioned as being heavily browsed in area, present in heterogeneous plot.

** based on heterogeneous type, one plot.

Abbreviations:

VAVI = Vaccinium vitis-idaea
Al = Alnus spp.
Sa = Salix spp.
BP = Betula papyrifera
BN = Betula nana
CF = coniferous forest
DF = deciduous forest
MF = mixed coniferous-deciduous forest
TS = tall shrub
cl = closed
op = open

TABLE 45. Suitability Index (SI) Values for Moose Winter Range Habitat Parameters by Vegetation Type

SCS Vegetation Type	Habitat Parameters V_1	V_2	V_3	V_4	Winter Range
21	0.2	0.8	0.8	0	.5
22	0.3	1.0	0.8	0.06	.7
24	0.7	0.8	1.0	0.06	.9
25	0.9	0.6	1.0	0.06	.9
26	0.3	0.8	1.0	0.03	.6
27	0.7	0.8	0.8	0	.8
28	0.2	0.6	0.8	0	.5
29	0.2	0.6	1.0	0	.5
31	0.7	0.8	0.6	0.06	.8
32	0.9	0.8	0.4	0	.8
33	0.7	1.0	0.4	0	.7
34	0.7	0.8	0.6	0	.7
35	0.2	0.2	0.6	0	.3
36	0.2	0.8	0.6	0	.5
41	0.2	0.2	0.8	0.06	.4
42	0.8	0.2	0.8	0.06	.7
43	0.2	0.2	0.6	0.03	.3
60	0.2	1.0	0.4	0	.5
61	0.9	1.0	0.4	0	.8

See Table 44 for definitions and vegetation characteristics on which these SI values are based. Classifications are based on SCS/FS vegetation data for the Talkeetna Subbasin.

TABLE 46. Characteristics of Talkeetna and Beluga Subbasin Vegetation Types as Described by Habitat Parameters for Moose Spring/Summer/Fall (S/S/F) Range

SCS Vegetation Type	Habitat Parameters V_1 Browse Species (percent total)	V_2 Production lbs/acre	V_5 S/S/F Cover	V_6 Forbs lbs/acre
21	Al(100)	428	cl CF	291
22	Al(94)Sa(4) Be(2)	636	cl DF	106
24	Al(60)Sa(23) Bp(16)	205	cl MF	71
25	Sa(54)BN(46)	47	cl CF	143
26	Al(83)BP(14) Sa(3)	147	cl MF	68
27	Al(50)Sa(50)	310	cl DF	22
28	Al(86)Sa(14)	598	cl DF	40
29	Al(100)	247	cl MF	96
31	BN(100)	360	op CF	64
32	Sa(100)	313	op MF	214
33	Al(70)BN(27) Sa(3)	105	op CF	370
34	Al(99)BN(1)	122	op MF	121
35	Al(100)	56	op DF	132
36	Al(100)	237	op MF	18
41	Al(100)BN(4)	19	cl CF	
42	0	0	cl CF	14
43	Al(100)	23	op CF	19
50	0	0	TG	0
51	0	0	LS	0
52	0	0	HSG	0
60	Al(100)	649	TS	38
61	Sa(79)Al(21)	560	TS	234
62	Sa(74)BN(26)	323	LS	121
63	BP(100)	3	TG	381
64	0	0	SGT	21
65	BN(57)Sa(43)	134	HT	14
66	BN(65)Al(31)Sa(4)	103	ST	38
67	0	0	MCT	13
68	0	0	HSG	0
69	BN(90)Sa(5) Al(5)	111	LS	12

Abbreviations:

cl = closed
op = open
TS = tall shrub
TG = tall grass
LS = low shrub
DF = deciduous forest
CF = coniferous forest
MF = mixed coniferous deciduous forest
ST = shrub tundra

VAVI = Vaccinium Vitis-idaea
Al = Alnus spp.
Sa = Salix spp.
BP = Betula papyrifera
BN = Betula nana
SGT = sedge-grass tundra
HSG = herbaceous sedge-grass
MCT = mat and cushion tundra

TABLE 47. Suitability Index (SI) Values for Moose Spring/Summer/Fall (S/S/F) Range Habitat Parameters by Vegetation Type

SCS Vegetation Type	Habitat Parameters V_1	V_2	V_5	V_6	Spring/ Summer/Fall Range
21	0.2	0.8	1.0	1.0	0.6
22	0.3	1.0	1.0	0.6	0.6
24	0.9	0.6	1.0	0.4	0.8
25	0.7	0.2	1.0	0.8	0.7
26	0.5	0.6	1.0	0.4	0.6
27	0.7	0.8	1.0	0.2	0.7
28	0.5	1.0	1.0	0.4*	0.7
29	0.2	0.6	1.0	0.6	0.5
31	0.6	0.8	1.0	0.4	0.7
32	0.9	0.8	1.0	1.0	0.9
33	0.5	0.6	1.0	1.0	0.7
34	0.2	0.6	1.0	0.6	0.5
35	0.2	0.4	1.0	0.8	0.5
36	0.2	0.6	1.0	0.1	0.4
41	0.2	0.1	1.0	0.1	0.3
42	0	0	1.0	0.1	0.2
43	0.2	0.1	1.0	0.1	0.3
50	0	0	0	0	0
51	0	0	0	0	0
52	0	0	0	0	0
60	0.2	1.0	1.0	0.2	0.5
61	0.8	1.0	1.0	1.0	0.9
62	0.8	0.8	0	0.6	0.6
63	0.8	0.1	0	1.0	0.5
64	0	0	0	0.2	0.1
65	0.8	0.6	0	0.4	0.5
66	0.6	0.6	0	0.4	0.4
67	0	0	0	1	0.1
68	0	0	0	0	0
69	0.6	0.6	0	0.4	0.4

*Estimated from one plot in heterogeneous type

See Table 46 for definitions and vegetation characteristics on which these SI values are based. Classifications are based on SCS/FS vegetation data for the Talkeetna Subbasin.

Non-forest and non-tall shrub types greater than 440 yards frcm cover are not S/S/F range.

The Bradley Lake version of the Moose Habitat Suitability model was modified one step further by D. Bader by defining vegetation types 27 and 61 as the major components of high-valued critical moose winter range (D. Bader pers. obs. 1971). This version was applied to the Talkeetna-Beluga subbasins of the Susitna planning area (Atlas Map B9b).

CARRYING CAPACITY MODELS

Habitat ratings obtained by methods like HEP are designed to reflect the relative carrying capacities of different areas; i.e., highly suitable habitats theoretically have higher carrying capacity for wildlife species than do less suitable habitats. Calculating theoretical carrying capacities (K) directly from theoretical vegetation nutritive values is an alternative approach to HEP SI ratings and can also be used to evaluate habitats. In order to evaluate habitat for wildlife in this way, Wayne Regelin, ADF&G, Fairbanks, provided information from the literature on moose carrying capacity by vegetation type, and the Habitat Division, Region II assembled a "Moose Carrying Capacity Model."

Theoretical moose "K" were calculated for mapped vegetation types for 1) existing summer range 2) existing winter range and 3) vegetation types that could be "enhanced for moose" in both the summer and winter ranges. Enhancement here is defined as altering the existing habitat, usually be logging or fire, to produce an earlier seral stage containing better moose browse and theoretically producing subsequent increases in the moose population. The "K" per mi^2 per vegetation type was determined by ADF&G, using cover types, forage production (annual and total available) collected in the SCS/FS studies (1978-1980), and using known moose forage consumption rates and vegetation potential enhancement factors (W. Regelin pers. comm.). These carrying capacity models, which depict the theoretical number of moose per mi^2 in different vegetation types were printed on computer-generated maps aggregating areas into high, medium, and low categories. Atlas Maps B13 and B14 illustrate the results of this analysis. Table 48 summarizes the carrying capacity/cover type relationships used in the model and compares it to the HEP and species diversity models.

Regelin (pers. comm.) noted that where small ($<$ 4 mi^2) areas are enhanced, moose may become so numerous that their intense browsing activities prevent regenerating browse species from becoming established and productive. He suggested that to prevent this, enhancement projects should be located where at least 50% of the vegetation within a 4 mi^2 area (1,280 acres) could be enhanced. On the basis of this recommendation, the habitat enhancement "K" model was modified by incorporating a 1,200 acre minimum for enhancement of areas supporting $>$50% enhancible vegetation; areas smaller than 1,200 acres were not considered feasible to enhance. The resulting model Atlas Map B14) illustrates habitats in which enhancement is potentially feasible according to model standards. (This procedure, however, is still in the theoretical stages).

For the carrying capacity model to function correctly, certain assumptions have to be met:

1. Preliminary annual forage production for each vegetation type as calculated from SCS/FS field data collected in the Talkeetna and

Beluga subbasins is reasonably accurate and is adequate to calculate the theoretical carrying capacity of each vegetation type.

2. Vegetation types 27 and 61 represent the major components of critical moose winter range (D. Bader pers. comm.).

3. Vegetation types 27, 28, and 29 have high potential for enhancement of carrying capacities.

4. Estimates of moose forage consumption rates and vegetation type enhancement potentials, calculated by Wayne Regelin, based on studies conducted in the Kenai, are reasonable representations of moose consumption and forage production rates in comparable vegetation types found in the Susitna basin.

Even though the moose carrying capacity and enhancement models do not incorporate environmental or physiographic constraints such as snow fall, slope, or aspect, on moose range suitability, they accurately reflect the distribution of vegetation used as summer and winter range, as well as theoretical and potential carrying capacities.

Furthermore, each category of cover type encompasses a range of environmental conditions affecting the quality and quantity of plants within it, and these conditions change from year to year. As a result, vegetative data collected in the field can provide only a rough indication of plant species composition and productivity of a particular cover type. Forage production rates per vegetation cover type are therefore rough estimates at best. The cover types with the highest carrying capacities in the Susitna planning area are alder-willow (type 61), open young white spruce forests (31), open older white spruce forests (33), closed older white spruce forests (25), medium-aged stands of mixed-deciduous forest (24), and all ages of stands of cottonwood (27, 28, 29). Moose per square mile in these vegetation types theoretically can range from 6.7 to 18 moose in the summer and from 1 to 3.1 moose in the winter (Table 45). The "enhancement" program could increase the moose per mi² in summer and winter to 27-48 and 4.5-7.2 respectively. Given the much higher carrying capacity ratio of summer to winter range in the planning area, availability of winter range is considered a major limiting factor for moose populations.. However, before "enhancement" for moose is conducted over a wide geographic area, certain repercussions (long-term loss of nutrients, decrease in populations of other species) must be considered (Casey and Kein 1983, Bock and Bock 1983).

Species Diversity Model

Ecological diversity (diversity of plants, animals, etc.) is generally considered an important component of ecological stability.* If ecological stability is considered an important objective, diversity should be encouraged. Furthermore, because many ecological relationships among animal species and among them and their habitat components are not known or clearly understood, it is best to take a conservative approach when planning land developments and to maintain as much of the original ecology as possible. At this point, we do not fully know the degree to which all living organisms are interdependent nor to what extent living organisms are regulated by their physical environment. We do know that in much of the rest of the United States and the world irreversible losses of species and habitat are occurring, usually with unknown effects on future environments and the humans depending on them.

McNaughton (1977) concluded that 1) increased complexity (diversity) stabilized certain ecosystem properties and that 2) more precisely, as an example, a large mammalian herbivore (e.g. moose) changed the total given plant biomass less in more diverse than in less diverse plots. Thus it follows that productivity would be greater in areas with greater species diversity. Clearly, then, the Species Diversity Model is directly related to the Key, or Indicator, Species Approach such as HEP and the carrying capacity models.

The reduction of species diversity is, in the long run, detrimental to humans, because by reducing this diversity, humans may be wasting some of their most valuable natural resources, on which they are dependent for food, oxygen, medicines, energy, building materials, and other countless benefits. Many plants and animals now in existence may have as yet undiscovered benefits for the human race, and it is important that these species be maintained. Individually, other species' interrelationships are not known, single species or combinations of species could prove important in the future. They could 1) control the structure and functioning of their community 2) aid in human nutrition 3) provide medicines for humans (Hoose 1981) or 4) possess undiscovered characteristics valuable to humans.

The Wildlife Species Diversity Model was prepared using the concepts of the USFS's Wildlife-Habitat Relationships Program and the accepted ideas of many planners and scientists today of emphasizing ecological diversity (Council on Environmental Quality 1980). To determine diversity values for each cover type, species' experts conferred, reviewed various literature, and came up with a list of bird and mammal species that occupied each of the identified 33 vegetative cover types in the planning area. Habitats meeting food, cover, and reproductive needs of a greater number of species were assumed to have a greater wildlife value.

* A stable ecosystem is defined as follows: The ecosystem will remain in its present state, and if perturbed it will return to its original state.

The number of bird and mammal species potentially inhabiting each general cover type (habitat) in the planning area were then identified (see the computer printout in the Appendix), and cover types were then grouped with respect to high (67-91 spp), medium (38-61 spp), and low (1-31 spp) species diversity.* These habitat categories are displayed in the Atlas Map B11. The relationships of the HEP, carrying capacity, and species diversity models are shown in Table 48.

Habitat Scarcity Submodel

The relative scarcity of different habitats (vegetation types) was assessed by examining how much the acreage of each mapped vegetation type was above or below an "equitable" share. This equitable share was determined by dividing the number of plant communities used in the analysis of wildlife species diversity into the total vegetated acres of the subbasin(s) being considered (a generalized chi-square analysis). For example, in the combined Talkeetna/Beluga subbasin (considered as a unit because of the environmental similarities between these two adjacent subbasins), 15 vegetation types occupied 3,555,120 acres. If each vegetation type were allotted an equal share of this vegetated area, each would occupy approximately 237,000 acres or 6.7% of the total (3,555,120 ÷ 15 or 100% ÷ 15).

General Habitat Synthesis Model

In order to construct a summary map depicting the lands most suitable for fish and wildlife resources, in addition to the moose models and the Species Diversity Model, the ADF&G wanted a general management plan for wildlife, not just for game species, that would include both the species diversity concept and the "key species" concept.

Similar general management plans for fish and wildlife have been developed by other agencies. The United States Forest Service (USFS), for example, has produced a Wildlife Habitat Relationships Program that develops a conceptual framework that will enable managers to 1) consider the needs of all vertebrate species (ecological diversity approach) 2) emphasize the management of particular wildlife species when desired (key species approach) and 3) identify habitats that require special attention (habitat approach).

These objectives emanated from strong public interest in all wildlife species, not just game species. The USFS has emphasized that habitat types supporting the highest species diversity should be considered for wildlife allocation, especially if they are limited in size (i.e., if they are scarce).

The USFS has emphasized species diversity because it ensures that 1) the biological and physical variety of natural ecosystems is maintained and 2) the viability of populations is directly related to species diversity over the long term (Thomas 1979, Patrick 1978, Siderits and Radtke

*Diversity is here defined as species' richness of total number of selected species.

Table 48. Comparison of Moose Habitat Suitability (HEP), Existing (ECAP) and Potential (PCAP) Moose Forage Capability and Species Diversity Ratings for Vegetation Types Found in the Susitna Study Area

Veg Type	Description	HEP Summer	HEP Winter	ECAP Summer	ECAP Winter	PCAP Summer	PCAP Winter	Species Diversity
21*	short stands white spruce 30', associated with alder, grass, open mixed	Med.	Med.	Low	Low	Med.	Med.	Med.
22	young deciduous mixed birch plus aspen, no spruce	Med.	Med.	Med.	Med.	Med.	Med.	Med.
24	same as 22; medium age some spruce 40-100 year age	High	High	High	High	High	High	Med.
25*	tall stands white spruce 30', mixed with old birch	Med.	High	High	High	High	High	Med.
26	old age decadent birch, dominant spruce	Med.	Med.	Med.	Med.	High	High	Med.
27	young stands cottonwood interspersed with willow & alder (0-40 year age)	Med.	High	Med.	High	High	No	Med.
28*	medium age riverine, alder, devils club	Med.	Med.	No	No	High	High	High
29*	old stands cottonwood 100 years old, some willow	Med.	Med.	No	No	High	High	High
31*	short stands white spruce higher elevation mixed with alder, grass	Med.	High	High	High	High	High	High
32*	medium age mixed deciduous and white spruce, birch aspen	High	High	Low	Low	Med.	Med.	High
33*	tall white spruce, riparian with alder, willow, grass	Med.	Med.	High	High	High	High	High
34	open old stands mixed deciduous and young spruce	Med.	Med.	Med.	Med.	Med.	Med.	High
35*	cottonwood medium age treeline above spruce, pocketed	Med.	Low	Med.	Med.	Med.	Med.	Med.
36	old cottonwood, riparian with birch, spruce, alder, grass	Med.	Med.	Low	Low	Low	Low	High
41*	short black spruce, 30' wet, cold sites with birch of poor quality	Low	Med.	Low	Low	No	No	Med.
42*	tall black spruce 30' good sites, sometimes birch very scattered	Low	Med.	Low	Low	Med.	Low	Med.

TABLE 48. (continued)

43*	short black spruce found in bogs, 15', very poor form	Low	Low	Low	Low	Low	Low	Med.
46	hemlock, tall, 30' found as stringes, limited	Low	Low	Med.	Low	Low	Low	High
50	grasslands, tidal, Elymus, shoreline	No	No	Low	Low	Low	Low	High
51	Myrica, low shrub tidal flats, wet	No	Low	Med.	Low	Med.	Low	Med.
52	tidal marsh with sedge, shallow lakes	No	No	Med.	Low	Low	Low	High
60	alder with grass ferns forbs, devils club	Med.	Med.	Low	Low	Low	Low	Low
61	alder-willow, riparian young cottonwood	High	High	High	High	High	High	High
62	willow-resin birch draws at higher elevation	Med.	Med.	High	Med.	High	Med.	Med.
63	calamogrostis grass lands	Med.	Low	Low	Low	Low	Low	Low
64	sedge grass tundra	No	No	Low	No	No	No	Med.
65	herbaceous tundra	Med.	No	Low	No	No	No	Low
66	shrub tundra, dominated by dwarf Arctic birch; grasses & forbs	Med.	Low	Med.	Low	Low	Low	Low
67	mat-cushion tundra	Low	Low	Low	Low	Low	Low	Low
68	sphagnum bog	No	Low	Low	Low	Low	Low	Med.
69	sphagnum shrub bog, some willow	Med.	No	Low	No	Low	No	Med.
70	culturally disturbed	----------Unknown-----------						
80	mud flats	----------No value-----------						
81	rock	----------No value-----------						
82	snow field	----------No value-----------						

TABLE 48. (continued)

83	glacier	----------No value----------
91	lakes greater than 40 acres	----------Unknown-----------
92	lakes 10-40 acres	----------Unknown------------
96	streams 165 feet wide	-------Unknown/No value------
97	wide rivers	-------Unknown/No value------

1977). Patten (1978) and Thomas (1979) expanded the traditional concepts of big game habitat relationships to embrace all species, and they emphasized the importance of integrating sound management of featured species (often big game) with the diversity approach to habitat management. In addition, they recommended maintenance of "special" habitats, such as riparian corridors or snags, that are important either for a variety of species or for a certain important species. Moreover, they emphasized that all successional stages are important for wildlife, especially the early and late stages and that large, dense monoculture imposed on a habitat is the most detrimental for wildlife (Thomas 1979). Through the General Habitat Synthesis Model, the ADF&G attempted to demarcate a variety of habitats that would, over time, maintain existing habitat diversity and thus a faunal diversity. The General Habitat Synthesis Model was developed cooperatively with the USDA-SCS.

Three categories of habitats for the General Habitat Synthesis Model were of particular concern to biologists involved with planning. The first consisted of habitats used by a large variety (high diversity) of species. Examples include riparian corridors, open mixed forests, and estuarine areas. Such areas make disproportionately large contributions to the full spectrum of wildlife resources currently found in the basin. The second and third categories consisted of habitats that are "scarce" in the basin and habitats that are particularly susceptible to degradation. It was assumed that species associated with "scarce" or "sensitive" habitats, particularly species narrowly dependent on them, could be disproportionately affected by land-use changes. For species using "scarce" habitats (such as upland willow-resin birch shrublands, shrub tundra, riparian cottonwood forests, etc.), few or no alternative sources of food, cover, and reproductive requirements would be available once the limited habitat areas they required were significantly altered. For species using "sensitive" habitats (such as streams, selected wetlands, mat and cushion tundra, etc.), land uses occurring in and outside such habitats, even at relatively great distances in some cases, could readily change conditions such as water quality, water flows, nutrient inputs, and sediment regimes on which these fish and wildlife species depend. On the assumption that planners could find it useful and meaningful to know which areas supported many kinds of wildlife and which were relatively scarce habitats, a model was developed to produce a map showing these habitat categories. The submodel of scarcity developed to map each category is presented in sections below. "Sensitive" habitats were later identified during the process of assigning management categories to demarcated fish and wildlife lands (Lehner pers. comm.).

The following account of the General Habitat Synthesis Model is from USDA (1983). The General Habitat Synthesis Model represented an integration of essentially two submodels: 1) the wildlife species diversity and 2) the habitat scarcity submodels. In addition, considerations of stream and river corridors and of moose habitat requirements (HEP moose model and enhancibility models) were also incorporated. To this, the department added information on known critical habitats of other big game species (caribou, Dall sheep, mountain goats, black and brown bears) and other species of interest (waterfowl, raptors), along with information on prime hunting and fishing areas. Thus, all areas important for fish and wildlife information were integrated into one map.

The computer maps produced from this model depicted "core" habitat areas that, on the basis of model and other criteria, were considered most highly suitable for a wide variety of valuable fish and wildlife resources. These core areas became the skeleton of the fish and wildlife "element" map, a map showing a system of basin lands that, if properly managed, would be highly suitable for maintaining area fish and wildlife and associated human uses. This synthesis of all models then became the Fish and Wildlife Element Map (Atlas Map C5). A summary of management of these habitat lands from the Element Map can be found in the chapter on Resource Management.

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CHAPTER III

RECOMMENDATIONS

CHAPTER III. RESOURCE MANAGEMENT (FISH AND WILDLIFE LAND AND WATER CLASSIFICATION RECOMMENDATIONS)

The Department of Fish and Game (ADF&G) is mandated to uphold the state's commitment for the protection, management, conservation, and restoration of the fish and wildlife of Alaska. It must protect and maintain, the fish, wildlife and plant resources of the state, and if possible, allow for the expansion of population numbers or improvement of habitat, (AS 16.05.010, 16.05.020[2]). In order to meet these obligations to the state, the general goal of the ADF&G is to maintain in public ownership as much land and water as is necessary to accomplish these goals in the Susitna planning area. Three specific management goals have been identified for the Susitna planning area 1) maintain a land and water habitat base large enough to support present fish and wildlife populations, 2) ensure access to public lands and waters, and 3) mitigate losses of fish, wildlife, and their habitats.

The management and protection of fish and wildlife resources and related public use opportunities in the planning area require both short and long term management practices. Short term management practices proposed by the Alaska Department of Natural Resources (ADNR) are the classification of lands into the following categories: habitat, recreation, forestry, watershed, and resource management. These classifications provide habitat protection as primary use and will have secondary uses mitigated through guidelines such as those proposed by ADF&G. The resource management classification is a compromise designation created when two or more resource values exist in a given area and no decision can be made to determine a primary use for that area. Land classifications may be changed, at some future date, by amendment of the area plan, or in some cases through administrative actions. However, most classifications should be determined in the planning process and would result in permanent long-term land use designation.

Long-term management practices for habitat protection are available through executive order by the governor to create wildlife reserves under AS 38.04.070 and through legislative designation of areas meriting special management, i.e., state game refuges, critical habitat areas, sanctuaries, game ranges, recreation areas, and/or other public land designations under AS 16.20, AS 41.15 and AS 41.20.

Management Categories for Fish and Wildlife Habitat Lands

Management assignments or categories of the "Habitat Lands" are described below. They are displayed in Atlas Map C5, the Fish and Wildlife Element Map. Briefly, all class A designations on existing state lands are considered "Fish and Wildlife Lands," and merit state retention and management for long-term public use. Class B lands are considered multiple-use lands, and fish and wildlife on these lands are of secondary importance.

<u>Class A-1, "single use" fish and wildlife lands.</u> The maintenance and enhancement of fish and wildlife resources constitute the overriding

management objective on Class A-1 lands. These lands support valued biological resources that are likely to be disturbed or disrupted by any human activity. As a result, few if any "non-wildlife" activities are permitted on these lands, and even recreation may have to be severely curtailed, at least seasonally. All A-1 lands should remain in public ownership and be managed jointly by the ADF&G and the Alaska Department of Natural Resources (ADNR).

In general, A-1 lands had to be specifically identified by local biologists because A-1 resources cannot usually be distinguished during vegetation cover-typing, habitat modeling, or other environmental mapping. As a result, A-1 lands will generally consist of specific sites within areas otherwise mapped and categorized as A-2 or A-3. Where disturbance is likely only at a particular time of year, the period of sensitivity will also be specified. Examples of potential A-1 lands include trumpeter swan nesting areas, peregrine falcon nesting sites, and caribou calving grounds. (A-1 lands in many cases may be analogous to areas of "high sensitivity," as identified in ADF&G 1979.)

Class A-2, "multiple use" fish and wildlife lands - conservative management. The maintenance and enhancement of fish and wildlife resources and human uses of these resources constitute the overriding management objectives on Class A-2 lands. A-2 lands support valued biological resources not abundant in the planning area (e.g., riparian communities or moose winter range) and/or are moderately susceptible to disturbance by human activities (e.g., vegetation communities, such as tundra, with relatively slow replacement rates). Because of the relative scarcity and sensitivity of A-2 lands, non-wildlife uses other than recreation will be permitted only after careful site-specific review and after the state determines that such uses will not affect the ability of A-2 lands to produce the fish and wildlife resources. Plans for siting, designing, implementing, monitoring, etc., non-wildlife uses should be approved in consultation with ADF&G before such uses can be implemented. Many A-2 lands were identified during vegetation cover-typing and habitat modeling, but, given the current state of knowledge, other A-2 lands, such as sheep wintering areas, may be specifically delineated as the information is available. The department recommends that A-2 lands remain in public ownership. Secondary uses allowed on A-2 lands could include forestry, oil and gas development, outdoor recreation, and mining.

In the Talkeetna-Beluga subbasins, examples of A-2 lands include scarce and very-scarce[1] vegetation communities that support high wildlife species diversity; very scarce vegetation communities that support moderate wildlife species diversity; riparian communities; open mixed forests (these are not abundant and support very high wildlife species diversity); and selected tundra communities. This category encompasses many areas of highly suitable moose winter and spring/summer/fall range.

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[1] See the Habitat Scarcity Model for definitions.

Class A-3, "multiple use" fish and wildlife lands - more liberal management. The maintenance and enhancement of fish and wildlife resources and human uses of these resources constitute the overriding management objectives on Class A-3 lands. A-3 lands support valued biological resources that are relatively abundant (e.g., closed coniferous and mixed deciduous forests or moose summer range) and which are relatively resilient to human activities. In many cases, A-3 lands constitute areas where habitat enhancement could be effectively undertaken. Non-wildlife uses, including disposals or recreational cabins, could be permitted when the state determines that these uses will not significantly diminish the ability of A-3 lands to produce the fish and wildlife resources or related uses. Plans for non-wildlife uses should be reviewed and approved in consultation with ADF&G before being undertaken. With the exception of selection of some limited recreational disposals, A-3 lands should remain in public ownership and be managed to provide for wildlife, forestry and public recreation benefits.

In the Talkeetna-Beluga subbasins, examples of A-3 lands include closed coniferous forests, closed mixed forests, muskegs, and alder shrublands. Many of these areas are highly suitable for moose habitat enhancement.

Class A-4, lands enhancible to A-2 or A-3 category. The enhancement of lands to increase moose habitat constitutes the overriding management objective on Class A-4 lands. A-4 lands at present are only minimally valuable for moose, but with logging or burning they could support vegetation types preferred by moose. The increase of moose populations on these lands theoretically could be as much as two to six times their present carrying capacity. Areas with high potential for moose habitat enhancement usually have high forestry values. Selective cutting of certain tree species and age classes can directly benefit moose by increasing forage production of preferred browse species.

Class B, "multiple-use" lands. The maintenance and enhancement of fish and wildlife resources and human uses of these resources constitute secondary management objectives on Class B lands. These lands are generally available for various disposal programs. Non-wildlife uses should be implemented in accordance with management guidelines, siting and design criteria, etc., that will minimize negative impacts of such uses on fish and wildlife resources occurring on Class B lands.

Management guidelines have been developed for all management assignments whether or not those lands are owned by the state. These guidelines are addressed in the third part of this chapter and include discussions on agricultural activities, mineral extraction, energy exploration and development, timber harvest, recreation, commercial, residential, and other potential uses of state lands and resources.

The ADNR Statewide Plan, 1983, addresses statewide resource management policies. These policies include goals and objectives for wildlife habitat and public use. The following sections discuss in detail the specific goals and objectives for wildlife and fish resources with recommended management designations for lands in the planning area.

Goal I. Maintain a Land and Water Base Large Enough to Support Present Fish and Wildlife Populations

The state should maintain in public ownership suitable land and water areas in order to provide for the habitat needs of fish and wildlife.

Because Southcentral Alaska's economy and recreational opportunities are strongly influenced by the availability of fish and wildlife resources, the maintenance of healthy populations of these animals on public lands is an important priority for land management. In 1980, more than 1,650,000 user-days of effort were spent enjoying hunting and fishing and other outdoor recreational activities on public lands in the planning area. Of this, more than 700,000 user-days were spent hunting and sport fishing, and 950,000 user-days were spent recreating (ADNR 1983). In 1981, the approximate harvests in the planning area were: 1,184 moose, 614 caribou, 159 black bears, 89 brown bears, 146 sheep, 218,264 fish and untold numbers of small game and furbearing animals (Chapter II). More than 1.65 million salmon harvested in the commercial fishery from upper Cook Inlet waters probably originate in Susitna area streams (Table 27).

The purpose of the first two objectives of Goal #1 is to address Fish and Game management goals through classification. Objective 3 proposes permanent, long-term protection, through legislative and/or administrative action, for those areas identified as most important for fish and wildlife production, public use (hunting, fishing, trapping, and outdoor recreation), and related revenue generation.

<u>Objective 1 - Reserve Instream Flows</u>

Reserve the amount of water necessary to maintain and protect aquatic habitats for fish and wildlife uses according to the provisions of AS 46.15.

a. <u>Reserve water for habitat purposes</u>. Quantify the amount of water required to maintain and protect fish and wildlife habitats pursuant to AS 46.15.145, and then apply to the ADNR for reservation of this amount.

b. <u>Nominate the streams listed in Table 1, Appendix E</u> for further instream flow study to determine the sufficient flows necessary to maintain or enhance historical levels of fish and wildlife production and to maintain related public use values.

   <u>Selection Process</u>. Streams were defined as important for fish if combined escapements were greater than 1,000 for sockeye, coho, pink, and chum salmon or greater than 500 for chinook salmon (Appendix A, Atlas Map C3). Each identified waterbody in Table 1 meets these criteria.

   Sufficient instream flows (ISF) need to be maintained to protect subsistence, commercial, and sport fishing, and to protect riparian habitats. Refer to Appendix E for an in-depth discussion of instream flow.

c. <u>Adopt instream flow guidelines</u> (see Part 3 of this Chapter), which minimize impacts on fish and wildlife resources by appropriations of water for other uses. The Alaska Department of Fish and Game has proposed ISF selection guidelines for this purpose. A thorough discussion of these guidelines can be found in Appendix E.

Objective 2 - Classify and Manage Habitats

Classify and manage important habitat lands for the purpose of maintaining and enhancing fish and wildlife production and existing populations. There are five ways the department has proposed to classify lands. The department has classified all lands in the planning area with the aid of computer simulation modeling, and with input by species experts.

The department has, for the past 18 months, gathered and summarized available information on fish and wildlife: habitat relationships, abundance and distribution, and human use in the Susitna planning area. This information is available in the Appendices and in the three Data Supplements. In addition, a map atlas displays all fish, wildlife, and human use values. This information has helped the department to identify the most important lands for both short term and long term habitat management.

a. Sensitive and scarce habitats. The department has identified and classified as A-1 or A-2 wildlife habitat areas needed for important life stages of selected species, e.g. species with low populations or those species which are especially vulnerable to impacts. Various selection criteria for these classifications include: all high-quality moose winter range, major caribou calving areas, trumpeter swan nesting lakes, waterfowl nesting concentration and migration staging areas, eagle nesting sites, sheep winter range, moose calving areas, and concentrations of bear feeding areas. Other criteria include all riparian lands and submerged lands necessary to support: important and diverse wildlife, anadromous and resident fish spawning, rearing, over wintering areas, and fish and wildlife migration corridors.

   The Alaska Department of Fish and Game identified only the high-value areas for selected animal species and human uses depicted by: the moose habitat suitability (Atlas Map B9a) and the existing carrying capacity models (Atlas Map B14a); the fish and wildlife habitat matrix evaluations (Data Supplement C); and the important anadromous fish streams discussed in Chapter II, and identified on Atlas Maps B7, B8, and C3.

   These particular habitats and production areas are important because the loss of any would cause serious losses to numbers of species and populations in the area.

   All areas designated A-1 and A-2 on the Fish and Wildlife Element Map (Atlas Map C5) meet Objective 2 and represent areas proposed for wildlife habitat classification. The management objectives on these lands have already been described.

b. Productive habitat lands. The department has identified and classified as wildlife habitat all high-valued spring/summer/fall range for moose, caribou and sheep. The ADF&G identified only the high-valued, and no more than 80% of the moderately-valued, spring/summer/fall range depicted in the existing carrying capacity and moose habitat suitability computer models (Atlas Maps B9a, and B14a) and wildlife matrix evaluations (Data Supplement C). Moderately-valued habitats adjoining highly-valued habitats were considered to be more important than those which did not, unless the latter contained high densities or high numbers of selected species.

High quality summer range is necessary for successful reproduction by large ungulate species i.e. moose, sheep, caribou. A decrease in the amount of summer range for these species could result in reduction of annual reproductive success and ultimately of population size. If populations decline, there will be fewer opportunities to use and enjoy these wildlife resources. There will probably be more competition among user groups and, for example, more stringent restrictions on hunting. Habitats identified for classification as wildlife habitat (spring/summer/fall range) represent a land base capable of maintaining approximately 50%-80% of the existing populations of moose, caribou and sheep in this region (D. Bader pers. comm.).

Areas designated as A-3 on the Fish and Wildlife Element Map (Atlas Map C5) meet Objective 2 and represent areas proposed for wildlife habitat classification.

c. Wildlife enhancement. The department has identified specific areas (A-4 Wildlife Habitat Lands) where habitat manipulation through controlled burning, water control or other measures is feasible and beneficial to improve habitat for moose. These land designations were limited to land units determined to have high enhancement potential in the moose habitat enhancement suitability model and potential forage production capability model as illustrated in Atlas Maps B10 and B14b.

Existing moose populations and related use opportunities cannot be maintained unless large areas having high potential for increased forage production are enhanced and managed for moose production. This is necessary to compensate for the ongoing reduction of moose range occurring through the continuing transfer of public wildlife production lands into private ownership. Recent high moose population levels are the result of past habitat modifications via minimal fire suppression (J. Faro pers. comm.). Without enhancement by selective forest practices and/or forest fires to open up new early successional browsing areas for moose, the available preferred moose habitat will decrease due to successional changes.

All areas designated A-4 on the fish and wildlife element map (Atlas Map C5) meet objective 2 and represent areas for habitat classification.

d. Consumptive resource use lands. The department has identified heavily used areas for trapping, hunting, or fishing. The department considered important for retention only those areas which contribute the upper 70% of hunting use, and those areas known to have the highest trapping and fishing values. In addition, most important access corridors and local community use areas were identified for public retention (Atlas Maps C1, C2a, C2b, C2c, C3, and C4).

The demand to use fish and wildlife resources within the Susitna planning area is currently high and rapidly increasing. Tourism has been identified by the Matanuska-Susitna Borough as a major industry with fish and wildlife related uses contributing significant economic benefits. There are no substitute areas available to replace existing public use areas. Reasonable access is limited or unavailable to other areas having wildlife resources. Capital expenditures have not been available to develop useable access to more remote recreational use areas. Displacement of the rapidly increased demand for outdoor recreation to areas more remote, will directly conflict with rural and subsistence lifestyles which depend heavily on fish and wildlife resources.

Many rural community residents use and depend on resources available adjacent to their communities, and their demand for fish and wildlife, is increasing. No substitute hunting, trapping, and fishing areas are available near most communities.

e. Non-consumptive resource use lands. The ADF&G will identify areas which are especially suited for non-consumptive uses of fish and wildlife resources.

The department has identified two areas specifically for this purpose. The first area is commonly referred to as the Sheep Mountain Closed Area located near Eureka; the other area is referred to as Bird Island and is located on Lake Louise.

Criteria used for selection were: prior non-consumptive use primarily, available access, and a high potential for viewing and photographing fish and wildlife. Recommended management policies for these areas include 1) there should be some measure of control over access to reduce the disturbance fish, wildlife, and habitat and 2) designated viewing areas should have the concurrence of the Alaska Board of Fish and/or the Alaska Board of Game. Under this selection, Bird Island may be totally closed to hunting and trapping. Sheep Mountain, as currently provided for by the Board of Game, will have hunting and/or trapping closures on Dall sheep and mountain goats, but not on small game and fur animals.

The Sheep Mountain Closed Area provides habitat for the only sheep population visible from the road system within the entire upper Susitna and Nelchina basin. Several local lodges along the Glenn Highway have based their businesses on the sheep's visibility, and they have provided telescopes and rooms with a view of the animals. Bus tours now make special efforts to highlight sheep viewing and photography at Sheep Mountain as one of Alaska's featured resource attractions. Local residents and a portion of the tourism trade are supportive in maintaining the Sheep Mountain Closed Area in public ownership. The Board of Game has supported the "closed to sheep and goat hunting" designation for more than 12 years. At the same time, the Board has allowed small game hunting and trapping. Other popular uses of the area include cross country skiing, mountain climbing and berry picking.

Bird Island is unique in that it supports the northernmost known colony of double-crested cormorants in North America and is the largest known herring gull colony in Interior Alaska. Islands are almost exclusively used for nesting by double-crested cormorants and herring gulls because they are free from mammalian predators. Not all islands are suitable as nesting sites for these species, and if Bird Island is unavailable for nesting, the cormorants and gulls will probably not find suitable replacement nest sites in the vicinity.

The greatest threat to the birds of Bird Island is human disturbance. Double-crested cormorants have suffered serious population declines throughout much of their range. Visits to the island during the critical egg-laying, incubation and chick-rearing periods are a source of disturbance and could result in population decline. If the Island's land status changed and it became a private recreational site with a cabin, the birds would abandon this traditional nest site.

These areas are illustrated on Atlas Maps C5 and C6 and represent areas proposed for habitat classification.

Objective 3 - Establish Special Use Areas

Establish and manage special Fish and Wildlife Use Areas legislatively, administratively and/or by municipal ordinance for the purpose of protecting and enhancing fish and wildlife populations and providing opportunities for their continued public use.

Permanent protection is needed to maintain these selected areas in state ownership because they are the principal public use and/or fish and wildlife production lands within the planning area, and are readily accessible to the people of this region. Their close proximity to large population centers gives people at most economic levels an opportunity to use and enjoy fish and wildlife resources. The level of use and production of fish and wildlife in these areas cannot be equalled by other locations within the Susitna planning area or elsewhere in Alaska (D. Bader pers. comm.). Loss of these lands would severely reduce not only local and regional revenues generated by tourism but also food-gathering and recreational opportunities within the entire planning area. The department calls these areas the "priority fish and wildlife lands." These areas are illustrated on Atlas Map C6.

The "priority lands" include the following:

- habitats supporting one or more important life stages of one or more selected high-use species, or populations (e.g. nesting, calving, spawning areas);

- areas having a present or historically high abundance of fish and wildlife species which are used and enjoyed by the public;

- special corridors of land, waterways, and trails supporting extensive public recreation, including hunting, fishing, trapping, and viewing of fish and wildlife;

- areas needing protection to preserve the distribution and abundance of areas where large numbers of birds or mammals congregate, or areas where rare or unusual species are located;

- habitats needing protection and/or restoration to propagate fish and wildlife species that are now or may in the future be threatened or endangered.

Areas meriting special designations which include many of the above values are presented and discussed in terms of two general categories: 1) riverine and riparian areas, which are important not only for fish but also for wildlife (forage, migration corridors, species diversity, etc.) and 2) large upland habitat lands containing a diversity of wildlife species and also key wildlife species.

A. Riverine and Riparian Areas (Areas 1-10 on Map C6)

The Alaska Department of Fish and Game proposes the designation "State Recreational River Corridor" for selected rivers with high biological and recreational values. High biological values include: high numbers of fish and wildlife, high species diversity, and high species productivity. Other values used as selection criteria include high economic values, potential water storage, and maintenance of water quality for people and animals using these corridors.

Riparian lands, more than other lands, are known to be valuable for fish and wildlife. For a more detailed description of these values, refer to Appendix C.

The department has identified selected river corridors where lands and waters have high production of fish and wildlife, and which support extensive public use. The disposal of these corridors into private ownership and their subsequent development may at some future time limit numbers of animals dependent on them.

The Alaska Department of Fish and Game has identified 10 river corridors meriting legislative consideration for special management designation. These areas are discussed separately below.

The department considered all river and waterway areas supporting large populations of sport and/or commercially important fish (including anadromous fish and resident fish), and having high sport fishing values and adequate access, (Atlas Maps B7, B8, C3). The department reviewed Statewide Harvest Studies, Federal Aid in Fish Restoration and Anadromous Fish Studies (see Chapter I), and public use patterns to determine important river corridors (Atlas Maps C1, C2a, C2b, C2c).

In order to be selected, the river corridor had to be highly productive for both fish and wildlife, highly sensitive to surface uses and/or have scarce vegetation or animals within the corridor. High diversity of animal species was also an important selection criterion. The habitat, plant, and animal values had to have regional, state-wide, and/or national importance in order for the river corridor to be selected. Of the hundreds of rivers and streams occurring in the planning area, twenty-seven were initially selected for consideration. From this list, ten rivers were finally selected for proposed legislative designation.

These special management corridors also had to provide one or more elements crucial to the life cycle of one or more fish or wildlife species whose abundance, unique character, quality, or productivity has great public value. River corridors selected could be used either for an entire life cycle of a species or for particular stages of a species' cycle (breeding, nesting, rearing, feeding, migratory concentration, overwintering etc.). In most instances, designated species may be harvested within the special management area. Another consideration was that the potential for alterations to or destruction of the habitat due to incompatible land uses would appreciably decrease the likelihood that the fish or wildlife populations could be perpetuated. Following are the river corridor nominations:

1- Deshka River. This designation includes a one mile corridor on Moose and Kroto creeks and the Deshka River, and a one-half mile corridor on Trapper Creek from Trapper Lake to Moose Creek, the unnamed lake and creek located in Section 1, T. 24 N., R. 7 W., Seward Meridian and the creek originating in Section 29, T. 21 N., R. 6 W. heading north and west to Section 33, T. 23 N., R. 7 W., Seward Meridian. The size of this corridor is approximately 126,474 acres.

   Justification: This system supports large numbers of chinook, pink and coho salmon, rainbow trout, Arctic grayling and Dolly Varden. The Deshka River has the highest number of chinook (king) salmon spawning, production and harvest of any stream in the Susitna planning area. The average escapement for the 1976-1982 period was 25,870 fish (Delaney and Hepler 1983); the highest estimated escapement (39,642) occurred in 1977. Coho and even-year pink salmon escapement has been estimated to be as high as 11,000, and 500,000 fish, respectively (Delaney pers. comm.; King pers. comm.). The Deshka River is also important for its large rainbow trout and Arctic grayling populations; however no population estimates are available.

There are diverse recreational opportunities in this area. The upper portion of the river corridor (Moose Creek) is accessible from the Petersville and Oilwell roads via automobile, trails and nonmotorized boats. Float fishing, hunting and camping are the most popular public uses in this area. These uses become more frequent along the middle and lower portions of the corridor because access to these areas is also available by power boat and aircraft. Areas adjacent to this corridor are heavily used by moose hunters traveling on 3-wheeled ATV's transported into the corridor by power boat.

Sport fishing is the dominant use throughout the entire corridor with most of the activity occurring in the lower portion of the corridor. Sport fishing accounted for more than 19,300 user-days in 1980 (Table 22) and 18,391 user-days in 1982 (Mills 1983). More than one-half of this effort was expended fishing for chinook (king) salmon providing an average harvest of 3,018 fish for the period 1979-1982 (Delaney and Hepler 1982).

The Deshka River has historically been the most important producer of chinook salmon in upper Cook Inlet (UCI). During the 1980 season 55% (4,080) of the total UCI harvest and 16.2% of the statewide harvest was from the Deshka River (Kubik 1980, Chapter I). In addition, more than 32% of all the UCI rainbow trout and 17.4% of all rainbow caught in west side Susitna River drainages in 1980 were caught in the Deshka River (Mills 1981b). More than 13,000 fish of all kinds were caught in the Deshka that year as well (Chapter I).

In 1980, more than 72% of the Deshka River fishing effort came from Anchorage anglers (Appendix A). The amount of money spent to travel to this river by the large number of recreational users of the Deshka represents a considerable economic investment and extensive public interest in the resource. The economic questionnaire sent to the Willow Creek anglers in 1980 (ADF&G 1980) asked the question: What is the smallest dollar amount you would accept to give up your rights to fish pink salmon (This is called "willingness to sell")? The average amount reported was $140.46 per day (Appendix A). Most fishermen would agree that fishing for chinook or rainbow trout has a higher dollar value than fishing for pink salmon. The above fishing-day dollar value derived for pink salmon and applied to all species harvested in the Deshka River yields a minimum of $2,583,199.80, representing anglers' willingness to sell their sport fishing opportunities.

The Kenai Peninsula rivers are considered some of the most important sport fishing stream in Southcentral Alaska. For comparison, the Deshka River, in 1982, provided 56% more sport fishing effort than did the Ninilchik, and 51% more than did Deep Creek (Mills 1982).

The Deshka River pink and coho salmon probably contribute significantly to the upper Cook Inlet commercial salmon gillnet fishery (B. King pers. comm.). However, the net worth cannot be determined.

Wildlife population numbers and game harvest information are not available for the Deshka corridor. However, the upper and lower portions of the corridor are located within moose harvest report code units having the first and eighth highest hunting effort within the Susitna planning area (Peters Hills and Trapper Lake, Chapter I). Separate radio telemetry studies conducted by the Alaska Department of Fish and Game on moose distribution near Trapper Lake and Peters/Dutch Hills indicate high concentrations along and within the corridor. Evaluations of moose habitat suitability and forage production capability (Chapter II, Part 2 and Atlas Maps B9a, B9b, B14a) indicate that 80% of the spring, summer, fall and winter habitat within the corridor is rated as high and/or moderate.

In comparison to the popular Kenai peninsula streams, the Deshka River in 1982 provided 56% more sportfishing effort than did the Ninilchik and 51% more than Deep Creek (Mills 1982).

Moose winter range availability based on estimated snow fall accumulation (Atlas Map B13) indicates that approximately 75% of the corridor's moose habitat would be available during winters of normal snow accumulation. Approximately 60% of the corridor's moose habitat would be available during high snow accumulation (severe) winters which occur once in every ten years.

The number of wildlife species (species richness) in the corridor, as represented by the wildlife diversity model (Atlas Map B11), indicates that approximately 25% of the area is rated as high (67 to 91 species present). The balance of the corridor has a moderate rating (38 to 61 animal species). Public access which includes fishing, hunting and camping activities, has already been reduced as a result of the state's open-to-entry and remote staking land disposal programs along Moose Creek and the Deshka River. Because fish and wildlife values and public use of the resources along the Deshka River are some of the highest in the Susitna planning area, this corridor should be permanently protected from further disposal and retained in public ownership.

2- Lake Creek. This designation includes a one mile corridor on Lake Creek, from Chelatna Lake to the Yentna River, Sunflower, and Camp creeks and a one-half mile corridor on Home, Mills, Yenlo creeks, the unnamed creek flowing from sections 25 and 35, T. 25 N., R. 11 W. (north of Willow Mountain). Shovel Lake and the trail connecting the lake to Lake Creek are included in the corridor. The unnamed lake in Section 23, T. 24 N., R. 10 W., Seward Meridian, and the trail connecting the lake to Lake Creek are also included in the corridor. This corridor is composed of approximately 62,718 acres.

Justification. The Lake Creek system annually ranks as one of the top five streams in the Susitna planning area in terms of fish and wildlife production and harvest. Large runs of spawning chinook (11,000), coho

(4,000), sockeye (23,000), and pink salmon (500,000) have occurred (Delaney pers. comm.). Lake Creek is famous for its large rainbow trout and Arctic grayling; however, no long-term population estimates are available.

Lake Creek is highly rated for its float trip opportunities. It combines Class II and III water with excellent clearwater sport fishing. The entire stream, from its beginning at Chelatna Lake to its confluence with the Yentna River, is floatable, although most floaters take out at Shovel Lake. Access to the upper reaches of Lake Creek is exclusively by aircraft at Chelatna Lake, then by raft to the creek. The lower two miles of the creek, where most of the chinook fishing occurs, can be reached by power river boat from the Yentna River and by trails from Bulchitna Lake (Delaney pers. comm.).

Sport fishing accounted for more than 8,325 user-days in 1980 (Table 22) and 8,649 user-days in 1982 (Mills 1983). In 1982, more than 3,657 user days (43%) were expended fishing for chinook salmon providing a harvest of 1,474 fish; more than 55% of the total fishing effort on Lake Creek was expended fishing for rainbow trout, Arctic grayling and coho salmon. More than 28% of the total rainbow trout and 24% of the total Arctic grayling caught in west side Susitna River drainages in 1982 were caught in Lake Creek (Delaney and Hepler 1983; Mills 1983).

In 1980, more than 75% of the Lake Creek sport fishing effort came from Anchorage anglers (Appendix A). The amount of money spent to travel to this river by the large number of recreational users of Lake Creek represents a considerable economic investment and extensive public interest in the resource. The analysis of the questionnaire mentioned previously (ADF&G 1980) determined the average "willingness to sell" one pink salmon was $140.46 (Appendix A). Most fishermen would agree that fishing for chinook, rainbow trout, Arctic grayling, or coho salmon would have a higher dollar value than fishing for pink salmon. The above fishing-day dollar value derived for pink salmon, and applied to all species harvested from Lake Creek yields, at a minimum, $1,214,838.00, representing the total anglers' willingness to sell their sport fishing opportunities.

More than 26% of the total rainbow trout and 30% of the total Arctic grayling caught in west side Susitna River drainages in 1982 were caught in Lake Creek (Mills 1982).

The Lake Creek pink, sockeye, and coho salmon probably contributes significantly to the upper Cook Inlet commercial salmon gillnet fishery (B. King pers. comm.). However, the net worth is not determinable.

Wildlife population numbers and game harvest information are not available for this corridor. However, since the headwaters and lateral tributaries of the corridor are located in areas historically surveyed for moose, some estimates can be made. It has been estimated that approximately 2,000 moose occur in and around the corridor (Bader 1982). Trophy hunting for moose, black bears and brown bears is known to occur in this general area also.

Evaluations of moose habitat suitability and forage production capability (Chapter II, Part 2 and Atlas Maps B9a, B9b, B14a) indicate that 30% to 40% of the spring, summer, fall and winter habitat within the corridor is rated as high and/or moderate. Moose winter range availability based on estimated snow accumulation (Atlas Map B13) indicates that only 20-25% of the corridor's moose habitat would be available during winters of normal snow accumulation. Theoretically, none of the moose winter range within the corridor would be available during severe winters of high snow accumulation occurring once in every ten years. However, south facing slopes and windswept ridges and troughs along the corridor retain less snow than other areas and would provide some winter range and relief under severe conditions. Sunflower Basin moose are believed to migrate to the Kahiltna River, Peters Creek, Peters Hills area during severe winters (Bader pers. comm.).

The number of wildlife species (species richness) in the corridor, ranges from 38 to 91 species per vegetation type. The wildlife diversity model (Atlas Map B11) indicates that nearly equal amounts of high, moderate and low valued habitats occur.

One of the major conflicts on Lake Creek is between miners and recreationists. Siltation from placer mining activities located on lateral tributaries, specifically Twin Creek (McKay pers. comm.; Delaney pers. comm.), tends to pollute Lake Creek. The siltation problem caused by poor mining practices may reduce fish numbers or may decrease the aesthetic water quality, and thus may limit fishing, floating, camping, and other related recreational opportunities. Mining activities also occur on Home, Mills, Sunflower, and Camp creeks. Poor compliance with water quality standards by any one of the existing or future mining operators could jeopardize water-related public recreation.

Fishermen floating Lake Creek may be faced with access conflicts across or near mining claims located on traditional camp sites at the confluence of Lake Creek and Sunflower, Camp, Home and unnamed creeks. One of the major aircraft pick up points for rafters (Shovel Lake trail) could be unavailable for public use because of conflicts with private property owners. The major access trail from Bulchitna Lake to the most heavily used lower two miles of Lake Creek possibly crosses private land. Public use on lands disposed as past open-to-entry parcels, land trades, and on manufacture sites, is restricted on parts of the mouth of Lake Creek at present (Delaney pers. comm.).

Because Lake Creek is one of the most important recreational corridors in the Susitna planning area, and due to the fact that public access and recreational opportunities have already been adversely affected by mining and land disposal activities, the Lake Creek corridor should be set aside to protect fish and wildlife resources and public use for present and future generations.

3- <u>Talachulitna River</u>. This designation includes a one mile corridor on the Talachulitna River, Talachulitna Creek, Judd Lake, and a one-half mile corridor on Thursday, Friday, Saturday creeks and the creeks from Hiline and Trinity lakes, and the unnamed creek flowing from Section 6, T. 17 N., R. 12 W., Seward Meridian. The size of this corridor is approximately 81,036 acres.

<u>Justification</u>. The Talachulitna River system annually ranks as one of the top five streams in the Susitna planning area in terms of fish and wildlife production. Large runs of spawning chinook (10,000), pink (500,000), sockeye (26,000), chum (10,000) and coho (4,000) salmon have been known to occur (King pers. comm.; Delaney pers. comm.). The Talachulitna is famous in southcentral Alaska for its large rainbow trout, abundant Dolly Varden and Arctic grayling; however, no population estimates are available.

The Talachulitna, a pristine, clear water stream, is renowned for its fishing opportunities. It receives special consideration from the Alaska Board of Fisheries, which instructs the department to manage the Talachulitna as a "catch and release" trophy rainbow trout fishery. This fishery is one-of-a-kind within the Susitna planning area. Even though active sport fishing exists for each salmon species, access and distance from Anchorage limits public use to mostly those people looking for a high quality float fishing experience. Sport fishing on Judd Lake and the Talachulitna accounted for 3,356 user-days in 1980 (Table 23). More than half of this effort was expended fishing for rainbow trout and Arctic grayling. More than 21% of all the Arctic grayling caught in west side Susitna River drainages in 1980 were caught in the Talachulitna system (Mills 1981b).

In 1980, more than 63% of the Talachulitna sport fishing effort came from Anchorage anglers; 21% of the effort was from non-residents (Appendix A). The amount of money spent to travel to this river by the large number of recreational users of the Talachulitna represents a considerable economic investment and extensive public interest in the resource. Refer to the economic analysis and the public's "willingness to sell" or dollar value of one pink salmon fishing day ($140.46, Appendix A). The above fishing-day value derived for pink salmon, and applied to all species harvested from the Talachulitna, yields at a minimum, $471,383.00, representing the total anglers' willingness to sell their sport fishing opportunities.

The Talachulitna River pink, sockeye, chum and coho production probably contributes significantly to the upper Cook Inlet commercial salmon gill net fishery (B. King pers. comm.). However, the net worth is not determinable.

Wildlife population numbers are not available for the Talachulitna corridor. However it has been estimated that approximately 2,500 moose occur in and around the corridor (Bader 1982). Trophy hunting for moose, black bears and brown bears is also known to occur in this general area.

Most of the moose hunting in this general area occurs within the proposed Talachulitna River corridor. This corridor is located completely within one harvest report code unit (16-02-011). In 1981, approximately 293 user-days were reported by moose hunters in this area (Table 2). This amounted to more than 51 hunters harvesting 16 moose (Data Supplement A). However, for every hunter reporting, there are 2.63 hunters not reporting their moose harvest tickets (Chapter I). Based on this information it is estimated that 134 hunters expended 770 user-days to harvest 42 moose. (Table 2 includes proportional adjustments in the statistical figures to compensate for reported effort from unspecified areas within the Susitna planning area.) The economic activity and value associated with moose hunting within this corridor in 1981 includes an estimated total expenditure of $ 31,758 by hunters and $77,800 as the value for moose meat (Appendix B).

Evaluations of moose habitat suitability and forage production capability (Atlas Maps B9a, B9b, B14a) indicate that nearly equal amounts of high, moderate and low valued habitats occur. Moose winter range availability based on estimated snow accumulation (Atlas Map B13) indicates that, theoretically, none of the moose habitat would be available during normal snow accumulation or during severe winters of high snow accumulation occurring once in every ten years. However, south facing slopes, windswept ridges and troughs along the corridor retain less snow than other areas and thus provides some relief under these conditions.

The migrational direction of moose occupying this area is unknown. However, it is believed that certain segments of this moose subpopulation move to the Susitna Flats State Game Refuge and the Susitna and Skwentna River floodplains (Bader pers. comm.).

The number of wildlife species, or wildlife richness, of the corridor ranges from 1 to 91 species per vegetation type. The wildlife diversity model (Atlas Map B11) indicates that approximately 45% of the habitat within the corridor has a high diversity of animals (67 to 91 species), 45% of the habitat has a moderate diversity of animals (36 to 61 species), and 10% of the habitat has a low diversity of animals (1 to 31 species).

Very few conflicts currently exist within the proposed Talachulitna River corridor. Existing private lands are limited to a few open-to-entry parcels along the upper stretches of the river and near the mouth; one private commercial lodge is located at Judd Lake and at least three others are located on the lower one mile of the river. Lodges provide accommodations and support for more than 60% of the recreational activities occurring on the Talachulitna (Delaney pers. comm.).

Long term protection is needed to maintain the extensive fish and wildlife resources and recreational opportunities for public use in the Talachulitna corridor.

4- Alexander Creek. This designation includes a one mile corridor on Alexander Creek from the Susitna River to Alexander Lake, lower Sucker Creek to Sucker Lake and Wolverine Creek; and a one-half mile corridor on Granite, Pierce and Trail creeks. Alexander Lake is included in the corridor. The size of this corridor is approximately 27,078 acres.

Land ownership within the Alexander Creek corridor includes Matanuska-Susitna Borough lands along the lower eight to ten miles of the creek, scattered open-to-entry parcels and private commercial recreational (lodge) property on Alexander Lake.

Justification. The Alexander Creek system annually ranks as one of the top five streams in the Susitna planning area in terms of fish and wildlife production and harvest. Large runs of spawning chinook (10,000), pink (250,000 even year), sockeye (5,000) and coho (5,000) have occurred (Delaney pers. comm.; Hepler pers. comm.). Alexander Creek is well known for its abundant rainbow trout and Arctic grayling; however no long-term population estimates are available.

Alexander Creek has good float trip opportunities for all kinds of recreation, including hunting and fishing. The entire system is floatable from Alexander Lake to its confluence with the Susitna River. The lower twenty-five (25) miles are accessible to power boats coming from Anchorage and/or Susitna Landing.

Sport fishing on Alexander Creek accounted for more than 10,748 user-days in 1982 (Mills 1983). More than 44% of the total fishing effort on Alexander Creek was expended fishing for chinook salmon providing a harvest of 1,474 fish (Delaney and Hepler 1982); more than 55% of the total fishing effort was expended fishing for rainbow trout, Arctic grayling and coho salmon. Approximately 21% of the total rainbow trout and 24% of the total Arctic grayling caught in west side Susitna River drainages in 1982 were caught in Alexander Creek; an estimated 9,600 fish of all kinds were caught in Alexander Creek in 1982 (Mills 1983).

In 1980, more than 71% of the Alexander Creek fishing effort came from Anchorage anglers (Appendix A). The amount of money spent to travel to this river by the large number of recreational users of Alexander Creek represents a considerable economic investment and extensive public interest in the resource. The economic analysis conducted on the Willow Creek sport fishery (ADF&G 1980) found the "willingness to sell" or dollar value of one pink salmon fishing day to represent economic importance of that fishery (Appendix A). The fishing-day value derived for pink salmon from the Willow Creek study, when applied to all species harvested from Alexander Creek, indicates that, at a minimum, $1,509,660. represents the net market value of fishermen's willingness to sell their sport fishing opportunities in 1982.

The Ninilchik River and Deep Creek on the Kenai Peninsula are good examples of some of the most heavily used recreational fishing streams in Southcentral Alaska (Bader pers. comm.). In comparison, the fishing effort (angler-days) on Alexander Creek (10,748), even though access is limited to boat and aircraft, was nearly equal to that of Ninilchik River (11,806 days) and Deep Creek (12,149 days) in 1982 (Mills 1983). Alexander Creek has the potential to provide recreational opportunities equal to or greater than those in the Ninilchik River, Deep Creek and even Anchor River combined because it has more fishable stream miles, in addition to a much higher escapement of chinook, coho, and other fish (two to four times larger than that on the Anchor and Ninilchik rivers or Deep Creek), (Delaney and Hepler 1983; Hammerstrom and Larson 1983).

Alexander Creek's pink, sockeye, and coho salmon contribute significantly to the upper Cook Inlet commercial salmon gillnet fishery (B. King pers. comm.). However, the net worth is not determinable.

Wildlife population numbers and game harvest information are not directly available for the Alexander River corridor. However, the department suspects that major portions of the Mount Susitna moose subpopulation (estimated in size to range from 3,000 to 5,000 animals), winter within the corridor (Bader 1982). Hunting for moose, black and brown bears commonly occurs along Alexander Creek. Trapping for coyotes, martins, mink, wolverines and beavers by local and other residents is common as well.

The harvest and user-day statistics for moose in the Alexander Creek corridor can be derived from the statistics available from the moose harvest report code unit # 16-02-012 (Mount Susitna/Alexander Creek). It is the fourth most intensively hunted moose harvest report code unit in the Susitna planning area. This unit includes Mount Susitna as well as the Alexander Creek corridor and accounts for more than 1,185 user-days reported. However, for every hunter reporting, there are 2.63 not reporting their moose harvest tickets. Based on this information, it is estimated that 3,116 user-days occurred in this unit in 1981. Other statistics indicate that moose hunters using boats accounted for 32.8% of the user-days and these hunters probably used Alexander Creek.

The economic value associated with moose hunting in the Alexander Creek corridor in 1981 includes an estimated total expenditure of $44,793 by hunters for travel, equipment, etc., and $131,520 as the replacement protein value of moose meat (Appendix B; Table 31).

Moose habitat suitability and forage production capability evaluations (Atlas Maps B9a, B9b, B14a) indicate that more than 90% of the spring, summer, fall and winter habitat within the corridor is rated as high and/or moderate value for moose.

Availability of moose winter range, based on estimated snow accumulation (Atlas Map B13), indicates that all of the moose habitat in the corridor would be available during winters of normal snow accumulation. Theoretically, none of this habitat would be available during severe winters of high snow accumulation occurring once in every ten years. Under these conditions, moose that don't migrate to the Susitna River flood plain would be placed under serious physiological stress and could starve to death.

The number of wildlife species (species diversity, or species richness) occurring in the corridor ranges from 38 to 91 species per vegetation type. The majority of the habitat in the Alexander Creek corridor is rated as either high or moderate for wildlife diversity (Atlas Map B11, and Chapter II Part 2).

Potential conflicts in the Alexander Creek corridor include those between interests of habitat protection and coal mining. There is a moderate probability that mineable coal will be available in this corridor.

Public access and recreational opportunities along the Alexander Creek corridor have already been adversely affected by public land allocations for past municipal entitlement and state land disposal programs. Because fish and wildlife values and public use of these resources are some of the highest in the Susitna planning area, this corridor should be permanently protected from further disposal and retained in public ownership.

5- Montana Creek. This includes a one mile corridor on Montana Creek, and its South, Middle and North Forks. The size of this corridor is approximately 125,698 acres.

Justification. Montana Creek is a popular sport fishing stream within the Susitna planning area (Mills 1983). Over 14,000 fish were caught there in 1980, and almost 26,000 angler-days were spent there in 1978 (Chapter I). Spawning runs of chinook (1,400) chum (1,500) and pink salmon (10,000 to 50,000) are believed to have occurred (D. Watsjold pers. comm.). Montana Creek is well known for its abundant rainbow trout; however no population estimates are available. Anglers at the mouth of Montana Creek intercept many fish bound for upper Susitna waters. More than 30% of the total coho, 24% of the total pink salmon and 29% of the total rainbow trout caught in east side Susitna River drainages in 1982 were caught in Montana Creek (Mills 1982).

Access to the most popular salmon fishing areas on Montana Creek is below the Parks Highway. Until recently, public use has occurred completely on privately owned land. Access to fishing on Montana Creek has been blocked in the past by private individuals. As a result of this, the Department of Fish and Game and Division of Parks acquired $400,000 to purchase and develop property along Montana Creek for public sport fishing access.

In the easily accessible fishing spots close to the roads, during the chinook open season, one can often find two and three tiers of fishermen, standing shoulder to shoulder, bank fishing on a typical summer weekend. The use on Montana Creek is high, but the catch is low (e.g. 897 user-days for chinook, and 85 fish caught), (Bentz 1983). More than 30% of the total coho, 24% of the total pink salmon and 29% of the total rainbow trout caught in east side Susitna River drainages in 1982 were caught in Montana Creek. In 1980, more than 68% of the Montana Creek sport fishing effort came from Anchorage anglers (Appendix A). The economic analysis conducted on the Willow Creek sport fishery (ADF&G 1980) used "willingness to sell" or dollar value of one pink salmon fishing day to represent economic importance (Appendix A). The fishing-day value derived for pink salmon from the Willow Creek study, when applied to all species harvested from Montana Creek indicates that, at a minimum, an estimate of $3,320,047 represents the net market value of fishermen's willingness to sell their sport fishing opportunities in 1982.

The Anchor River is the third most popular river on the Kenai Peninsula (Mills 1982). In comparison, fishing effort on Montana Creek, in 1982 (23,645), was nearly equal to the effort expended on the Anchor River in that year (24,709). In comparison to other rivers on the Kenai, Montana Creek provided 95% more sport fishing effort than Deep Creek and over 100% more than did the Ninilchik River in 1982.

Pink salmon production from Montana Creek contributes significantly to the upper Cook Inlet commercial salmon gillnet fishery (B. King pers. comm.). However, the net worth is not determinable.

Wildlife population numbers are not available for the Montana Creek corridor. However, the department believes that the corridor provides habitat for large numbers of moose. It is suspected that Montana Creek corridor is an important part of the moose range occurring on the western slopes of the Talkeetna Mountains for the 5,000 to 6,000 moose estimated there (Bader 1982). It is possible that approximately 800 to 1,000 moose occupy the Montana Creek corridor.

The Montana Creek corridor makes up the major portion of the moose harvest report code unit #14-02-014. In 1981, this unit accounted for an estimated 472 user-days reported (Chapter I). However, for every hunter reporting, there are 2.63 not reporting their moose harvest tickets. Based on this information, it is estimated that 1,241 user-days occurred in this unit in 1981. Based on department estimates, approximately 153 hunters harvested 24 moose (Data Supplement A). Most of this effort occurred within the Montana Creek corridor, which is the twelfth highest hunting effort of any single reporting unit in the Susitna planning area (Table 2). The economic value associated with moose hunting in the Montana Creek harvest report code unit in 1981 includes an estimated total net expenditure of $36,261 by hunters for travel, equipment, etc. and $44,457 as the replacement protein value of moose meat (Appendix B; Table 31).

In addition to hunting for food, trophy hunting for moose, and black and brown bears is known to occur throughout the corridor, but especially in the upper portions, because better visibility and access exist there (D. Bader pers. comm.). Large numbers of moose located in the riparian habitat attract hunters to trails accessing the lower reaches, and to bush airstrips accessing alpine areas.

Suitability and forage production capability evaluations of moose habitat (Atlas Maps B9a, B9b, B14a) indicate that more than 50% of the corridor is highly rated for spring, summer, fall and winter habitat. Much of this is located along the riparian areas in the lower and middle portion of the corridor. The balance of the corridor is of moderate value. The model of moose winter range availability based on estimated snow accumulation (Atlas Map B13) indicates that, theoretically, approximately 58% of the moose habitat within the corridor would be available during years of normal snow accumulation. Approximately 24% of the moose habitat would be available during severe winters of high snow accumulation which occur once in every ten years. However, south facing slopes, windswept ridges, and troughs along the alpine portions of the corridor retain less snow than other areas and thus provide some relief under severe and normal snow accumulations.

The migrational corridors of moose occupying this general area have been examined as a result of Susitna Hydroelectric downstream big game studies (Modafferi pers. comm.). These studies generally indicated that, under winter conditions, portions of this moose subpopulation move to the floodplain and adjacent upland habitats along the Susitna River. Other segments of the subpopulation utilize habitats within the corridor.

The number of wildlife species (species diversity or richness) occurring in the corridor ranges from 38 to 91 species per vegetation type. The majority of the habitat in the Montana Creek corridor was rated as approximately 70% high and 30% moderate for wildlife diversity. Long term protection is needed to maintain the important values associated with this diversity.

6- Chunilna Creek (Clear Creek). This designation includes a one mile corridor on its main stem to its headwaters including the creeks from Sockeye, and Mama Bear, Papa Bear lakes; a one-half mile corridor on the creeks from the unnamed lakes located in Section 33, T. 30 N., R. 2 W., and Section 23, T. 30 N., R. 3 W., Seward Meridian; on the north and middle forks of Chunilna Creek, and the unnamed creek located in Section 33, T. 28 N., R. 3 W., Seward Meridian. The size of this corridor is approximately 68,076 acres.

Justification. Chunilna Creek ranks as one of the more important fish and wildlife systems in the Susitna planning area in terms of production and harvest. Large runs of spawning chinook (2,000), pink (up to 250,000 in even-year), sockeye (5,000 to 10,000), coho (2,500), and chum (7,500) salmon have been known to occur (King pers. comm.; Watsjold pers. comm.). This creek is also well known for its abundant rainbow trout, Arctic grayling and Dolly Varden; however no population estimates of these species are available.

Chunilna Creek is highly rated as a sport fishing stream by fishermen using power boats and now by residents of recently established Chase I and II communities (D. Bader pers. comm.). Access to this corridor is primarily by the Alaska Railroad, local roads, and power boat up the creek.

Chunilna Creek has more than twenty miles of fishable stream and large populations of a variety of fish species. With the advent of recent and proposed road construction for the Chase I, II, and III state subdivisions, the potential is high for sport fishing effort to exceed that in many other streams in the Susitna planning area or on the Kenai Peninsula. This creek system has an estimated potential to provide as much as 50,000 user-days of sport fishing.

Sport fishing on this stream accounted for approximately 5,125 user days in 1978 (Chapter I). A five year average yields 4,260 user-days of fishing effort (Chapter I). More than 47% of the total fishing effort on Chunilna Creek in 1982 was expended fishing for chinook salmon providing a harvest of 792 fish (Delaney and Hepler 1982). In 1983, more than 2,800 user-days were expended fishing for chinook salmon providing a harvest of 1,000 fish (Hepler 1983). The 1983 total number of angler days (sport fishing effort) for Chunilna Creek is not yet available. However, during the past four years (1979-82) the average chinook fishing effort in Chunilna accounted for 30% of the total sport fishing effort in the state (Delaney and Hepler 1982). Based on this average, it is estimated that approximately 9330 total user-days of effort was expended in 1983. In 1982, more than 26% of the total Dolly Varden caught in east side Susitna River drainages were caught in Chunilna Creek (Mills 1982); approximately 10,430 fish of all kind were caught in Chunilna Creek in 1978.

In 1980, more than 59% of the sport fishing effort on the Chunilna came from Anchorage anglers (Appendix A). The amount of money spent to travel to this creek by the large number of recreational users of the Chunilna represents a considerable economic investment and extensive public interest in the resource. The economic analysis conducted on the Willow Creek sport fishery (ADF&G 1980) used "willingness to sell" or dollar value of one pink salmon fishing day to represent economic importance (Appendix A). The above fishing-day dollar value derived for pink salmon and applied to all species harvested from Chunilna Creek yields a minimum of $1,310,491, representing anglers' willingness to sell their sport fishing opportunities.

Chunilna Creek's sockeye, pink, coho and chum salmon production probably contributes significantly to the upper cook Inlet commercial salmon gillnet fishery (B. King pers. comm.), however, the net worth is undeterminable.

The most prominent conflict on Chunilna Creek is associated with water pollution from extensive placer mining activities located on the main channel and lateral tributaries. The siltation problem caused by poor mining practices has resulted in poor fishing at times when the normally clear stream becomes turbid. Conflict over access has occurred within the corridor near the headwaters where most mining activities are located.

Wildlife population numbers are not available for the Chunilna Creek corridor. However, the department suspects that 400 to 500 moose occupy the general area (Bader 1982). Consumptive uses along this corridor include hunting for moose, black and brown bears, and trapping for mink, marten, wolverines, beavers and coyotes.

Suitability and forage production capability evaluations of moose habitat (Atlas Maps B9a, B9b, B14a) indicate that approximately 25% to 30% of the corridor is highly rated for spring, summer, fall, and winter habitat. Much of this habitat is located along the riparian areas in the lower and alpine portions of the corridor. The number of wildlife species (species diversity or richness) occurring in the corridor ranges from 61 to 91 species per vegetation type over much of the area. This means the corridor has mainly high rated habitat (90%) for total number of species, and thus is probably quite productive and stable.

Moose winter range availability based on estimated snow accumulation (Atlas Map B13) indicates that, theoretically, approximately 5% of the moose habitat in the corridor would be available during years of normal snow accumulation. Very little moose habitat would be available during severe winters of high snow accumulation which occur once in every ten years. However, south facing slopes, windswept ridges, and troughs along the creek and alpine portions of the corridor retain less snow than other areas and thus provide some relief during severe winter conditions.

The exact migrational corridors of moose occupying this general area are not known. However, it is estimated that certain segments of this moose subpopulation move to the Susitna and Talkeetna River floodplains (Modafferi pers. comm.).

Extensive open-to-entry privately owned parcels and state subdivisions are scattered throughout the Chunilna corridor area. Trespass and conflicts on resource use have occurred in the past (D. Bader pers. comm.). Extensive placer gold claims exist throughout the system, the presence of which may cause future conflict with public recreational use within the corridor.

Long term protection is needed to maintain the extensive fish and wildlife resources and public uses remaining on public lands in this corridor.

7- Peters Creek. This designation includes a one mile corridor on Peters, Martin, Big, String, South Fork, Lunch Gulch, Sand, and Black creeks, and the unnamed creeks located in sections 12 and 22, T. 27 N., R. 9 W., and Section 29, T. 28 N., R. 9 W., and Section 6, T. 29 N., R. 8 W., Seward Meridian. The size of this corridor is approximately 54,060 acres.

Justification. The Peters Creek watershed ranks as one of the more important fish and wildlife production and harvest systems in the Susitna planning area. It is believed to be the fifth most important west side Susitna river for chinook salmon production (K. Hepler pers. comm.). No population estimates are available, however, for resident fish species. Peters Creek supports large numbers of spawning chinook (6,000), coho (2,000), and pink (11,000) salmon (Delaney pers. comm.; Hepler pers. comm). Peters Creek is also becoming well known for its rainbow trout, Arctic grayling and Dolly Varden.

The Peters Creek system is readily accessible by road and trail. ATV trails extend from the bridge at Peters Creek to Shulin Lake and to the Kahiltna River/Peters Creek confluence, and cross country to the Kahiltna River flats. The entire length (approximately 36 miles) of this creek is floatable and is crystal clear, except near placer mining operations.

Prior to 1983, most of the sport fishing effort was for rainbow trout, Arctic grayling, and coho salmon (Kubik pers. comm.). This system was opened in 1983 for the first time in many years to chinook salmon fishing. On the Peters Creek system, total angler days for all fish species were 1,000 (Hepler pers. comm.).

The amount of money spent to travel to this creek by the fairly large numbers of recreational users of Peters Creek represents a considerable economic investment and an extensive public interest in the resource. The economic analysis conducted on the Willow Creek sport fishery (ADF&G 1980) used "willingness to sell" or dollar value of one pink salmon fishing day to represent economic importance (Appendix A). Applying the above fishing-day value derived for pink salmon to all fish species harvested from Peters Creek yields a minimum of $140,460.00, representing anglers' willingness to sell their sport fishing opportunities. By applying this assessment to the recreational potential if Peters Creek were made more accessible in the future, the net projected worth of this system could range from $702,300 to $1,404,600.

Peters Creek has the potential ability to exceed many high use fishing streams on the Kenai Peninsula, except the Kenai River in providing sport fishing recreation. It has 4 to 5 times more fishable stream miles; it has more than double the salmon population of Deep Creek, Ninilchik and Anchor rivers (Delaney and Hepler 1982; Hammerstrom and Larson 1982); it is floatable, and it has relatively good road access. This stream has the potential to provide as much as 50 to 100,000 user-days of sport fishing (D. Bader pers. comm.).

Peters Creek salmon production probably contributes fish to the upper Cook Inlet commercial gillnet fishery (B. King pers. comm.; D. Bader pers. comm.). However, the net value is not known.

Estimates of moose population numbers range from 3,000 to 5,000 moose for the larger Peters Creek/Peters Hills upland moose management nomination area (Bader 1982). The Peters Creek corridor is an important part of this area and may provide habitat for a thousand or more moose.

Because of the road access, the Peters Creek watershed is the most intensively hunted unit for moose within the Susitna planning area. The Petersville/Peters Creek harvest report code unit for moose (16-01-002) accounted for an estimated 3,937 reported user-days (Table 2).

However, for every hunter reporting, there are 2.63 hunters not reporting their moose harvest tickets (Chapter I). Based on this information, it is estimated that 10,354 user-days occurred in this reporting code unit in 1981. This is more than double the effort for any other single reporting unit in the Susitna planning area. Using the 5.4 user-day average per hunter (Chapter I) and the 17.5% success of hunters within this code unit (Data Supplement A), an extrapolation of approximately 1,917 hunters and 336 moose harvested can be made for 1981. The economic value associated with moose hunting in the Petersville/Peters Creek reporting unit includes an estimated total expenditure of $454,329 by hunters on recreational equipment, travel, etc. and $622,406 as the protein replacement value for moose meat (Appendix B; Chapter I, Table 31).

Other consumptive activities in this area include hunting for black and brown bears, and small game, and trapping of various other animals. However no harvest or population information is available to assess levels of effort or numbers of animals harvested.

Moose habitat evaluations (Atlas Maps B9a, B9b, B14a) indicate that more than 80% of the corridor's vegetation is highly suitable as spring, summer, and fall habitat. More than 50% of the habitat in the Peters Creek corridor is rated as having a high forage production capability.

Moose winter range availability based on estimated snow accumulation (Atlas Map B13) indicates that none of the moose winter range within the corridor would be available during winters of normal or severe snow accumulation. Perhaps some south facing slopes, windswept ridges, and troughs along the corridor retain less snow than other areas, and would provide some winter range and relief under normal conditions.

Some migration corridors for moose in the Peters Creek corridor and adjacent Petersville areas were located during moose studies in the lower Susitna Valley (Didrickson and Taylor 1978) and recent Susitna Hydroelectric big game studies (Modafferi 1982). During both of these studies the Peters Creek corridor was identified to be important for spring, summer, fall and early winter foraging habitat, although most of the high value winter habitat for moose is located outside of the corridor boundary (but within the larger Petersville/Peters Creek upland legislative nominative wildlife area. The corridor was also identified as an important moose calving area.

The number of wildlife species (species diversity or richness) in the corridor can include up to 91 species per vegetation type (Chapter II, Part 2, Atlas Map B11). An analysis of the distribution of wildlife diversity indicated that approximately equal portions of high, moderate, and low rated habitats occur in the corridor.

Access to the Peters Creek corridor has not been a problem in the past. However, a recent state disposal near Peters Creek was located directly in a major public hunting area. At present, there are some conflicts between new land owners and hunters.

Placer gold mining claims exist throughout the watershed. Public access has not yet been denied by miners in the area, although it has been denied in the neighboring Cache Creek drainage north of the Peters Hills. The flow of sediments from mining activities in Peters Creek makes the area less attractive for sport fishing. In addition, the sediment contaminates fish spawning and rearing habitats and the drinking water of the local residents.

Long term protection is needed for the Peters Creek corridor to protect the extensive fish and wildlife resources and public recreational uses.

8- Sheep Creek. This designation includes a one mile corridor on Sheep Creek from its headwaters to its confluence with the Susitna River and on Goose Creek from the Susitna River to its connection with Sheep Creek. The size of this corridor is approximately 22,172 acres.

Justification. The Sheep Creek watershed ranks as one of the more important fish and wildlife production and harvest systems in the Susitna planning area. It is considered the third most important east side Susitna River sport fishing stream (Chapter I). Sheep Creek supports large numbers of spawning chinook (2,000), and pink (50,000 to 100,000) salmon (Bentz 1983; Watsjold pers. comm.). This creek is known for its rainbow trout, Arctic grayling, pink, red, silver, and coho salmon. No long-term population estimates are available however for resident fish species.

Most of the sport fishing for salmon on Sheep and Goose creeks occurs below the Parks Highway. Very little public access or land is available to accommodate public use. No boat access exists to Goose

Creek. Because of private ownership surrounding most of the area, the only publicly owned fishing area is immediately below the highway bridge. Until the recent purchase of five acres at the mouth of Sheep Creek by the Division of Parks for $30,000, most fishing on this creek was in trespass on private land. There are several trails and roads to Goose and Sheep Creek which go through private land, and are often blocked. The Division of Parks is attempting to acquire additional funds to purchase more land near Goose and Sheep creeks in an attempt to provide more public access. The available Matanuska-Susitna Borough lands located on Sheep and Goose creeks could satisfy a significant portion of the future demand for sport fishing, camping space and access.

Sport fishing accounted for almost 12,000 user-days in 1978 and 9,090 user-days in 1982 (Chapter I, Mills 1982). A five-year average was over 8,330 angler days (Table 22). Sheep Creek is ranked as the second most important chum salmon fishery in the Susitna planning area in 1982 (Mills 1983). More than 26% of the total chum salmon caught in east side Susitna River drainages were caught at the confluence of Sheep creek and the Susitna River. More than 16.9% of the total pink salmon caught in east side Susitna River drainages were caught in Sheep Creek. More than 10,430 fish of all kinds (including coho salmon, rainbow trout, Dolly Varden and Arctic grayling) were caught in Sheep Creek in 1978, with a 5 year average of 6,950. In 1980, more than 77% of this creek's sport fishing effort came from Anchorage anglers (Appendix A).

The amount of money spent to travel to this stream by the fairly large number of recreational users of Sheep Creek represents a considerable economic investment and extensive public interest in the resource. The economic analysis conducted on the Willow Creek sport fishery (ADF&G 1980) used the public's "willingness to sell," or dollar value of one pink salmon fishing day, to represent economic importance (Appendix A). Applying this fishing-day value to all species harvested from Sheep Creek, yields approximately a minimum of $1,276,781 representing anglers' willingness to sell their sport fishing opportunities.

Sheep and Goose creeks could provide substantially greater sport fishing opportunities if more land and access were purchased below the highway. The level of effort could potentially exceed any stream on the Kenai peninsula except the Kenai and Russian rivers (D. Bader pers. comm.) If access and camping sites were acquired, sport fishing effort could theoretically approach 25,000 to 50,000 user-days.

Wildlife population numbers are not available for the Sheep-Goose Creek corridor. However, the department suspects that the corridor provides habitat for large numbers of moose from the western slopes of the Talkeetna Mountains. It is estimated that the Sheep Creek corridor probably supports approximately 500 to 1,000 moose (D. Bader pers. comm.). This corridor is located within the 14-02-011 moose harvest reporting code unit. In 1981, this reporting unit accounted for an estimated 224 user-days as reported on harvest tickets returned

(Chapter I, Table 2). However, for every hunter reporting, there are 2.63 hunters not reporting their harvest tickets (Chapter I). Based on this information it is estimated that approximately 589 user-days were spent in this corridor by 107 hunters who theoretically harvested 16 moose in 1981 (Data Supplement A). The economic value associated with moose hunting in the Sheep Creek area in 1981 includes an estimated total expenditure of $25,359 on recreational equipment, travel, etc. by hunters and $29,638 as the replacement protein value for moose meat (Appendix B; Table 31, and Chapter I).

Other consumptive activities in this area include trophy hunting for moose and black and brown bears in the upper portions only because of better access there.

Evaluations of suitability and forage production capability of moose habitat (Atlas Maps B9a, B9b, B14a) indicate that more than 30% of the corridor is highly rated spring, summer, fall habitat. More than 50% of the area is highly rated and 45% is moderately rated for wildlife diversity (Atlas Map B11). Moose winter range availability based on estimated snow accumulation (Atlas Map B13b) indicates that, theoretically, more than 50% of the moose habitat in the corridor would be available during years of normal snow accumulation. Only 5% to 10% would be available during severe winters of high snow accumulation occurring once in every ten years. However, south facing slopes, windswept ridges and troughs along the alpine portions of the corridor retain less snow than other areas and thus could possibly provide some relief under severe and normal snow accumulations.

Some migration corridors for moose in the Sheep/Goose Creek corridor have been studied during the Susitna Hydroelectric big game studies. These studies indicated that in winter, portions of this moose subpopulation move to the flood plain and adjacent upland habitat along the Susitna River, while other segments of the subpopulation utilize habitats within the corridor.

Conflict exists in the area between the high demand for public use of fish and wildlife resources and the private ownership of lands surrounding public waters. The Division of Parks and ADF&G have recognized this conflict for many years, and they have purchased five acres of land in the area in an attempt to satisfy the high public demand. The remaining public lands along Sheep and Goose creeks should be permanently protected for public use so future buy back situations can be avoided.

9- Chuitna River. This designation includes a one mile corridor on the Chuitna River from Cook Inlet to its headwaters, Chuit and Lone creeks; and a one-half mile corridor on the unnamed tributaries in sections 5, 6 and 13, T. 12 N., R. 12 W., Seward Meridian. The size of this corridor is approximately 30,394 acres.

Justification. The Chuitna River watershed is an important fish and wildlife production and recreational use system in the Susitna planning area. This river supports large numbers of spawning chinook (7,500), pink (20,000 even-year), and coho (1,800) salmon (King pers. comm.). This river is also known for its resident populations of rainbow trout and Dolly Varden, although no population estimates are available for these resident species.

Most of the sport fishing on the Chuitna River occurs on its lower two miles, although the entire river provides excellent sport fishing. There are three main salmon fishing areas, and all are accessible. They are located at 1) the mouth of the river where roads from Tyonek and the Beluga airstrip converge (accessible via float or wheel planes) 2) the washed out Chuitna River bridge where roads from the Beluga airstrip and Tyonek converge, and 3) the "upper hole," approximately seven miles up river where access is by road, trail, and super cub airstrips on two wide spots on a road paralleling the river. A cable car also crosses the river at this hole providing access to the other side. However, the lands on the south side of the river are privately owned by the Tyonek Village Corporation and are not open to public fishing. The north side of the river is mainly in public ownership, and should remain so if public recreational opportunities are to be maintained.

Sport fishing along the Chuitna accounted for approximately 3,100 user-days in 1983 (Hepler pers. comm.). More than 76% of the effort in 1983, was spent fishing for chinook salmon, providing a harvest of 1,052 fish (Hepler 1983). The Chuitna River ranks as the fourth most important chinook salmon harvest stream within the Susitna planning area. In 1983 more than 2,000 fish of all species were caught in the Chuitna River. More than 72% of the sport fishing effort, in 1980, came from Anchorage anglers (Appendix A). The amount of money spent to travel to this river by the fairly large number of recreational users of the Chuitna represents a considerable economic investment and extensive public interest in the resource. The economic analysis conducted on the Willow Creek sport fishery (ADF&G 1980) used the public's "willingness to sell," or dollar value, of one pink salmon fishing-day to represent economic importance (Appendix A). The "willingness to sell" one chinook salmon fishing day is probably much higher. The above fishing-day dollar value derived from the Willow Creek study, applied to fishing on the Chuitna River in 1983 yields a minimum of $435,426 representing anglers' willingness to sell their sport fishing opportunities.

The Chuitna River has salmon populations two to three times larger than the Anchor or Ninilchik rivers or Deep Creek on the Kenai Peninsula (Hammerstrom and Larson 1983; Delaney and Hepler 1983). The Chuitna has at least twice the fishable river miles as do Kenai Peninsula rivers, and the area has reasonably good access. Once the road from Anchorage is constructed to this area, fishing effort may reach as high as 50,000 user-days (D. Bader pers. comm.).

Chuitna River salmon production contributes an unknown number of fish to the upper Cook Inlet commercial and subsistence gillnet fishery.

Wildlife population numbers are not available for the Chuitna corridor. Population estimates for moose have been suggested at 500 to 800 moose (D. Bader 1982). The entire Chuitna corridor is located within a moose harvest report code unit ranked seventeenth highest within the Susitna planning area with respect to user-days (Chapter I, Table 2; Atlas Map C2a). As reported on harvest tickets, 49 moose hunters expended 381 user-days harvesting 10 moose (Chapter I and Data Supplement A). However, for every hunter reporting, there are 2.63 hunters not reporting their harvest tickets (Chapter I). Based on this information, it is estimated that approximately 129 hunters expended 876 user-days to harvest 26 moose in 1981.

Local subsistence users take about 20% of the total moose harvest from the Chuitna corridor (Foster pers. comm.).

The economic value associated with moose hunting in the Chuitna area includes an estimated total expenditure of $30,573 by hunters for travel, recreational equipment, etc. and $48,162 as the protein replacement value for moose meat (Appendix B; Table 31; Data Supplement A).

Other consumptive uses in the areas include trophy and subsistence hunting for moose and black bears. Lone Ridge, Lone Creek and the road systems constructed during past state timber sales and oil and gas development are the most popular areas for these activities (D. Bader pers. comm.). Subsistence trapping is also an important activity there.

Evaluations of suitability and forage production capability of moose habitat (Atlas Maps B9a, B9b, B14a) indicate that nearly the entire corridor is moderately rated as suitable spring, summer, and fall habitat. More than 25% of the corridor is rated as having a moderate forage production capability on both summer and winter habitats.

Moose winter range availability based on estimated snow accumulation (Atlas Map B13) indicates that, theoretically, only 25% of the corridor's moose habitat would be available during years of normal snow accumulation. Only 10% of the corridor's habitat would be available during severe winters of high snow accumulation occurring once in every ten years.

However, some south facing slopes, windswept ridges, and troughs along the alpine and canyon portions of the corridor retain less snow than other areas and thus could possibly provide some relief under severe and normal snow accumulations.

Some migration corridors for moose in the Chuitna River corridor have been studied (J. Faro pers. comm.). The findings of these studies indicate that many of the moose within the corridor migrate through the Chuitna watershed. Some winter in the corridor, others winter near Granite Point. Other segments of this subpopulation have been observed near Beluga River, Threemile Creek, Chakachatna and McArthur rivers.

The number of wildlife species (species diversity or richness) in the corridor can include up to 91 species (Chapter II, Part 2; Atlas Map B11). More than 60% of the habitat has a high diversity of animals per vegetation type (67 to 91 species); 25% of the habitat has a moderate diversity (38 to 61 species), and 15% of the habitat has a low diversity (1 to 31 species) per vegetation type.

Existing conflicts for this area concern private ownership of lands on the south banks of the Chuitna River and the public demand for more access and use of the fish and wildlife resources.

Coal development on the upper part of the Chuitna River corridor and watershed will eliminate all surface fish and wildlife values where mining occurs. Public use opportunities will also be eliminated in mining areas. Water quality and instream flow requirements for fish populations may be jeopardized as well in tributaries and mainstem areas. Even though some mitigation measures may compensate for the loss of moose habitat, impacts on bear and fish populations and their habitat as well as public use thereof need to be addressed.

The remaining public lands should be permanently protected for public use so that buy back situations can be avoided and future public use can be accommodated.

10- Susitna River corridor. This designation includes the Susitna River's 100 year flood plain, all the riparian upland habitats within three miles on either side of the main stream from the northern boundary of the Susitna Flats State Game Refuge to the section line boundary between sections 19-24 and 25-30, T. 27 N., R. 5 W., Seward Meridian. The size of this corridor is approximately 241,370 acres.

Justification. The Susitna River is one of the most important fish production areas in Southcentral Alaska. The river and its tributaries are responsible for a large percentage of the commercial salmon catch for this region of Alaska. Total numbers of salmon returning to the Susitna River can be estimated by using a percentage of the salmon bound for the Susitna River which are caught commercially in upper Cook Inlet. Catch percentages of Susitna bound salmon were developed by the Commercial Fisheries Division (ADF&G) and the Susitna Hydroelectric adult anadromous fish investigators (Barrett pers. comm.). Based on these percentages, the salmon destined for the Susitna River and caught in the central and northern subdistricts were estimated in 1982 at: 12,240 chinook; 1,439,235 sockeye; 485,148 coho; 127,169 pink; 833,548 chum; for a total of 2,895,596 (Chapter I, Table 26). In 1982 these figures were: 2,064 chinook; 647,475 sockeye; 388,566 coho; 666,376 pink; 1,214,328 chum; for a total of 2,918,809 salmon. In 1982, the

Susitna Hydroelectric anadromous fish investigations estimated that 265,200 sockeye, 79,800 coho, 890,500 pink, and 458,200 chum salmon totalling 1,693,700, representing a minimum Susitna River spawning escapement (ADF&G 1983). ADF&G's Sport Fish and Commercial Fisheries divisions' stream surveys of areas not covered by the Susitna Hydroelectric studies, in 1982, accounted for an escapement of 43,468 chinook, 39,500 sockeye, 50,000 coho, 71,000 pink, and 7,500 chum salmon, totalling approximately 211,468 spawning salmon (King pers. comm.; Delaney pers. comm.). By combining numbers of spawning fish and the commercial catch for 1982, an estimated 4,832,977 salmon were produced in the Susitna River. The salmon harvest and escapement in 1982 for the Susitna River does not include escapement into the Yentna River system, so the grand total of salmon attributable to the entire planning area is much greater than the figures presented here.

The fisheries production for the Susitna River compares favorably with that of the Kenai River. In 1982 (an above average year for the Kenai) approximately 4.6 million salmon (catch and escapement) were attributed to the Kenai River (Florey pers. comm.); the Susitna River produced about 4.8 million salmon.

The Susitna River, in addition, has two populations of Eulachon (hooligan) numbering in the millions that spawn in the mainstem of the Susitna from the Kashwitna River downstream (ADF&G 1983). There are three species of white fish (Bering ciscoe, humpback, and round white fish), numbering in the thousands, spawning from Talkeetna southward. Rainbow trout, Arctic grayling and burbot numbering in the thousands are also found all along the Susitna River.

During the year, and especially during the spring, there are literally hundreds of millions of salmon smolt/fry in the river feeding. Older age classes prepare to migrate downstream to Cook Inlet during the spring, and these fish number in the hundreds of thousands.

On the Susitna River, from Talkeetna down to its confluence with the Yentna River, there are nine tributaries flowing into the east side and one flowing into the west side, that contain significant numbers of fish. These streams alone generally produce more than two million salmon (Watsjold pers. comm.).

Recreational or sport fishing is an important use of Susitna River fish. Salmon are harvested by sports fishermen primarily at the confluence areas of rivers where clear water tributaries flow into the Susitna River. Salmon tend to congregate at these clear water confluence areas (Watsjold 1983). The growth of the sport fisheries in confluence areas as well as in other areas along the Susitna River is dependant on maintaining these confluence back water areas that attract a large number of salmon. During high flow periods, (when deep back water areas are available) the tributary mouths provide ideal resting or staging areas for all adult fish species as well as rearing areas for juvenile fish during high flows. At low flows, much of the backwater habitat is eliminated. This results in shallower water at the mouths of tributaries and reduces their attractiveness to fish. If seasonal flows are reduced significantly, for example by removal of Susitna River water for agriculture, industry, or private use, a serious impact on sport fishing would result. Much of the fish harvest that occurs below Talkeetna takes fish that spawn above Talkeetna.

More than 100,000 user-days of fishing effort occurred on these confluence fisheries in 1982. At least 50% of this effort took place within the proposed Susitna River corridor (Watsjold pers. comm.). The amount of money spent to travel to the Susitna by the large number of recreational users of the Susitna represents a considerable economic investment and extensive public interest in the resource. The economic analysis conducted on the Willow Creek sport fishery (ADF&G 1982) determined the "willingness to sell," or dollar value, of one pink salmon fishing day was $140.46 (Appendix A). This value for pink salmon when applied to all species harvested in the Susitna River, yields a minimum of $7,023,000 representing the anglers' willingness to sell their sport fishing opportunities.

Access plays a major role in limiting and/or allowing growth of the recreational fisheries that occur on the Susitna and its tributaries. Much of the adjacent land is in private ownership. Public land that is available is generally undeveloped. The only public boat launch facility is at Talkeetna. The state has recognized this problem and has initiated a road construction project that will provide access directly to the Susitna River at the mouth of Willow Creek. This project which is expected to cost in excess of $5 million will result in a substantial increase in angler access to the Susitna River and its tributaries.

The Susitna River is the third or fourth (depending on the particular year) most important king salmon producing system in Alaska (D. Watsjold pers. comm.). King salmon are thought to be the most highly prized sport fish in Alaska, attracting large numbers of anglers to the limited areas that are opened for fishing. Sport fishing for king salmon is currently allowed on only five Susitna River tributaries from Talkeetna to Cook Inlet. There is a possibility that other streams above Talkeetna and in drainages downstream of and including the Deshka River might be opened to chinook fishing in the future (D. Watsjold pers. comm.). With the completion of better access to the Susitna River near Willow Creek and more liberal chinook salmon seasons, the Susitna has the potential to surpass any river system in southcentral Alaska in terms of providing sport fishing opportunities. The Susitna River has more fishable river miles, has larger populations of a variety of fish species and provides a greater diversity of recreational opportunities than any other stream in Southcentral Alaska (ADF&G 1983; Delaney and Hepler 1983; Hepler and Bentz 1984; Hammerstrom and Larson 1983).

Over 20% of the increase in the state angler populat.on base in 1981 occurred in west Cook Inlet - Lower/Susitna drainage areas (D. Watsjold 1983). Record high fishing effort occurred in 1982 in Alaska's waters. There was an increase in the 1982 angler population base of almost 44,000 anglers. Over 34% of this increase occurred in west Cook Inlet - Lower Susitna drainage areas. Most of the anglers on the Susitna River and its main tributaries came from Anchorage.

The Susitna River is also one of the most important river systems in southcentral Alaska and within the Susitna planning area for maintenance of moose population numbers and reproductive success (D. Bader pers. comm.).

Wildlife population numbers and game harvest information are only available for moose in selected areas along the Susitna. The Alaska Department of Fish and Game has been conducting investigations on moose by radio-telemetry and by tagging in the Chuitna River/Beluga/Tyonek, Peters/Dutch Hills, Lower Susitna River, and Matanuska-Palmer areas (Didrickson and Taylor 1978; Modafferi 1982; Faro pers. comm.). In addition to these studies, population censuses have been conducted for most of Game Management Unit 16A and in the Tyonek-Beluga Lake portion of the Susitna lowlands area (Taylor pers. comm.). These investigations indicate that moose depend heavily on the stream terraces, flood plains, and adjacent uplands of the Susitna River during the winter. These moose originate from subpopulations located in: 1) the western slopes of the Talkeetna Mountains; 2) the Willow subbasin including the capital site; 3) the Susitna/Beluga Mountains; 4) the Peters Creek/Peters Hills areas; 5) the Chuitna/Beluga River; and 6) the Susitna lowlands The department has estimated that 5,000 to 6,000 moose may winter within this corridor during severe winters of high snow accumulation. Moose winter range availability based on estimated snow accumulation (Atlas Map B13) indicates that 100% of the moose habitat in this corridor would be available during winters of normal snow accumulation. Likewise, even during severe winters of high snow accumulation occurring once in every ten years, this corridor would still be available.

The relative importance of the Susitna River corridor during winter is best shown in comparison to the other nine river corridors previously discussed. During winters of normal snow accumulation, at least 44% of the moose winter range present in all 10 river corridors would not be available for moose forage. During severe winters of high snow accumulation that occur once in every ten years, at least 59% of the moose winter range would not be available. In the latter scenario, of the remaining (41%) available winter range, the Susitna River corridor is estimated to provide approximately 68% of the total available winter habitat for moose (D. Bader pers. comm.). This means that moose from at least six different summer subpopulations far removed from the Susitna River corridor depend on the winter range in this corridor for survival during normal and high snow accumulation years.

If winter range availability for moose is restricted by incompatible land uses, declines in their populations may result. They could overbrowse and destroy preferred forage plants resulting in massive die-offs. Similar die-offs have occurred in other states. Thousands of deer, elk, and antelope in Wyoming, Montana, Utah, and Idaho starved during the winter of 1983-84 because inadequate amounts of winter range were protected and maintained in public ownership (D. Bader pers. comm.).

TABLE 49. Effects of Normal and High Snow Accumulation on the Availability of Moose Winter Range in 10 Candidate River Corridors in the Susitna Planning Area[1]

Corridor	Corridor Acreage	Amount of Available Habitat in Years of Normal Snow Accumulation - Acreage	Amount of Available Habitat in Years of High Snow Accumulation - Acreage	Relative Percent of Available Habitat for All Corridors in Years of High Snow Accumulation
Deshka River	126,474	75% = 94,855	60% = 75,884	21.6%
Lake Creek	62,718	20% = 12,543	0% = 0	0
Talachulitna River	81,036	0% = 0	0% = 0	0
Alexander Creek	27,078	100% = 27,078	0% = 0	0
Montana Creek	125,698	58% = 72,901	24% = 30,167	8.6%
Chunilna Creek	68,076	5% = 3,401	0% = 0	0
Peters Creek	54,060	2%± = 1,081	0% = 0	0
Sheep Creek	22,192	50% = 11,096	5% = 1,109	1.0%
Chuitna Creek	30,394	25% = 7,598	10% = 3,039	1.0%
Susitna River	241,370	100% = 241,370	100% = 241,370	68.6%
Subtotals 100%	839,096	56% = 471,922	41% = 351,569	100%

[1]Snow accumulation data derived from Atlas Map B13

The numbers of moose using the Susitna River corridor for shelter and forage cannot be supported by the active flood-plain alone. Lands capable of high forage production adjacent to the river must also be set aside specifically to support large numbers of moose. Thus a three mile corridor has been proposed along the Susitna River in order to protect forage for moose.

Moose carrying capacity evaluations (Atlas Map B14a) indicate that of the existing habitat, along the Susitna corridor, approximately 75% of the winter forage production capability is highly rated, 15% is moderately rated and 10% has a low rating. Evaluations of the habitat suitability models show that 75% of the spring, summer, fall, and winter habitat is highly rated and 25% is moderately rated (Atlas Maps B9a, B9b).

Moose hunting effort and harvest for this area can be identified by combining and analyzing nine separate moose harvest report code units (14-01-045, -064, -065; 14-02-013, -018, -028; 16-01-012; 16-02-012 and 16-10) located within and adjacent to the river corridor (Data Supplement A; Chapter I, Table 2; Atlas Map C2a). Based on this information for 1981, approximately 226 hunters spent 1,775 user-days and harvested 71 moose.

The economic value associated with moose hunting in the Susitna River corridor includes an estimated total expenditure of $420,675 by hunters and $131,520 as replacement protein value for moose meat (Appendix B; Table 31).

The number of wildlife species (species diversity or richness) occurring in the corridor ranges from 38 to 91 species per vegetation type. An evaluation of wildlife diversity (Atlas Map B11) indicates approximately equal portions of highly and moderately rated habitats.

In summary, the Susitna River corridor is the most important river within the Susitna planning area with respect to numbers of fish and wildlife produced, numbers harvested, hunting and fishing effort, and generation of revenue.

The Susitna River corridor has the potential to provide recreational opportunities equal to or greater than those on the Kenai River. It can also provide alternate recreational opportunities to the crowded public recreation lands on the Kenai Peninsula and elsewhere within Southcentral Alaska. However, the problems with incompatible land uses, access, private ownership of valuable public resources which have occurred on the Kenai Peninsula will soon occur on the Susitna unless this river and adjoining uplands within the corridor are retained in long term public ownership.

B. Upland Habitat Areas (Areas A-I on Map C6)

The Alaska Department of Fish and Game has identified 9 upland areas meriting legislative consideration for special management designation. These areas are proposed for designation into one or more of categories: critical habitat, game refuge, sanctuary, game range and/or public use area.

However, specific management designations forthese areas will not be suggested at this time. Rather, the department intends to solicit public and agency comments on these proposed areas prior to preparing a more specific designation proposal.

The department selected priority areas possessing habitat with high to moderate suitability for large numbers of moose, and for a diversity of other species (Atlas Maps B9a, B9b, B14a). In general, fish and wildlife in these areas are relatively more abundant, representing higher concentrations than found elsewhere in the planning area or the state. In this regard, the nominated areas have regional, state-wide or national importance. Candidate areas 1) support at least moderate to high fish and wildlife production; 2) are able to maintain historical distribution and abundance of wildlife populations; 3) provide one or more elements important to the life cycle of a species of major abundance or importance, as well as provide general habitats for other species representative of the regional fauna; 4) have concentrations of or a diversity of waterfowl, big game, shore birds and/or other representative species (Atlas Maps B1, B2, B3, B4, B5, B6, B7, B8, B11; Data Supplements B and C).

Public access was also an important consideration. Areas selected had publicly owned access in a variety of forms and were readily accessed over dedicated lands and waters (Atlas Maps C1, C5).

Extensive public hunting, trapping, fishing and related outdoor recreation also currently occur in these proposed areas, and there is a high probability of increasing use in the future. Nominated areas were selected from lands within the upper 70% intensity of use (tables 2, 7, 9, 12). The following sources of information were considered in these nominations: modes of user access; hunting effort for moose, caribou, and sheep sport fishing location, access and effort; local community resource use areas, (Atlas Maps C1, C2a, C2b, C2c, C3, and C4); harvest ticket data summary for 1980, Data Supplement A; sport fish and game economic reports, (Appendices A, and B) and subsistence users information (Appendix D).

In addition, habitat within the area that has vegetation with a high and/or moderate to high enhancement potential should be preserved for wildlife. This kind of vegetation is quite responsive to manipulation and "rehabilitation" to increase forage production for moose. This increased forage may maintain moose populations at higher levels, (Atlas Maps B10 and B14b).

A- Nelchina Public Use Area. This area includes all state lands within the proposed boundary illustrated on Atlas Map C6; the size of the proposed area is approximately 2,350,220 acres.

Justification. The primary purpose of this nomination is to protect and maintain the Nelchina caribou herd and its most important habitat. The population is now about 25,000 caribou (Su Hydro 1983). This herd depends on lands within the proposed nominated area for calving, and spring, summer and fall habitat use. The proposed area is considered essential for the herd's preservation. One of the most important features of this particular area is that most of the important calving grounds are included.

Historic records for this population are available for the past 180 years. The herd has reached two growth peaks over the last 100 years, one in the mid-1800's and another in the early 1960's. The herd declined for about 70 years following the first peak and then increased at a geometric rate from 1947 to 1962 to approximately 71,000 animals. It began its second recorded decline in 1962 (Hemming 1972), and continued its decline until about 1973 (Bos 1972) when the population numbers stabilized at about 10,000 animals. The population has since increased to about 25,000 caribou in 1983 (Pitcher pers. comm.). This herd has consistently relied on lands within the proposed nominated area throughout its history for calving, and spring, summer and fall habitat use. To maintain the caribou at the highest stable population numbers that the habitat will support, the Nelchina land base must be maintained.

This area is also the most heavily used caribou hunting area in the state for urban residents. More than 6,800 people applied for 1,000 caribou hunting permits for the Nelchina hunt in 1981 (Chapter I). More than 1,650 user-days were expended by 943 hunters to harvest 613 caribou in 1981 (Atlas Map C2b; Data Supplement A). The residency information for these caribou hunters showed that 53% were from the Anchorage-Girdwood area, 19.6% were from the Palmer-Skwentna area and 14.5% were from the Fairbanks-Delta area. The remaining 12.8% hunters came from other areas (Chapter I; Data Supplement A).

Based on cost/hunt estimates (Appendix B) total net expenditures for caribou hunters in the Nelchina Public use area amounts to approximately $701,779. The replacement protein value for caribou meat is approximately $290,332 (Chapter I, Table 31; Appendix B). The Nelchina Public Use Area also has some of the highest concentrations of moose, sheep, brown bears, black bears, wolves, wolverines, small game, and furbearing animals in the Susitna planning area (D. Bader pers. comm.).

This nomination area is the third most intensively hunted land for moose within the Susitna planning area. In 1981 a total of 3,662 user-days were reported by 645 hunters in this area. They harvested 134 moose (Atlas Map C2a; Appendix B). However, for every hunter reporting, there are approximately 2.63 not reporting their moose harvest tickets (Chapter I). Based on this information, it is estimated that approximately 1,696 hunters spent 9,631 user-days to harvest 352 moose within this area in 1981. Sixty percent of the moose hunters were from the Anchorage area, 18% were from the Matanuska-Susitna Borough and 18% were from other locations (Appendix B).

The economic value associated with moose hunting in this area for 1981, includes an estimated total net expenditure of $401,952 by hunters and $652,044 as the replacement protein value for moose meat (Appendix B; Chapter I, Table 31).

A moose population census has not been conducted for this particular area. However, historical spot sampling for moose (composition surveys) and density estimates during Susitna Hydro studies indicate that an estimated 5,000 to 6,000 moose live in this area (D. Bader 1982).

The Nelchina Public Use Area is one of the more important hunting areas in the state for sheep, especially by urban residents. In 1981, more than 155 hunters expended 666 user-days to harvest 65 Dall sheep (Atlas Map C2c; Data Supplement A, Table 12).

Approximately 49% of the sheep hunters came from the Anchorage area, 26% were from the Palmer-Wasilla area, 17% were Alaskan non-residents, and 8% were from other Alaskan areas (Data Supplement A).

The economic value associated with sheep hunting in this area for 1981, includes an estimated net expenditure of $129,000 by residents and $260,000 by non-residents totaling $389,000. No protein replacement value for meat has been estimated (Appendix B).

Although composition counts (spot sampling) for sheep in the Talkeetna Mountains have indicated a population of approximately 1,700 animals in 1982, no total population census has ever been conducted for this area (ADF&G Big Game Data Index files). The department suspects that the sheep population, however, ranges from 2,000 to 2,500 animals.

No black or brown bear population estimates or harvest figures are available for the Nelchina area at this time. However, a considerable amount of guided and non-guided hunting for bears occurs in the Talkeetna Mountains portion of the Susitna basin. Total cost for bear hunting in the entire Susitna basin amounted to $1,610,000 in 1982 (Appendix B).

B- <u>Peters Hills-Peters Creek Area</u>. This area includes all state lands within the proposed boundary illustrated on Atlas Map C6. The size of this area is approximately 458,290 acres.

<u>Justification</u>. This is one of the most accessible, and for this reason, probably the most popular, moose hunting locations within the Susitna planning area. This is a very popular hunting area because public access over the numerous roads, trails, and streams is readily available to people from most economic levels and walks of life. Highway and all terrain vehicles provide most of the access; however, the area accommodates most other modes of transportation (Atlas Map C1). In 1981, this area supported nearly two times the moose hunting effort (3,937 person-days) than did any other single harvest reporting code unit within the Susitna planning area as reported on moose harvest tickets (Chapter I, Table 2; Atlas Map C2a). Table 2 includes proportional adjustments in statistical figures to compensate for reported effort from areas not clearly identified on harvest report cards within the Susitna planning area.

Approximately 729 hunters harvested 128 moose here in 1981 (Data Supplement A). However, for every hunter reporting, there are approximately 2.63 hunters not returning their moose harvest tickets (Chapter I). Based on this information, it is estimated that as many as 1,917 hunters expended 10,354 user-days to harvest 336 moose in this area in 1981. Residency information for reporting moose hunters indicates that 78% were from the Anchorage area, 13.5% were from the Palmer-Wasilla area and 8.5% were from other areas (Appendix B; Data Supplement B). According to a recent survey (G. Knapp pers. comm.) the Anchorage Bowl population area will increase over 150% by the year 2000. Theoretically, then, the demand for moose hunting will increase at a similar rate.

It is estimated that more than 2,000 moose (not adjusted for unreported harvest ticket holders) have been harvested from this area since 1969 (ADF&G data files). During the late fall/early winter period, the density of this moose population is as high or higher than any geographic area within the Susitna planning area (Bader 1982).

The economic value associated with moose hunting in this area for 1981 includes an estimated total net expenditure of $454,393 by hunters and $622,406 as the replacement protein value for moose meat (Appendix B; Table 31).

Since 1969, moose production in the Petersville area has been high, as indicated by moose calf:cow ratios ranging from 29:100 to 51:100 with a mean of 39:100 (ADF&G data files). In 1969 the highest production of moose in Game Management Unit 16 was 53 calves per 100 cows. This production occurred in the Petersville Road area (Didrickson 1970). Even though hunting pressure has been high in this area, the bull:cow ratio has remained at fairly moderate levels as indicated by the mean of 29:100 for the period 1969-1982 (ADF&G data files).

Aerial moose surveys in 1967, in the Peters Hills-Kahiltna portion of the nominated area, yielded 1,121 moose. This area represents less than 5% of the land area in the (Game Management Unit 16) Petersville, Sunflower basin, Susitna lowlands, Beluga, Mount Susitna and Alaska Range subregions. Based on more recent counts (1978) it is estimated that 3,000 to 5,000 moose occupied the nominated area as year round residents (Didrickson and Taylor 1978). It is probable that the Kahiltna winter range portion of the nominated area is shared with moose populations from the Sunflower basin and possibly from Mt. Yenlo. This is believed because, densities on the Kahiltna winter range have exceeded four moose per square mile in some winters (Didrickson and Taylor 1978).

The Peters Hills-Peter Creek area is suspected to support as much as 28% of the moose utilizing the Susitna lowlands, Petersville, Sunflower basin, Mt. Susitna, Beluga, Alaska Range, and Denali State Park planning subregions. Didrickson and Taylor (1978) reported that virtually all vegetated slopes of the Peters Hills at and above timber line provide lush summer range for moose, and as fall approached, pre-rutting groups of 30+ moose were often seen along the south-facing slopes of Black Creek summit and above Bunco and Swan lakes (Didrickson and Taylor 1978). Habitat computer modeling supports Didrickson's observations and illustrates the distribution of highly, moderately, and low-valued forage vegetation (Atlas Map B14a).

Chatelain (1951) (in Didrickson and Taylor 1978) concluded that the single most important limiting factor to moose population growth in the Susitna River valley was the lack of adequate winter range. Three important wintering areas for the Peters Hills moose population were identified by Didrickson and Taylor. They are as follows 1) The lateral and terminal moraine, at the east side of the Kahiltna Glacier, from Granite Creek to Cache Creek, 2) the west side of the Little Peters Hills, and 3) the Tokositna River from Bunco Lake to Home Lake. Moose densities in these areas have exceeded four moose per square mile (considered to be high winter concentrations) in some winters. These areas provide winter habitat for most of the moose inhabiting the nominated area including the Peters-Dutch hills (Didrickson and Taylor 1978).

Habitat computer modeling of important winter areas for moose supports Didrickson and Taylor's winter range identifications. The modeling revealed that within the nominated area, the existence of high production winter forage vegetation is limited to Martin, String, Big, South Fork, Lunch Gulch, Sand and Black creeks, to the winter ranges identified above (Atlas Map B1), and the area extending from Peters Creek to Moose Creek.

Moose winter range availability based on estimated snow accumulation (Atlas Map B13) indicates that approximately 30% and 15% of the moose winter range within the nominated area would be available during normal winters and during severe winters respectively. There are some south facing slopes, windswept ridges, and troughs (i.e. winter ranges identified by Didrickson and Taylor 1978) that provide habitat and relief under winter conditions.

The movements of moose within this area have been studied over a number of years (Didrickson and Taylor 1978, Modefferi 1982). These studies found that moose in this area do not range widely, remaining generally in the area. However, some moose from the Sunflower basin and from the Susitna River are known to winter, summer, breed and possibly calf here as well.

Highly valued winter moose range exists elsewhere within the Susitna planning area. For example, land between the western slope of the Talkeetna Mountains and the Parks Highway is productive winter moose range, but more of it is already in private ownership, and cannot be relied on for long term moose management or public hunting. This situation is complicated by state and borough land disposals.

More than 96,000 acres of wildlife habitat within the Petersville and Parks Highway planning subregions have already been converted into private ownership and an additional 169,670 gross acres are proposed for disposal there. More than 52% of these proposed disposals are located within the Petersville area (First Round Designations ADNR, October 1983).

The majority of the highest valued winter habitat located in the Kahiltna winter range (below Cache Creek) and the winter range between Peters Creek and Moose Creek are currently proposed for disposal and settlement. The department feels that this presents a major land use conflict, that if not reversed, could seriously affect the success in maintaining the extensive hunting opportunities and moose population numbers within this area. As noted previously, about 28% of the moose population located in the western half of the planning area resides in the Petersville area. In addition to lost opportunities and a possible decrease in population numbers, there would also be a reduction in revenues generated from big game hunting.

The number of wildlife species (species richness) occurring in the nominated area includes up to 91 species per individual vegetation type. An evaluation of the wildlife diversity within this area indicated that approximately 40% of the habitat has a high (67 to 91) species diversity; about 40% has a moderate (38 to 61) diversity; about 15% has a low (1 to 31) diversity; and about 5% has zero wildlife species. These are indicators of the productivity and stability of wildlife habitats in this area.

Public consumptive uses of the area is extensive and includes hunting for moose, black and brown bears, and trapping for marten, lynx, beavers, mink, wolves, and wolverines. Spruce grouse hunting is also available, as is ptarmigan hunting in the alpine rock and shrub lands.

Many important streams, including Martin, Peters, Twenty Mile, Bear, Gate, Kroto, and Moose creeks, are located within and/or are adjacent to the nominated area and support heavy public use in addition to highly productive riparian and aquatic habitats for big game, furbearers, small game, three species of resident, and five species of anadromous fish (Atlas Maps B7, B8, B12, C3).

A majority of the moose habitat here is rated as having high and/or moderate winter, spring, summer, and fall suitability and forage production capability. The forage production potential is rated high in the eastern and southern portions of this area and would allow moose habitat enhancement when required to increase moose production and survival (Atlas Maps B9a, B9b, B10, B14a, B14b). Land disposals proposed for the area between Peters Creek and Moose Creek would, if approved, limit habitat enhancement and big game hunting. Because of the increase in incompatible land uses and the transfer of public lands into private ownership here and elsewhere in Southcentral Alaska, forage production remaining on state lands is not expected to be able to sustain existing moose populations and moose hunting at present levels, unless areas such as the Peters Creek-Peters Hills nomination are retained in public ownership.

C- <u>Lower Susitna - Yentna River Delta</u>. This area includes all state lands within the proposed boundary illustrated on Atlas Map C6. The size of this area is approximately 833,266 acres.

<u>Justification</u>. It is estimated that up to 5,000 moose may use this area during the winter (Bos pers comm.). Recent studies on movement of moose along the Susitna River indicate use of this area by moose from several high-density populations. These populations include

animals from the Mt. Susitna-Beluga area and the southwestern flank of the Talkeetna Mountains from the Little Susitna River to Montana Creek.

Moose populations in southcentral Alaska are strongly influenced by the cold and deep snow of winter, and their adult survival and calf production are directly influenced by availability of browse to carry them through periods of stress. In the Susitna River drainages, moose move from higher elevations to riparian habitat and from upstream areas downstream during the winter. The density of moose found in important winter habitats reflects the severity of winter stress. The denser the numbers, usually the more severe the winter. With high concentrations of moose on the riparian lowlands, competition for available browse is great. During mild winters, the animals are usually more dispersed, due to the availability of adjoining areas. When additional areas are not available for forage, moose can become stressed and die.

In the Susitna basin, winter habitats available during moderate to high snow fall periods are generally located in and along the flood plains of rivers and streams. This type of habitat is relatively abundant between the lower Susitna and Yentna River deltas. The vegetation types that make up the winter habitat in this triangle (and which are the only plants available in severe winters) are relatively scarce within the Susitna planning area as a whole, representing only 6.2% of all the vegetation present. Reliance on these vegetation types alone for maintenance of moose populations without the additional browse in adjacent areas would result in reduced numbers of moose surviving a stressful winter.

Development of uses that are incompatible with moose in adjacent areas could force moose to use these scarce riparian habitats regardless of winter severity. Reductions in the carrying capacity of the winter range provided in the proposed designation due to overbrowsing could significantly reduce moose numbers over much of the western half of the study area.

Availability of moose winter range based on estimated snow accumulation (Atlas Map B13) indicates that approximately 95% of the proposed nominated area would be available during winters of normal snow accumulation and approximately 75% of the proposed area would be available during winters of high snow accumulation occurring once in every ten years. Available winter range within the proposed special management area represents 43% (mild winters) and 32% (severe winters) of the all available winter range in the planning area west of the Susitna River.

The habitat suitability analyses show that within this area the majority of the moose habitat is rated as having high and/or moderate suitability for winter, spring, summer, and fall. Riparian habitats have a high forage production capability. The forage production potential of much of the uplands is also high and could be enhanced to increase moose production and survival (Atlas Maps B9a, B9b, B10, B14a, and B14b).

Public access is readily available to much of the area by boat and float or wheeled aircraft. Other modes of transportation are limited. Even though the area is remote, public use is extensive and includes hunting of moose, black and brown bears, small game, and trapping for beavers, mink, marten, wolves and wolverines.

Moose hunting within the proposed area occurs within harvest report code units which are ranked as fourth, sixth and eighth with respect to user-days, (Chapter I, Table 2). More than 72% of the hunters access the nominated area by boat and aircraft. Based on this information, it is estimated that at least 185 hunters spent approximately 1,200 user-days harvesting approximately 100 moose in 1981 (Atlas Map C2a; Data Supplement A). However, for every hunter reporting, 2.63 hunters do not report their moose harvest tickets (Chapter I). Based on this factor, it is estimated that as many as 486 hunters may have spent 3,156 user-days to harvest 263 moose. Seventy-nine percent of the moose hunters came from the Anchorage area, 9% came from the Palmer-Skwentna area, and 12% were from other areas (Data Supplement A).

The economic value associated with moose hunting in this area for 1981 includes an estimated total net expenditure of $115,182 on recreational equipment, lodging, etc. by hunters and $487,181 as the replacement protein value for moose meat (Appendix B; Chapter I, Table 31).

D- Trumpeter Swan Areas. This includes all state lands within seven areas identified as D on Atlas Map C6. The total size of these areas is approximately 297,774 acres.

Justification. There are 6,912 square miles of habitat considered suitable for trumpeter swan (Cygnus buccinator) nesting in the Cook Inlet basin including the Kenai Peninsula (King 1983). A total of 1,375 trumpeters were found here in 1980 (King and Conant in King 1983). There are 1,705 square miles tentatively considered critical to the continuation of the population at the current level. This 25% of the nesting habitat hosted 68% of the pairs and 74% of the broods in 1980.

Trumpeter swans, once distributed across much of the continent, did not survive settlement of the land. By the 1930's they existed only in a few remote valleys of the Rocky Mountains, in a small area of wilderness Alberta, and in the unsettled regions of Alaska (Banko 1960, Hansen et al. in King 1983). Vulnerability to pioneer gunners seems to have been a major cause of the decline of the trumpeter. Since they are also extremely sensitive to disturbance on their nesting lakes, reduced productivity could have been a major contributing factor (King 1983). In 1960, no more than 1,500 swans were thought to exist in the entire world (Scott 1961).

The Cook Inlet basin, where half the people of Alaska live (212,000 in the 1980 census) and where the growth potential is large, had 1,375 trumpeters in 1980 or about 16% of the entire world population.

Because of the newly discovered trumpeter swan population in Alaska as a result of the detailed 1968 survey, trumpeters were taken off the Federal Endangered Species List.

In the Susitna area, there is evidence that swans have already been driven away from many larger lakes where they formerly nested due to human activity (Timm and Wojeck in King 1983). Without a conscious effort to provide protected areas for swans, they could be crowded completely out of the basin as has happened elsewhere.

By dedicating some wetlands where the needs of swans will be given primary consideration it is possible that trumpeters can continue to have prime habitat near a civilized area such as Anchorage. The nomination of this area includes portions of a proposal by the USFWS and adopted by ADF&G for the Susitna planning area. If the proposal proves to be inadequate for safeguarding either the needs of people or swans, adjustments should be made.

It is the intent of this plan to devise a method for ensuring that trumpeter swans remain a healthy and visible part of the fauna of the Susitna planning area (and Alaska) in spite of growth and development by the people there.

1. These nominated areas will provide protection for nesting sites used by 69-76% of the eligible nesting swans as identified in 1980. The Northwest Section of the Wildlife Society meeting in Juneau in 1982 and the American Ornithologist's Union meeting in New York in 1983 recommended 75% be provided protection.

2. The identified areas distribute protected sites in blocks in various parts of the basin in hopes of encouraging continued use of suitable habitats in areas where human activity is less restricted and thereby retain swan distribution for the entire area.

3. Retaining these areas in public ownership will encourage continued growth in the swan population by protecting habitats with a potential for some growth.

4. The identified areas are swan critical habitats that for the most part have a low value for human development i.e., boglands.

5. The ADF&G, USFWS and ADNR need to educate the public about the needs of swans in hopes that they will avoid disturbing swans during the nesting and rearing period.

6. Resource agencies will need to monitor the swan population to determine if the plan is succeeding.

7. State and federal agencies should be prepared to increase restrictions on use of critical habitats if swans decline below the 1980 population whether the candidate areas are designated as habitat or not.

8. State agencies should be prepared to adjust the size and number of critical habitats as necessary.

9. Public interest groups and resource agencies would be on the alert to consider nominating the trumpeter swan for inclusion into either the Threatened and/or Endangered Species List if a trend occurs indicating a definite decline in the population over a period of three or more years.

Swan biology. The following discussion was obtained from information provided by King in 1983. There were some 8,728 trumpeter swans tallied in North America during the last complete census in 1980 (Weaver in King 1983). The Alaska count found 7,696 and the Cook Inlet basin count (including the Kenai Peninsula) found 1,375 (16% of the world population). These two censuses nearly doubled in the preceding five years since comparable counts in 1975. In spite of the increase, a shift in population away from larger lakes where recreation cabins had been built was detected (King and Conant in King 1981).

Alaska swans winter along the Pacific coast in fresh waters that remain open from the Kenai River to the mouth of the Columbia River. As more habitat is available toward the southern end of the range, most trumpeters winter south of Alaska.

They return to the Cook Inlet basin in April staging in the intertidal marshes mostly along the west side of the Inlet. Nesting birds proceed to their nesting lakes at the first sign of open water and are generally incubating their eggs by the time the ice is gone. The pairs defend a territory around their nest, normally including the entire lake, from intrusions by any other swans. Normally they display and issue a vocal warning to swans flying over and no landing is made. A fight ensues if a landing is made. A similar message seems to be directed at low flying aircraft. Continual aerial disturbance like this interferes with the swans normal breeding behavior.

Swan broods hatch in June or July and the young begin to fly in mid-September. Families sometimes move overland during the summer especially if disturbed. Some young are lost during the summer and some of this loss may result from encounters with large predators during portages.

Swans do not normally nest until three or more years old. The younger birds remain in flocks where pairing occurs. New formed pairs evidently spend one or more summers searching for a suitable unclaimed nesting territory and hold their claim through the summer returning directly to it when they are ready to nest the following year. Only a small percentage of lakes contain a suitable blend of food and protective cover. If nesting is successful, the same pair might continue to use the same territory for 20 or more years. Loss of nest or brood could cause desertion of the territory. Disturbance during the search period by airplanes landing, boats, the proximity of a road, or other activity may cause rejection of what is otherwise a suitable territory. Thus establishment of human activity within the territory of a pair of swans that have been successful for a number of years may not cause that pair to desert, but could prevent establishment of a new pair at this site when the old pair is gone.

Nest failures of trumpeter swans are common so that in spite of clutch sizes to nine eggs, trumpeters often fail to replace their losses in some years. They survive in tenuous balance with their environment and must have consideration from the impacts of an increasing human population if they are to survive.

Critical habitats of the Susitna Planning Area (Cook Inlet basin). The USFWS and ADF&G have identified 15 critical habitat areas that appear to meet the goal of about 75% of the present trumpeter nesting territories (tables 1 and 2 in King 1983) and providing a good geographic spread (Figure 1 in King 1983). Twelve of these areas occur within the Susitna planning boundary. Seven of these are depicted in the Atlas (Map C6) and are nominated for legislative designation, and the other five are at present being negotiated by the Susitna Planning Team and will appear in the Public Review Draft. These twelve are described below:

D1. Capps Glacier -- This is a small area south of Beluga Lake and below Capps Glacier. This area might have room for a few more swans especially if the glacier retreats. The potential for conflicts with recreationists seems low. The size of this area is approximately 13,178 acres.

D2. Kroto Slough -- This area is a low bog along Kroto Slough lying in a triangle between the Yentna and Susitna rivers. Much of it appears to be subject to regular flooding and unsuitable for development. The habitat for swans appears particularly favorable and has the potential to produce 20 or more swans per year. The size of this area is approximately 17,517 acres.

D3. Red Salmon Lake -- This area between the Skwentna and Hayes River and including Trimble River contains the toe of two glaciers. Except for Red Salmon Lake most of the ponds are too small for airplane use. As the glaciers retreat and vegetation invasion is followed by beaver use, more swan habitat could be created and more swans produced. The size of this area is approximately 30,527 acres.

D4. Yentna River -- This area below the Kahiltna Glacier is very similar to the Upper Yentna and may have a potential for producing more swans. Several airstrips in the area may not pose a threat to swans. The size of this area is approximately 110,080 acres.

D5. Kahiltna -- This area below the Kahiltna Glacier is very similar to the Upper Yentna and may have a potential for producing more swans. Several airstrips in the area may not pose a threat to swans. The size of this area is approximately 51,047 acres.

D6. Tokositna River -- This unit has extremely good habitat along the Tokositna. It is mostly in state and national park status now. Swan Lake should be protected from further development and current cabin owners encouraged to avoid scaring swans. The size of this area is approximately 61,650.

D7. Hidden River -- This riverine habitat has a potential for higher production and a low recreation potential. It is mostly within Denali State Park. Boating activity on the Chulitna would probably not pose a threat to swans. The size of this area is approximately 19,884 acres.

The following five areas are to be negotiated by the planning team and are not shown in the Susitna Atlas.

D8. Tyone Creek -- This area is characterized by numerous lakes and creeks and has a potential for increased swan production. Float plane landings will need to be restricted to allow this to occur. The area is approximately 190,080 acres in size.

D9. Upper Susitna -- This relatively small area has a high density of nesting swans. It is close to the Denali Highway and offers an opportunity to create some hidden viewing areas for swans in a natural setting. The area is approximately 36,480 acres in size.

D10. Grayling Lake -- This area of numerous lakes had a good population of nesting swans in 1980 and appears to have potential for more. Its close proximity to the developing Lake Louise area will require good management to allow swans and people to both use this area. It is approximately 131,200 acres in size.

D11. Bell Lake - This unique collection of wetlands on the northeast side of the Lake Louise area contained numerous swan nest sites in 1980 and has potential for more. It also will require special management because of its location near an expanding human population. This area is approximately 98,560 acres in size.

D12. Y-Lake -- This unique collection of small lakes has good potential for expansion of a healthy nesting population of trumpeters. It is approximately 83,200 acres in size.

There are five possible strategies for swan conservation. Emphasis on the first three strategies could preclude the necessity for use of the last two.

A. Designation of critical trumpeter swan habitats as areas meriting special management by the Alaska State Legislature.

   Much of the land in the twelve critical habitats proposed here is already in state ownership and should be protected from further recreational cabin building or other development within the designated boundaries.

B. Development of regulations for uses of these habitats.

Regulations - It will not be necessary to stop all human activity within these twelve areas. Only activities that conflict directly with swan production will need modification. Some activities that will need regulation are:

1. Airplane landings - Float plane landings should be prohibited May 1 to September 10 at nest sites and from April 1-30 and September 10 to October 1 at staging areas. No more recreation lots with float plane access should be sold in swan habitats. After September 10, landings could be allowed in lakes not occupied by swans. Wheel plane landings could continue on gravel bars or airstrips at distances greater than one mile from swan nest sites or staging areas from May 1 to September 10. Overflight below 1,500 ft should be prohibited.

2. Cross country vehicles should be restricted to designated areas on all units from April to mid-September. They should not come within one mile of swan nesting or staging areas.

3. Boating should be confined to major rivers. Airboats should not be allowed to penetrate lakes or bogs in the habitats where swans nest or stage.

4. Roads should be constructed well clear (at least a mile) of known swan territories.

5. Power lines are a leading cause of swan mortality in many places and should be limited as much as possible. If power lines must be built several design features could render them less destructive. Lines should be built in forested areas only and kept as close to treetop level as possible. Wires should be strung on one horizontal plane rather than in multiple, vertical stacks. All wires should be the same diameter. Where wires cross rivers or bogs they should be well marked (as around airports). The power lines from Tyonek to Anchorage generally conform to these criteria and even though they cross some high use swan habitat no conflict has been reported.

6. As swans have moved out of the larger lakes in the Cook Inlet basin they have taken advantage of the extensive beaver ponds of the region. Particularly in the units below glaciers, the beavers are creating swan nesting habitat. Beavers therefore should be managed for optimum pond building. This might require limiting or eliminating beaver trapping in some places.

C. Public education.

The people who have developed wilderness cabins on the larger lakes that are suitable for swan use often welcome and value the presence of swans. These people may be unaware of how their activity conflicts with swans. In some cases swan have adjusted and continue to nest on lakes where airplanes regularly service recreation cabins. If people use care in their activities, it may be possible to have nesting swans and recreation use of some lakes. Some ways that people could try to avoid driving swans away might be:

1. from May 1 to September 10, airplane landings should be prohibited within one mile of swan nesting areas from April 1-30 and September 10 to October 1 at staging areas;

2. use the same landing area and stay at least one mile away from any swans;

3. never use boats to investigate or photograph swans on the lake closer than one mile to swans;

4. keep boats and planes at least one mile from the part of the lake the swans prefer;

5. make every effort to avoid any disturbance of paired swans possibly investigating the lake for future nesting;

6. do not hunt ducks in the marshy places used by swans for cover.

If these guidelines are followed some swans may continue to use larger lakes in spite of some recreational activity. If the critical habitats continue to produce well, eventually some spill-over pairs may continue to investigate the larger lakes used by their ancestors and slowly perhaps develop more tolerance for humans.

D. Habitat Improvement.

E. Reintroduction of wild or hand-reared stock to suitable unoccupied territories.

There is no need to consider D and E above while the Alaskan trumpeter swan population is maintaining itself and the land use program for the twelve proposed areas in conjunction with the aforementioned public education are working to the swans benefit.

If the Alaskan trumpeter swan population falls to the point where it reaches the threshold warranting listing and protection under the Federal Threatened and/or Endangered Species laws, habitat improvement and the possible reintroduction of swans would be two of many options to consider while developing a recovery plan to reverse the population status of trumpeter swans.

TABLE 50. Maximum Number of Trumpeter Swans of Cook Inlet Management Units

Unit and Area	No. Pairs	No. Broods	No. Swan	Sq. Mi. Habitat	# Square Mile Per: Pair	Brood	Swan
A Redoubt-Trading Bay	83	40	405	526	6	13	1
*B Mount Susitna	11	4	38	113	10	28	3
*C Capps Glacier	8	2	24	21	2	11	1
*D Kroto Slough	7	4	35	26	4	7	1
*E Red Salmon Lake	13	4	49	48	4	12	1
*F Yentna River	28	8	95	172	6	22	2
*G Kahiltna River	20	7	81	83	4	12	1
*H Tokositna River	26	7	102	90	4	13	1
*I Hidden River	8	1	19	31	4	31	2
J Kenai	33	13	125	595	18	28	5
*K Tyone Creek	42	20	199	297	7	15	1
*L Upper Susitna	10	6	138	57	6	10	4
*M Grayling Lake	28	10	160	205	7	21	1
*N Bell Lake	35	14	130	154	4	11	1
*O Y-Lake	22	9	76	130	6	14	2
Total Units	374	149	1,676	2,548	7	17	2
Total Cook Inlet - West Gulkana	529	196	2,260	8,520	16	43	4
Percent on Units	71%	76%	74%	30%			
Total Alaska	1,662	683	7,696	29,453	18	43	4
Percent on Units	23%	22%	22%	9%			

* Proposed trumpeter swan habitats located within the Susitna planning area

TABLE 51. Maximum Number of Trumpeter Swans, Susitna Plan Area Plus Kenai

Unit and Area	No. Pairs	No. Young	Flocked & Singles	Total Swans	No. Broods	Sq. Mi.
Cook Inlet (plus Kenai)	349	434	243	1,375	122	6,912
Susitna Reserves	238	329	170	973	90	1,705
% in Reserves	68	76	70	71	74	25
Susitna	180	242	316	885	74	1,608
Susitna Reserves	137	186	246	703	59	843
% in Reserves	76	77	78	79	80	52
Susitna Plan (plus Kenai)	529	676	559	2,260	196	8,520
Susitna Plan Reserves (plus Kenai)	374	515	416	1,676	149	2,548
% in Reserves	71	76	74	74	76	30

TABLE 52. Maximum Numbers of Trumpeter Swans in Management Units, Cook Inlet

Area and Maps	Unit	No. Pairs*	No. Young	Flocked & Singles	Total Swan*	No. Broods	Sq. Mi. Habitat
Redoubt-Trading Bay	A						
Kenai C-6	A	7	12	9	35	3	90
Kenai C-7	A	10	18	4	42	5	46
Kenai D-5	A	10	19	8	47	5	67
Kenai D-6	A	33	55	33	154	15	136
Kenai D-7	A	6	12		24	3	25
Tyonek A-5	A	6	13	36	61	4	97
Tyonek A-6	A	11	19	1	42	5	65
Subtotal	A	83	148	91	405	40	526
*Mount Susitna	B						
Tyonek A-3	B	1	3		5	1	15
Tyonek B-2	B	3	2	5	13	1	38
Tyonek B-3	B	7	6		20	2	60
Subtotal	B	11	11	5	38	4	113
*Capps Glacier	C						
Tyonek B-5	C	8	8		24	2	21
*Kroto Slough	D						
Tyonek C-2	D	7	20	1	35	4	26
*Red Salmon Lake	E						
Tyonek D-5	E						4
Tyonek D-6	E	13	11	12	49	4	44
Subtotal	E	13	11	12	49	4	48
*Yentna River	F						
Talkeetna A-4	F	13	8	9	43	2	76
Talkeetna B-4	F	12	17	1	42	6	76
Talkeetna B-5	F	3		4	10		20
Subtotal	F	28	25	14	95	8	172
*Kahiltna River	G						
Talkeetna B-2	G	3	5	1	12	1	10
Talkeetna B-3	G	17	25	10	69	6	73
Subtotal	G	20	30	11	81	7	83

TABLE 52. (continued)

Area and Maps	Unit	No. Pairs*	No. Young	Flocked & Singles	Total Swan*	No. Broods	Sq. Mi. Habitat
*Tokositna River	H						
Talkeetna C-1	H	10	6	1	27	2	52
Talkeetna C-2	H	16	22	21	75	5	38
Subtotal	H	26	28	22	102	7	90
*Hidden River	I						
Talkeetna D-1	I	7	3		17	1	28
Talkeetna Mts. D-6	I	1			2		3
Subtotal	I	8	3		19	1	31
Kenai	J						
Tyonek A-1	J	1		1	3		3
Tyonek A-2	J			5	5		6
Kenai C-2	J	1	4	1	7	1	17
Kenai C-3	J	7	4	2	20	1	140
Kenai C-4	J	3	3		9	1	18
Kenai D-1	J	8	17		33	5	121
Kenai D-2	J	9	9	4	31	3	213
Kenai D-3	J	4	8	1	17	2	69
Kenai D-4	J						8
Subtotal	J	33	45	14	125	13	595
Cook Inlet/Kenai GRAND TOTAL		237	329	170	973	90	1,705

* Pairs X 2 + young + flocked and single = Total Swans
* Trumpeter swan areas located within the Susitna planning area

TABLE 53. Five Additional Proposed Trumpeter Swan Areas in the Susitna Planning Area

Critical Habitats		No. Pairs	No. Young	Flocked & Singles	Total Swan	No. Broods	Sq. Mi. Habitat
Tyone Creek							
Talkeetna Mts.	D-1	-	-	41	41	-	5
" "	C-1	22	29	5	78	11	198
" "	B-1	7	9	1	24	3	39
Gulkana	C-6	13	20	10	56	6	55
Subtotal		42	58	57	199	20	297
Upper Susitna							
Healy	A-1	7	19	30	63	4	24
"	A-2	2	7	-	11	2	12
Talkeetna Mts.	D-1	.1	-	62	64	-	21
Subtotal		10	26	92	138	6	57
Grayling Lake							
Gulkana	A-6	9	6	8	23	2	73
"	B-6	19	21	72	137	8	132
Subtotal		28	27	80	160	10	205
Bell Lake							
Gulkana	B-6	5	10	1	21	3	28
"	C-6	20	22	13	75	8	74
"	C-5	5	4	-	14	1	26
"	B-5	5	9	1	20	2	26
Subtotal		35	45	15	130	14	154
Y-Lake							
Gulkana	C-5	12	19	1	44	5	57
"	B-5	10	11	1	32	4	73
Subtotal		22	30	2	76	9	130
Upper Susitna Grand Total		137	186	246	703	59	843
GRAND TOTAL		374	515	416	1,676	149	2,548

E. Jim-Swan lakes. This area includes all state lands within the boundary illustrated on Atlas Map C6. The size of this area is approximately 23,341 acres.

Justification. This area is a popular sport hunting and fishing area. Jim Creek is an important salmon-producing watershed of the Knik River system (Watsjold pers. comm.). In 1982, more than 2,300 coho, 800 sockeye, 150 chum, and 1,250 Dolly Varden/Arctic char were harvested from the Knik River and its tributaries including Jim Creek (Mills 1982). Of the 6,653 fishing-days expended and fish harvested on the Knik River, most are attributed to the Jim Creek system (Mills 1982). In addition, thousands of swans, ducks, and geese stop here in September-October during their fall migration.

The amount of money spent to travel to Jim-Swan lakes by the large number of recreational users represents a sizeable economic benefit. The economic analysis on the Willow Creek sport fishery (ADF&G 1982) uses "willingness to sell" or dollar value of one pink salmon fishing day ($140.46) (Appendix A). This value, when applied to all species harvested in the Jim Creek area, indicates that, at a minimum, $456,495 is spent as a result of this sport fishery in 1982.

A moose population census has not been conducted for this particular area. However, moose aerial surveys (composition surveys) have been conducted in the past. Density estimates of moose derived from these surveys indicate populations of 200 to 250 moose (D. Bader 1982).

The Jim-Swan lake area is quite accessible, and for this reason is considered important for moose hunting. In 1981, approximately 69 hunters reported hunting in this area and spent 283 days to harvest 17 moose (Appendix B). However, for every hunter reporting there are 2.63 hunters not reporting their moose harvest tickets (Chapter 1). Based on this information, it is estimated that as many as 181 hunters spent 744 user-days to harvest 44 moose here in 1981. Fifty-four percent of these moose hunters were from the Anchorage area, 45% were from the Palmer-Wasilla area, and 1% were from other areas.

The economic value associated with moose hunting in this area for 1981 includes an estimated total net expenditure of $42,897 by hunters for recreational equipment, lodging, etc. and $81,505 as the replacement protein value for moose meat (Appendix B, Table 31).

F. Matanuska Valley Moose Range. This area includes all state lands within the proposed boundary illustrated on Atlas Map C6. The size of this area is approximately 150,000 acres.

Justification. The Matanuska-Susitna Borough enacted an ordinance in 1980, zoning 30,000 acres as the Moose Creek Reserve Special Use Area to preserve public use and allow moose management. This proposed nomination for the Matanuska moose range would expand that area and would allow moose management on approximately 120,000 additional acres of state-owned land.

This area is a readily accessible moose production and harvest area within the Susitna planning area. Moose population and harvest information is available. In a 1982 aerial survey, 931 moose were counted. Based on this information and other moose density estimates from Susitna basin studies (Bader 1982), population estimates range from 1,500 to 2,000 moose.

Moose harvest and hunting effort for this area is derived by combining the statistics for five separate report code units (14-01-007, -009, -011, -013, and -017). These statistics show that 334 hunters spent 1,579 user-days to harvest 212 moose in 1981 (Appendix B; Data Supplement A). However, for every hunter reporting, 2.63 hunters do not report their moose harvest tickets (Chapter I). Based on this information, it is estimated that as many as 878 hunters spent 4,153 user-days to harvest 558 moose within this area in 1981. Sixty-three percent of the moose hunters were from the Anchorage area, 34% were from the Palmer-Wasilla area, and 3% were from other areas (Appendix B; Data Supplement A).

The economic value associated with moose hunting in this area for 1981 includes an estimated total net expenditure of $208,086 by hunters for recreational equipment, lodging, etc., and $1,033,639 as the replacement protein value for moose meat (Appendix B; Chapter I, Table 31).

One of the main purposes of establishing this area as a moose range is to reserve a land base where the plant browse species can be manipulated ("enhanced") to return them to an earlier seral stage which moose prefer. This enhancement technique may increase production of moose forage. "Habitat enhancement" was attempted on approximately 875 acres within the original 30,000 acre moose reserve designation in 1983. A draft cooperative management plan between forestry and wildlife representatives has proposed the rehabilitation of an additional 3,000 to 5,000 acres per year until the year 2015, by various timber harvesting practices and chaining (a technique which knocks down trees by dragging a chain through the forest), (Didrickson pers. comm.). Through this type of habitat management, the potential moose carrying capacity of the habitat in the area may be increased with a concomitant increase in moose productivity.

The proposed legislation for the Matanuska moose range is a multiple use designation. It would allow public hunting, fishing, trapping, timber cutting, coal mining, and other outdoor related activities. The designation only prevents the disposal of state land into private ownership.

An important reason for proposing legislative designation is to test the practice of "habitat enhancement" in order to attempt to increase population numbers of moose. In addition, a large area of good habitat for moose will be retained near a major population center.

G. <u>Mount Susitna - Beluga</u>. This area includes all state lands within the proposed boundary illustrated in Atlas Map C6. The size of this area is approximately 210,392 acres.

Justification. This area is one of the important wildlife production and harvest areas within the Susitna planning area. Large numbers of moose, brown bears, black bears, wolves, wolverines, numerous small game, and furbearing animals inhabit the nominated area.

Aerial composition surveys (spot sampling) have been conducted in this area since 1953 (ADF&G files). In 1971, aerial surveys alone counted 1,139 moose in a portion of the proposed area. Based on this sample information, and moose density estimates derived as part of this department's Susitna basin studies (Bader 1982), population estimates range from 3,000 to 4,000 moose.

Moose harvest and hunting effort for this area is represented by portions of the moose harvest report code units 16-02-012 and -013. Hunter access to this area is primarily by airplane. The Data Supplement A, indicates that approximately 220 hunters reported using aircraft for the two code units in this area. These hunters spent 1,161 days to harvest 74 moose. However, for every hunter reporting, 2.63 hunters do not report their moose harvest tickets (Chapter I).

Based on this information, it is estimated that approximately 579 hunters spent 3,053 days to harvest 195 moose within the two specified harvest report code units. Eighty percent of the hunters in this area were from Anchorage, 5% were from Palmer-Wasilla, 9% were Alaskan non-residents, and 6% were from other areas (Data Supplement A).

The economic value associated with moose hunting in this area for 1981 includes an estimated total net expenditure of $137,223 by hunters for recreational equipment and lodging, etc. and $361,218 as the replacement protein value for moose meat (Appendix B; Chapter I, Table 31).

Evaluations of habitat suitability for moose, and forage production (Atlas Maps B9a, B9b, B14a) indicate that approximately 95% of the habitat in the area is moderately valued for these parameters during the spring, summer and fall seasons. At least 30% of the winter range has moderately and highly rated forage production capability.

The number of wildlife species (species diversity or richness) occurring in this area ranges from 1 to 91 species per vegetation type. An evaluation of the wildlife diversity of this area (Atlas Map B11), indicates that 80% of the habitat is highly rated (67 to 91 species per vegetation type), 15% is moderately rated (36 to 61 species per vegetation type), and 5% has a low rating (1 to 31 species per vegetation type). This rating is an indication of environmental productivity and stability.

Availability of moose winter range based on estimated snow accumulation (Atlas Map B13) indicates that nearly all of the area's moose winter range would not be available during normal and/or severe winters. Moose that don't migrate to the Susitna River corridor or the Susitna Flats State Game Refuge under high snow accumulation conditions could starve.

This area has a very high recreation potential. Moose, black and brown bears are abundant. The potential for increased forage production in the eastern lower elevations (20% of the area) is high and suggests that habitat enhancement could be developed in this area to attempt to increase moose production and maintain existing populations (Atlas Map B14b). Access is currently limited to aircraft and air-lifted all-terrain vehicles. When all weather/season road access is developed to Beluga, this area will provide greater public use opportunities comparable to most other areas within the Susitna planning area.

H. Prairie Creek. This nomination includes all lands and waters within 0.25 miles of either side of Prairie Creek beginning at its head waters at Stephan Lake to its confluence with the Talkeetna River. The size of this area is approximately 9,299 acres.

Justification. Prairie Creek has the highest density of spawning king salmon per stream mile of any stream within the Matanuska-Susitna Borough (Engel pers. comm.). In 1982, chinook salmon escapement was 3,844, but has been as high as 6,513 fish in 1976 (Bentz 1983). Equally important, is the fact that these salmon support the highest concentration of brown bears during July and August of any known location within the Susitna planning area. It is estimated that nearly 40 brown bears from as far away as 100 km are attracted to Prairie Creek to feed on king salmon (Miller pers. comm.). One bear tagged (during the Susitna Hydroelectric big game downstream studies) moved from upper Gold Creek to Prairie Creek to fish for king salmon, even though chum salmon were available in the Susitna River around the mouth of Gold Creek, much closer to this bear's regular home range.

Prairie Creek may not have as high a concentration of bears as does the nationally known McNeil River State Game Sanctuary, where as many as 70 bears regularly utilize the McNeil River falls. It nevertheless is the largest known concentration of feeding brown bears within the Susitna planning area. The king salmon that spawn in Prairie Creek and the adjoining upland habitats are critical in supporting possibly 40 bears during July and August.

In order to maintain the present population of king salmon and the accompanying populations of brown bears, the stream and its adjoining uplands should be protected from incompatible land uses. The proposed area is currently in native ownership. The department recommends that the plan identify the state's interest in this parcel and propose the development of cooperative land management agreements with the land owners or possible trade or purchase to protect the values of this area.

I. Bird Island (Western Lake Louise). This area includes all uplands in the SW¼ of Section 8, T. 6 N., R. 7 W., Copper River Meridian. The size of this area is approximately 1.97 acres.

Justification. Bird Island is unique because it supports the northernmost known colony of double-crested cormorants in North America, and is the largest known herring gull colony in Interior Alaska. Double-crested cormorants have suffered serious population declines throughout much of their range in the lower 48. Islands are the preferred nesting habitat by double-crested cormorants and herring gulls, because they are free from mammalian predators. These bird species require specific habitat parameters for nesting, and not all islands are suitable. If this particular island is lost to them for nesting, the birds probably will not find suitable nest sites in the vicinity, and the breeding population will disperse.

It is important to maintain these breeding populations because many people in the area do not have a chance to view other seabird colonies unless they travel hundreds of miles to Homer or to Kodiak (nearest true oceanic areas for seabirds). The presence of these birds adds to the quality of peoples' lives aesthetically and educationally. The greatest threat to the birds of Bird Island is human disturbance. Human visitation to the island during the critical egg-laying, incubation and chick-rearing periods would be a source of disturbance and population decline and should be prohibited.

If the island's land status should change to become a private recreational site, with a cabin and associated human use, the birds would abandon this traditional nest site.

Goal II. Ensure Access to Public Lands and Water

The state will ensure access to public lands and waters for the purpose of promoting and/or enhancing the responsible public use and enjoyment of fish and wildlife resources.

Retaining the major hunting and fishing trails, river corridors, lake shores, airstrips, and other access areas in public ownership is a paramount necessity for maintaining public use opportunities at the levels occurring today. Additional access considerations are needed to accommodate the projected increase in use and demand associated with the projected human population increases for Anchorage and the Matanuska-Susitna Borough to the year 2000 (G. Knapp pers. comm.).

Access retained in public ownership protects the people's right to choose for themselves when, where, and under what circumstances they participate in outdoor recreation (hunting, hiking, boating, fishing and viewing). Most Alaskans pursuing recreational interests came to the state because it offers an abundance of opportunities to enjoy the outdoors. The fact that more than 1,650,000 recreational user-days, are expended annually in the Susitna planning area makes this fact vividly apparent. During 1980, more than 69,000 recreational fishermen and 19,000 hunters spent over 700,000 days in the Susitna planning area. Non-hunting and fishing activities such as RV and tent camping, picnicking, hiking, snowmobiling, cross country skiing, boating and driving for pleasure contributed nearly 950,000 additional user days.

The state should protect the public's access to outdoor resources within the Susitna planning area. Public retention of use areas and access corridors, such as trails, waterways, shorelines and airstrips, in state ownership will reduce conflicts between private landowners and the public. These actions are needed to maintain public use at existing levels and to reduce the need to repurchase (with public funds) access and use rights.

Objective 1 - Maintain or Improve Public Access and Establish a Trail System

Maintain or obtain sufficient rights to lands which the state leases or sells to protect or improve public access to areas where public use of fish and wildlife resources exists.

The department recommends that the state retain in public ownership river and lake shore lands and traditional access routes that are on public lands or that cross lands that will soon be in private ownership. The ADF&G has identified these access routes and included trails used for hunting, fishing and other related outdoor recreational activities. These are identified on Atlas Maps C1 and C3.

The Susitna planning area has only limited access into most of the area. Only the existing access routes which support the upper 80% of public use (Atlas Maps C2a, C2b, and C2c) were considered for retention and classification. Trail corridors need to be established, in these areas if no trails are present and all ADF&G guidelines should be followed. Some popular trails on private lands should be considered for repurchase, or to have access easements on them. On public lands, sufficient space should be retained at trail heads and termina to accommodate parking and camping activities. Special effort should be made to acquire stream corridors and public boat launch and camping facilities on popular fishing streams and lakes, where the banks are mainly in private ownership, and little or no opportunity exists for public use. On public lands and waters, stream corridors of sufficient width are necessary to protect riparian wildlife habitat and to allow for public hunting, fishing, camping, parking, and boat launching facilities.

Human use of the fish and wildlife resources is directly dependant on access. Most of the hunting and fishing is concentrated in or near the areas of access. Thus, in order to maintain hunting, fishing, and related outdoor recreation at its existing level of 1,650,000 person-days and to accommodate any future increase in demand, specific provisions must be made to retain public ownership of existing and potential access areas within the Susitna planning area.

Maintaining the existing access, the 80% most used public hunting areas, and the subsistence areas in public ownership meet this objective (Atlas Maps C1, C2a, C2b, C2c, C3 and C4).

GOAL III - Mitigate Losses of Fish, Wildlife, and Their Habitats

Where development is to occur, the state will seek to maintain as much wildlife habitat as is possible in conjunction with any development project that is undertaken.

The use of public lands and waters for the development of forestry, coal, minerals, agriculture and ultimately settlement are important issues to many people, because these same lands are, often times, important fish and wildlife production and harvest areas. The availability of state land for all these purposes has been a concern expressed by many communities and by thousands of people within and adjacent to the Susitna planning area, because all these uses are not compatible. Some of the uses can lead to significant loss of fish and wildlife populations through disturbance, alteration, or destruction of important habitat.

Some habitat loss or alteration is inevitable when development occurs and little can be done to prevent it. However, major habitat losses can sometimes be avoided or minimized by proper planning of development projects.

Fish and wildlife needs should be considered and mitigated for during planning and development of land or water resources to avoid or minimize potential adverse effects on habitats. Planning prior to development can lead to practical alternatives that reduce harm to fish and wildlife. It is also important to provide for the restoration or rehabilitation of damaged habitat where it occurs and to maintain it upon rehabilitation.

Because the development of resources, other than fish and wildlife, and the settlement of Alaska's lands are inevitable, a state mitigation policy is needed to address the public's interest and minimize the loss of our fish and wildlife resources. The Alaska Department of Fish and Game has developed such a policy and is proposing it to ADNR for adoption. This Mitigation Policy is presented later in this chapter. Currently no formal process exists to address mitigation. As a result of this situation the department has formulated a consultation process for ADNR's consideration and adoption. This process is discussed further on in this chapter.

Effective mitigation of development of other resources or of settlement on or adjacent to fish and wildlife habitat and related public use areas includes the adoption and implementation of best management practices through development guidelines. ADF&G will provide guidance for minimizing detrimental impacts to fish and wildlife associated with many land uses by improving the accessibility of information on existing best management practices.

This department has developed guidelines for ADNR's consideration and adoption. General guidelines and guidelines for the development of agriculture, settlement, forestry, refuges and critical habitats, transportation and utility corridors, wetlands, buffer zones, riparian areas and other special fish and wildlife areas are presented later in this chapter.

The following goal and objective address mitigation in general, this department's proposed mitigation policy, the consultation process, and the developmental guidelines.

Objective 1 - Minimize Loss of Habitat

Where possible, avoid the loss of the natural fish and wildlife habitat and minimize the need for costly human-assisted habitat restoration efforts.

a. Include fish and wildlife habitat considerations in the early phases of the planning and design of resource development projects.

This department has presented its concerns regarding ADNR's project consideration process. Currently no formal consultation process exists. As a result of this situation, the Department of Fish and Game is proposing the following consultation process for adoption:

The Consultation Process. Department refers to the Alaska Department of Natural Resources for the purpose of this consultation process.

Purpose: The results of the consultation process provide a basis for analysis of the environmental, social and cultural aspects of a proposed project, and will identify any problems that should be considered in the department's resource allocation and permitting procedures. The department will implement the consultation process as an initial step in compliance with AS 38.05.035. The consultation process is not viewed as a new or additional administration procedure, but rather a clarification of the department's interagency coordination process.

Pre-project consultation: The pre-project consultation process is a useful initial step in budgeting project related expenditures. The department might find, after discussions with appropriate agencies, that the project is wholly or partly infeasible, or otherwise poses unforeseen economic, social or environmental problems. Pre-project consultation helps to ensure better applications and expedites the formal interagency consultation process as required by the plan.

Consultation must be complete and documented. Each project must be a self-contained document so that the department, other state and local agencies, and the interested members of the public may fully understand the proposed project. The information contained in the project description should be specific, accurate, and sufficiently quantified to convey a precise picture of the project and its probable effects. The consultation process is comprised of several steps.

State statutes require the department to consult with other agencies having responsibility to review projects as part of the department's resource allocations and permitting procedures. The department begins by contacting the appropriate agencies and describes in writing the proposed project and its potential effects to the extent possible. A list of agencies to be contacted for pre-project consultation will be identified for each resource management subregion defined in the area plan. This initial contact will provide an opportunity for agencies to comment and define any studies that may be needed to identify potential impacts and to recommend adequate protective and mitigative measures. The project proposal is prepared following initial agency contacts.

Formal consultation request: The second step in the process occurs when the department formally requests consultation with agencies. This request must be made to allow a resource allocation or permit. The request should be made in writing to facilitate documentation of the consultation process. At this point, the project is described in detail to the agencies, and the information presented includes the results of any studies performed and responds to the preliminary comments and recommendations of the agencies. A specific time frame for preparing and considering agency comments and recommendations for the project will be determined.

Documentation: The third step of the consultation process is documentation. The department's response to comments and recommendations received during the agency review period must be stated in the finding of facts which result in a best interest determination. At that time, a copy of the final proposal and the findings and the best interest determination should be provided to each of the agencies consulted. Should any agencies with whom the applicant is required to consult fail to provide written documentation indicating a completed consultation within the prescribed time, the department may provide a summary of its attempts to consult and the results of any consultation that has certain activities or specific project approvals may be exempted from the consultation process if agreed to by the department and the agencies with whom consultation is requested.

Section 2-C of this draft addresses the role of planning in minimizing the loss of habitat as well.

b. Develop siting and design criteria which will minimize wildlife-caused damages to life and property (in areas where human development conflicts with fish and wildlife resources).

The ADF&G has developed guidelines regarding the development of specific resources (e.g. coal). These appear in the guideline section later in this chapter.

This department, in conjunction with ADNR, developed guidelines for subdivision design and siting. The results of this effort appear in a ADNR publication entitled "Design of Residential and Recreational Subdivisions" and represents a systematic approach to site evaluation and design for use in Alaskan land disposal programs.

c. Identify and provide greenbelts adequate to protect water quality of anadromous fish waters, major fishing streams and their tributaries.

The ADF&G has considered the protection of these resources by providing guidelines for buffer zones associated with the development of various resources and/or settlement activities. These appear later in the guideline section of this chapter.

Through careful project design and execution, the spatial and temporal extent of the impacts of developmental activities can be minimized. For example, giving attention to the sensitivities of specific fish, wildlife and habitats, using natural buffers or vegetative screens to isolate disturbance, and seasonal restrictions on development, can significantly minimize impact and hasten recovery.

Objective 2 - Habitat Restoration

When loss of habitat cannot be minimized, it will be necessary to restore or rehabilitate the habitat that was lost or disturbed to its pre-disturbance condition (where cost effective).

a. Assess the present and/or potential damage that may occur as a result of a development project.

   The ADF&G has addressed the subject of damage assessment that may be incurred by development projects in section II D of this department's proposed mitigation policy later in this chapter.

b. Onsite evaluation and monitoring of land and water developments should be conducted.

   The ADF&G considers these issues to be paramount in providing minimum protection for public resources, minimizing losses and/or assessing habitat damages. This is addressed in the section on the consultation process.

c. Rectification of disruptions to habitat should be implemented through permit, lease, or project stipulations.

   The ADF&G considers rectification as the third priority mitigative approach and is discussed in section II B 2a of this department's mitigation policy in this chapter.

Objective 3 - Compensation

When plans that call for major state commitments of land and other natural resources could result in significant, unavoidable loss of fish and wildlife resources or use opportunities, it is reasonable that other habitat areas may be dedicated for compensation of resource loss.

The ADF&G has considered the subject of compensation for habitat and related resource losses in the section of this chapter dealing with proposed mitigation policy. Compensation, per se, is discussed in Section II B 2c of the proposed mitigation policy.

Proposed State Policy
on
Mitigation of Fish and Wildlife Habitat

I. The Need for Policy

Logging, construction, mining, agriculture, settlement and other developmental activities which use land or water are of great importance to many Alaskans. When properly pursued, these undertakings can be compatible with proper management and use of Alaska's valuable fish and wildlife resources. However, improper practices can lead to significant degradation of the state's fisheries and wildlife resources and related public use opportunities by altering or destroying important habitat components.

Development includes a multitude of practices such as road building, bridge construction, culvert placement, excavation, dredging, clearing, dragging, dumping, and other activities. All these impart existing land and water, the very basis of all fish and wildlife habitat. Each development action requires space, and thereby alters fish and wildlife habitat and compromises other types of uses. Development activities, when disruptive to fish or wildlife resources, may, for example, increase erosion or sedimentation, divert, obstruct, alter, or pollute water flow, aggravate temperature extremes, alter and destroy populations of animals and vegetation, reduce food supplies, restrict movement of fish and wildlife, disturb or destroy spawning, nesting and breeding areas, change adjacent or downstream habitats, change the capacity of a stream or wetland to store and use storm or flood waters or reduce public access or use opportunities.

Often, such habitat losses are inevitable and little can be done to prevent or control them, but often they can, in the public interest, be abated or "mitigated." The overall mitigative goal of the State of Alaska is to maintain or establish an ecosystem with the developmental project that is as nearly desirable as the ecosystem that would have been there in the absence of that project. The decision levels through which a project is reviewed - preventing, minimizing, and replacing ecosystems - is outlined and discussed in this policy.

The magnitude of the impact of development on fish and wildlife habitat is dependent on the degree to which development is properly planned and on the conscientious adherence to practices designed to protect fisheries, wildlife and public use values. Therefore, it is the primary objective of the state that fish, wildlife and habitat values be prominently considered by developers and regulatory agencies prior to land and water allocations, or issuance of regulatory approvals. Consideration should take place during the planning and implementation associated with land and water development. This is necessary to avoid or minimize foreseeable or potential adverse environmental effects before damage takes place, and early enough to consider all beneficial alternatives. Similarly, it is imperative to provide for repair, restoration, or rehabilitation of habitat damage after it occurs, should it occur at all, as well as to maintain the reconstructed habitat over time.

These concepts--preventing, minimizing, replacing--when molded into a working definition of mitigation, will contribute to the sustained functioning of aquatic and terrestrial systems, and the continued viability of fish and wildlife resources, while providing for the other needs of Alaskans. A mitigation policy, therefore, is essential to guide, not stop, development actions by insuring considerations of alternatives to fulfill the sustained yield management precepts of Alaska law.

II. Statement of Policy

A. Definition

The nature of and extent to which mitigation is carried out is left to the state's discretion. In considering mitigatory options it is essential to recognize the differing degrees of stress that may be placed on natural fish and wildlife habitat. Lightly-stressed aquatic or terrestrial systems adjust to change, and recovery takes place through natural processes when the stress is removed. In contrast, a heavily or overstressed natural system cannot restore itself to original conditions through natural processes alone. In this case, the system's capacity for maintenance and repair has been impeded, and at this point, humans must provide assistance for the system to be restored. These differences in recovery potentials dictate different approaches to implementing mitigation measures.

Accordingly, the state, when defining and administering mitigation measures, agrees with the definition of mitigation in the Federal regulations (40 CFR 1508.20) which implements the National Environmental Policy Act (42 U.S.C. 4321 et seq.). Mitigation includes, in priority order of implementation:

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

(2) minimizing impacts by limiting the degree or magnitude of the action or its implementation;

(3) rectifying the impact by repairing, rehabilitating, or restoring the affected environment;

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

(5) compensating for the impact by replacing or providing substitute resources or environments.

B. Implementation

The state will implement the five forms of mitigation pursuant to its statutory authorities to manage and regulate the use of land and waters under its jurisdiction in the following manner:

1. Mitigation to Avoid or Minimize Habitat Damage

a. Avoidance

The state's primary approach to mitigation is one of preventive conservation designed to avoid an ever shrinking base of natural habitats and costly restoration efforts. It is founded on preventing adverse, predictable, and irreversible trends or changes in natural aquatic or terrestrial systems. The objective is to maintain as much existing natural habitat on state lands as possible, even if the relative importance or interrelationships of living organisms are not fully known. Apart from denying outright allocations or the issuance of a permit or lease, this may be accomplished by attaching stipulations or conditions to permits or leases for proposed developments. Specifically various developmental activities must be individually tailored to fit the particular site. Seasonal timing must also be taken into consideration in order to maintain individuals or groups of fish and wildlife species that use various habitats in an annual or seasonal cycle. Mitigation by permit or lease stipulation can be employed to avoid activities in areas with a high risk of adverse impact, such as nest sites, winter ranges, or critical habitat. Development consistent with the objectives for designated areas can proceed according to the stipulations or conditions. This fundamental approach provides for beneficial land and water use programs in natural systems.

b. Minimization

Minimization differs from avoidance in that it is acknowledged that some habitat damage will occur. The state recognizes that land and water development projects are mandated by public need, legislative or constitutional prioritization of land use, or by pervading economic considerations. It is recognized that industrial, agricultural and residential development in Alaska will cause some amount of habitat destruction, and that this damage has been accepted by developers and policy makers as the price of economic benefit. The second priority mitigative approach to habitat management is to make that loss less severe, or to minimize foreseeable disruptions to aquatic and terrestrial systems. The focus of this approach is to maintain habitat diversity and the capacity of each system to restore itself naturally from stress or damage, while accommodating other uses of land and waters. These other uses may reduce species abundance or diversity to some degree or cause some disturbance to species' behavior.

Minimal adverse habitat disruption may be achieved by permit or lease stipulations which limit development actions when and where necessary, to the extent needed to maximize conservation of fish and wildlife values. For example, temporal mitigation measures, which involve adjusting the timing of project activities to reduce impacts in areas of high risk, can be used to restrict development to the seasons when the impact is least, or to reduce the amount of time spent in a sensitive area. Habitat may be stressed temporarily, but recovery can take place through no-cost natural processes.

2. Mitigation In Lieu of Habitat Damage

a. Rectification

The third priority mitigative approach is to repair, rehabilitate, or restore abused aquatic or terrestrial systems. This requires either 1) onsite or post-construction evaluations of water and land developments after the fact of damage, or 2) estimation, during the planning stage, of likely environmental damage. Rectification is less desirable than avoidance or minimization because, even if restoration is complete, there is a net loss of fish and wildlife and habitat, resulting from the time lag between the impact and full replacement. Such time lags may vary from days to decades. Thus, gains or benefits to be realized from this form of mitigation are somewhat less than those of full prevention.

The objective is to restore the same habitats and associated wildlife as those that were lost, or, to restore the habitat to pre-disturbance conditions. However, if it is impossible to restore the habitat by any means (e.g. flooding by a dam) it makes little sense to devise and implement factors which cannot alleviate that situation. The simplistic view of maximizing one kind of habitat at the expense of another should be avoided. The state recognizes that there will be situations where no rehabilitation of the loss incurred is possible.

If proper planning occurred, rectification should only be necessary when the developer has not complied with the plan, applicable laws, and permit stipulations. Rectification of disruptions to the habitat may be implemented through permit or lease stipulations and amendments imposed by a court ordered penalty. It is likely that the disturbed environment from completed or partially completed projects can be restored using the best methods now available. This could result in the recovery of substantial amounts of project-caused fish and wildlife losses.

b. Preservation and Maintenance Actions

Mitigation should be recognized as a continuing obligation throughout and during the entire life of the project. The state recognizes that if mitigation measures are approved but not instigated and maintained during the life of the project, no habitat improvement will be realized. If the promise of mitigation helped justify the project in the first place, and this mitigation is not implemented, litigation could ensue. The state believes that costs of mitigation are all normal costs of any land or water development and must be borne by the developers and beneficiaries of the project.

Habitat preservation and maintenance may be imposed through permit or lease stipulations or their amendments. For example, drainage structures installed in fish streams should be required to be maintained properly, and erosion must be corrected when it occurs. Revegetated areas which are not successful, for whatever reason, must be revegetated until they have become established. In these ways, adverse impacts will be reduced or eliminated over time.

A requirement (or permit or lease stipulation) that developers continue to mitigate by maintenance operations during the life of the project will ensure that conservation objectives are met and litigation is avoided.

c. Compensation

Whenever an allocation of land and water resources will cause a reduction or loss of values to the public--losses in terms of fish and wildlife populations or habitat, recreation opportunities, access, and other foregone resource use opportunities--the project sponsor must create or restore an equivalent part of the aquatic or terrestrial ecosystem to compensate for the loss. The most difficult problem encountered with this approach is determining what kind of action is appropriate and how much mitigation is adequate. The problem can be resolved qualitatively, through negotiation and quantitatively through the establishment of evaluation procedures.

It is the state's position that compensation should not involve a simple payment of dollars, but instead should involve replacement of lost habitat, populations or recreational opportunities.

Compensation by replacing or providing substitute resources or environments is the least desirable form of mitigation because it accepts loss of habitat at the outset and and often cannot result in total reparation for those losses. When it must be implemented, however, the preferred form of compensation is onsite mitigation; that is, all damage caused by a project should be replaced within the development site or project area where damage occurs. The same functions or types of habitat that are lost should be directly restored, replaced, or compensated. Only secondarily should compensation by substitution of other lands, (trade-off of an unavoidable ecological loss for an ecological improvement elsewhere) be used. Tradeoffs or conversions only exchange one kind of environment for another, and the latter may be desirable or not. There are divergent views and interests between local and more distant users regarding the value of the "improvement" or development of the endemic ecosystem.

Any type of compensation will be costly, and the values of lost resources cannot be measured solely through economic cost/benefit ratios or person-day expenditures. This sort of analysis must be accompanied by evaluations which measure factors other than human uses of land, water, and the resources within. The value of the interdependent biological relationships within an entire ecosystem is too often ignored. Since some ecosystems, such as wetlands, may never be successfully replaced or substituted, it is important that the land owner, developer, and the various government agencies work together to salvage such lands to rectify the loss of the resource values of those areas. The state recognizes, however, that in some rare cases, the only compensation negotiable may be prevention of future losses in another or adjacent area.

C. The Role of Planning

Proper mitigation of fish and wildlife habitat losses requires that land and water use projects be properly designed and planned. This requires active participation by fish and wildlife experts at the earliest project conceptualization or design state, before permits or leases are issued.

Proper area planning, particularly at the management level, will assist in abating a common cause of fish and wildlife habitat decline piecemeal habitat losses which are cumulative. Management or area planning, when it precedes significant land or water use programs, will allow reduction of the cumulative effects resulting from a variety of projects.

Prior to permit or lease issuance there should be a realistic assessment of the specific losses which likely will be incurred. The losses should be identified first in terms of lost resources and secondly in terms of the uses which may be foregone. This is because human use and resource productivity do not always correlate. The state cannot accept analyses which equate low human use figures to low estimates of losses. Low human use has no bearing on how much fish, wildlife, or their habitat may have been lost; or how much productivity, biological diversity or critical processes were impaired. However, the loss of human use should be a factor that will need to be mitigated.

Losses of fish and wildlife habitat that cannot be mitigated will affect the people who use those resources. Wherever the carrying capacity of the land or water is reduced, harvest of species by subsistence, commercial, and recreational users may have to be reduced. Recreational opportunities to view resources may also decline. As the population of the State of Alaska increases, competition for fish and wildlife resources will surely increase. Decreased abundance of these resources will mean that some resource users will get less of the resource than they may have had in the past. As more and more habitat is damaged or lost, the problem of a growing population base and its pressure on fish and wildlife, will be aggravated.

The impacts of a proposed project and alternatives to it on all the natural resources affected, therefore, should be assessed early in the project planning process. The effects of a fish and wildlife project on other resources, such as timber, water, human use, or on fish and wildlife should be assessed. Alternatives, to building structures e.g., providing minimum stream flows rather than a hatchery to maintain a population of fish, to achieve the project objective should be required and considered first, because they have the least negative impact.

Consideration of all natural resources early in the planning process (plants, animals, ecosystem diversity) should lead to development of ways to minimize effects on these resources in all phases of project development. This will reduce the need to later add on the more costly, conspicuous, and less desirable remedies after the fact of damage. The specific properties and characteristics of the natural system which must remain after development should be defined prior to initial project approval. The developer is then allowed to proceed with the project under pre-established mitigation measures, which will guarantee functioning of a natural system and not cause permanent or costly public harm.

D. Assessment of Damages

The combination of population pressures, diminishing space, energy needs, and the necessity of considering economic variables in most decisions have culminated in questions regarding the intrinsic values of human's surroundings. Attempting to place price tags on an area's worth, whether in terms of its retention as a natural system or in terms of its value in an altered condition, is inherently difficult.

The state of the art in valuation of habitats will lag behind the need to make resource allocation decisions. The state believes that fish and wildlife habitat should be preserved unless the expected benefits of the development is demonstrably "large" relative to loss of fish and wildlife values. Of course, what is deemed acceptable must be a broad social decision which necessarily requires assessment of the resource damage likely to be incurred as a result of the development.

In theory, it would seem a simple matter to observe the impact of a construction project, determine if fish or wildlife are killed, and then assess damage. In practice, it is anything but. Damage may be incremental, and not identifiable without extensive baseline and post-project data. Mortality may affect juveniles as well as adults. Damage to habitat or to populations of juveniles may not impact resource users or be measurable for several years. However, these effects will be obvious when the particular cohort should have reached adulthood. Other damages, such as those affecting migratory species or the "lower" members of a food chain, may be visible but not able to have a dollar value placed on them. Less tangible aspects of resource damage include decreased aesthetic worth and decreased ability to provide a specific wildlife habitat. Finally, in an environment possessing many, often only partially understood, natural interrelationships - and impacted by any number of human-related activities - definitive assessment of precise cause and effect relationships between development impacts and fish or wildlife mortalities will be difficult and often impossible.

This problem is intensified by the absence of even rudimentary data at a large number of site-specific locations. It follows that assessment of damage will, at best, be a combination of assessment of the partial data base available concerning stock levels, seasonal and cyclical abundance and location, together with a scientific judgement of the "most likely" result of environmental damage. This is based on a general understanding of fish and wildlife habitat dependencies and tolerances.

These types of judgements have put extreme pressure on land and water managers, and pose unknown risks for fish and wildlife resources. In such cases, and where the only other alternative is to stand mute and observe a steady erosion of fish and wildlife values, (uncorrected and uncompensated for) a judgement decision is necessary.

The state holds that the appropriate standard for measuring damages to natural resources is the cost which would be reasonably incurred by the state to restore or rehabilitate the environment in the affected area to its pre-existing condition, or as close thereto as is feasible without grossly disproportionate expenditures.

The question is prompted: "At what point do indirect or cumulative effects become so remote that mitigation should not be required?" It is from baseline data that the degree of project impact, and hence the degree of mitigation required, is measured. Because damage estimates will be based upon scanty or incomplete knowledge, and will often be probabilistic in nature, it is possible that estimates of "most likely" level of damage may, from time to time, vary. It is the Department of Natural Resource's belief that in such cases of difference, the onus of proof to explain any lower estimates must lie with the developer. This position is based upon the recognition that the developer is the potential beneficiary of both an early start (relative to time required for adequate environmental inventory) and of any lower damage estimate that is put forth.

III. Summary

(1) Mitigation is necessary to guide land and water allocations and resource development in order to preclude, abate, repair, or indemnify the adverse effects upon fish, wildlife, their habitat and related uses resulting from development projects on lands and waters under the jurisdiction of the State of Alaska.

(2) The state's authority to approve resource allocations and development plans on state lands as well as the public trust doctrine asserting the public's right to unimpaired fish and wildlife production on public lands, provide the means and the obligation to compel mitigation measures.

(3) Differences in recovery potentials due to differing degrees of stress placed upon fish, wildlife, and their habitat dictate that mitigation measures be selected accordingly.

(4) Mitigation before the fact of damage is the preferred means, with avoidance of damage or loss as the primary objective, and minimization rectification, maintenance, and compensation following in that order. Each may be implemented through permit or lease stipulations.

(5) Mitigation measures imposed after the fact of damage or in lieu of expected damage, may require rectification of damage, maintenance of corrections over time, or compensation by replacing or substituting resources or environments.

(6) Rectification, necessary only when the permittee or lessee has not fulfilled his obligation, may be imposed by stipulation or by court ordered penalty. Projects may be required to restore environments in order to recover fish, wildlife, and habitat losses.

(7) Maintenance mitigation actions are project related. The state holds that maintenance mitigation costs are normal development costs to be borne by the developer and project beneficiaries. This form of mitigation may be imposed by permit stipulations or later amendment.

(8) Compensation by providing substitute resources or environments is the least desirable form of mitigation. When imposed it preferably should be implemented onsite rather than by "improving" an existing ecosystem elsewhere. Compensatory mitigation will only be implemented by negotiating a written agreement with the developer.

(9) Mitigation should be considered at the earliest project conceptualization or design stage. All impacts should be assessed early in the project planning process with first consideration given to nonstructural alternatives to the project objective.

(10) Fish and wildlife habitat should be preserved unless the public benefit of the project is demonstrably large. Assessment of damages will be a decision based in part on existing data bases and in part on "most" likely judgements.

(11) The burden of proof to justify lower estimates of damage to fish and wildlife habitat lies with the developer.

Following are the guidelines relating to and affecting the land and water allocation advocated by the ADF&G.

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GUIDELINES

Introduction

Agricultural activities, mineral extraction, energy exploration and development, timber harvest, recreation, commercial, residential and other potential uses of state lands and resources are important to the growth and well-being of Alaska's economy. However, without proper planning these activities may significantly decrease the capacity of lands to produce fish and wildlife resources. Development activities have the potential for altering or destroying fish and wildlife habitat or directly disturbing species during critical stages of the life-cycle. Varying degrees, timing and intensity of activity, siting, design and methods of construction and operation all interact to increase or decrease the effects on wildlife. By using available knowledge and the best management practices, adverse effects can be appreciably reduced or avoided. The amount of damage resulting from a particular habitat disturbance depends on the development activity and the characteristics and vulnerabilities of the specific habitat or species involved.

Land use or resource development plans should protect productive fish and wildlife core areas and maintain unifying ecological processes. Unifying processes are the dynamic flows of energy, nutrients and water, as well as species interactions and associations (e.g. food webs) which link essential fish and wildlife use areas and the resources dependent upon them. Attempts to mitigate activities on lands and waters, that do not consider their continuous and highly interrelated nature will fail to protect their capacity to produce fish and wildlife. The scope of a habitat protection strategy must extend beyond the boundaries of the core area. For example, if a 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 accommodate natural biological and physical processes.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.

The following guidelines are intended to ensure the continued maintenance of unifying natural processes that contribute to the abundance and diversity of Alaska's fish and wildlife resources. In many instances there may be several technically adequate alternatives that can be applied to minimize impacts. These guidelines are not intended to restrict alternatives, but encourage the use of the best management practices available to achieve the desired goals. In some instances the exclusion of a certain use may be the best alternative.

It is recognized that these guidelines may not be applicable in all situations. Site specific conditions and management objectives should be reviewed on an individual basis by professional biologists. However, these guidelines are intended to make development activities more compatible with existing fish and wildlife resources.

Definition of Terms: The following terms are used throughout this chapter and are defined as follows:

commercial and industrial: for the purpose of this plan these are all uses requiring a plan of operation, lease, development plan, miscellaneous land use permit, contract or Title 1le permit.

compensation: involves replacement of lost habitat, populations or recreational opportunities. Whenever a project will cause a reduction or loss of values to the public--losses in terms of fish and wildlife populations or habitat, recreation opportunities, access, and other foregone resource use opportunities--the project sponsor must create or restore an equivalent part of the aquatic or terrestrial ecosystem to compensate for the loss. Refer to Statement of Policy on Mitigation of Fish and Game Habitat Disruptions. Alaska Department of Fish and Game. March 1982.

consultation: includes 1) specific provisions for interagency review in the development and consideration of alternative project or management plans 2) ensure that project or management plans address loss prevention, compensation and/or enhancement of fish and wildlife and 3) identification of factors to be addressed by the state in determining the best public interest associated with a project or management plan.

enhancement: means development or improvement of fish and wildlife resource values for an area beyond that which would occur under natural conditions.

feasible and prudent: feasible and prudent means consistent with sound engineering practice and not causing environmental, social, or economic problems that outweigh the public benefit to be derived from compliance with the guideline which is modified by the term "feasible and prudent."

fish: includes all harvested fish species except blackfish and sticklebacks.

fish habitat: fish habitat means the waters identified in the ADF&G Anadromous Fish Stream Atlas and those waters which are known to support resident freshwater fish species.

goal: a general statement of intent, usually not quantifiable nor having a specified date of completion. Goals identify desired long-range conditions.

guidelines: a definite course of action to be followed by land managers.

Guidelines range in their level of specificity from simply giving the land manager general guidance on how a decision should be made or what factors are to be considered, to detailed standards that will be followed when making on-the-ground-decisions.

mitigation: The definition of mitigation promulgated in the federal regulations (40 CFR 1508.20) which effectuate the National Environmental Policy Act (42 U.S.C. 4321 et seq.) will be used. Mitigation includes, in priority order of implementation:

1. avoiding the impact altogether by not taking a certain action or parts of an action;

2. minimizing impacts by limiting the degree or magnitude of the action or its implementation;

3. rectifying the impact by repairing, rehabilitating, or restoring the affected environment;

4. reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action;

5. compensating for the impact by replacing or providing substitute resources or environments.

For further information refer to Statement of Policy on Mitigation of Fish and Game Habitat Disruptions, Alaska Department of Fish and Game. March 1982.

productive habitat: lands which are important in maintaining optimal levels of local and/or regional fish and/or wildlife populations by contributing to important life-history and/or life-sustaining requirements including but not limited to optimal or favorable spring, summer, fall or winter range; calving grounds, breeding grounds, nesting areas, staging areas and migration routes.

public access: the right to enter, travel upon or recreate on lands and waters which have traditionally been used by the public for such purposes in order to travel to or participate in hunting, fishing or other forms of recreation.

riparian ecosystems: includes riparian lands and the associated aquatic habitat.

riparian lands: are composed of plant communities along rivers and streams and around lakes, ponds, springs or bogs, whose vegetative structure and function is primarily determined by influences from the adjacent aquatic system; including a high water table or overbank flooding. Along rivers and streams, riparian lands are these which are located within or adjacent to the boundaries of the active floodplain (100-year floodplain).

sensitive habitat: a general term describing lands or waters providing a supporting optimal or favorable fish and/or wildlife habitat which if altered or disturbed by development activities could cause a significant decline in fish and/or wildlife populations.

<u>should</u>: the word "should" is used when the plan provides intent but allows the land manager or permitting agency to use existing procedure to determine the best methods of achieving the same intent. Where the word "should" is used, no written finding is required by this plan.

<u>wetlands</u>: lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface. The single feature that most wetlands share is soil or substrate that is at least periodically saturated with or covered by water. Generally, these are land areas which, at least periodically, support predominantly hydrophytes and in which the substrate is predominantly very poorly drained or undrained hydric soil.

<u>wetlands hydrologically important to fish habitat</u>: wetlands adjacent to fish habitat which store surface runoff and ground water. The discharge of water from these wetlands is necessary in maintaining and stabilizing water levels to maintain productivity of fish habitat during periods of extremely high (floods) or reduced (winter) flow rates.

<u>will</u>: the word "will" is used when the guidance in the plan is definitive on the issue. Not following the plan in these cases will require an amendment of the plan.

<u>will, to the extent feasible and prudent</u>: the phrase "will, to the extent feasible and prudent" is used when the land manager or permitting agency's decision must be consistent with sound engineering practice and not cause environmental, social, or economic costs that outweigh the public benefit to be derived from compliance with the guideline which is modified by the term "feasible and prudent."

A written decision justifying a variation from a guideline modified by the term "feasible and prudent" will be necessary.

Agriculture

Agricultural development, including cropland, pastureland and grazing can result in the degradation of aquatic and terrestrial habitats. The major impacts resulting from the conversion of wildlife lands to agricultural lands are loss and alteration of fish and wildlife habitat, wildlife depredation on crops or livestock, toxic effects of agricultural chemicals on fish and wildlife, disease transmission between domestic animals and wildlife, competition for forage and cover on rangeland and access problems for wildlife users.

The widely held notion that agriculture benefits wildlife by providing cover at the edges of fields and through diversity of habitat does not apply to most modern agriculture. Large fields reduce habitat diversity and create barriers to wildlife.

Agricultural practices can cause reductions in water quantity and quality by altering surface runoff patterns, increasing erosion, introducing fertilizers and pesticides into the aquatic system, and through stream channelization and draining projects. Sixty-eight percent of the basins in the United States report water pollution caused by agricultural activities. Cropland is the greatest single contributor to stream sediment, yielding four times more sediment to public waters than any other erosion source. This results in a loss of fish habitat and a subsequent reduction in fish populations.

Fish habitat is affected by widening and shallowing of streambeds, silt degradation of spawning and invertebrate food producing areas, and loss of streamside and instream cover; resulting in increased water temperatures, increased velocities and decreased terrestrial food input. Livestock grazing affects wildlife habitat by eliminating forage plants, changing height and density of vegetation, reducing plant vigor, altering plant communities, and changing successional processes. Crop depredation by wildlife often results in the elimination of wildlife to prevent further losses. Waterfowl, passerine birds, moose, bears, and small mammals all depredate crops. When agriculture expands into wildlife habitat depredation is common.

Agricultural chemicals affect wildlife in many ways, e.g., acute and chronic toxicity, lowered reproduction, increased disease, and habitat alteration.

If the effects of agriculture on fish and wildlife are to be minimized, the following land use and management guidelines must be considered in the location, design, and operation of agricultural and grazing projects. These guidelines attempt to plan and regulate the development of agricultural lands to minimize the loss of fish and wildlife habitat and the loss of other resource values, and to maintain current levels of fish and wildlife populations.

Planning Agricultural Development

Land quality and location. Lands classified for agricultural use will contain a minimum of 50% Class 2 and 3 soils as determined by a detailed USDA, SCS soil survey. In addition, those areas of suitable soils will be otherwise suitable for crop production, including but not limited to: slope, aspect, shading by landforms, and microclimate. Class I and II wetlands will not be considered suitable.

Agricultural classifications will be reviewed by ADNR in consultation with ADF&G. At a minimum, the following issues will be addressed: protection of existing land uses compatible with agriculture; potential depredation of crops or livestock by wildlife, and an economic review of the value of wildlife. To the extent feasible and prudent, adequate means will be provided to minimize the effects of wildlife habitat lost through improvement of wildlife habitat quality in other areas.

To the extent feasible and prudent, lands classified for agriculture will have road access and be adjacent to existing agricultural areas.

Interim use of agricultural lands. Lands classified for agricultural use will be retained in public ownership and managed to protect their agricultural potential. Habitat enhancement and forestry management will be allowed, but not any form of development which would preclude future agricultural use.

Size and layout of farms. Farms should be small (40-160 acres), in order to maximize habitat diversity. If larger farms are developed for grain and livestock production (maximum 640 acres), public greenbelts will be reserved within them to keep field sizes small. These greenbelts will be interconnected to the extent feasible and prudent to increase habitat availability. For the same reason, woodlots, headquarters sites, and undeveloped areas will, to the extent feasible and prudent, be located along greenbelts or buffer strips. Vegetation suitable for wildlife food and cover should be allowed to grow between fields and along roadsides.

Forested strips will be left as windbreaks, connected to greenbelts, in areas subject to wind erosion.

Facilities serving farming areas will, to the extent feasible and prudent, be centrally located on soils unsuitable for agriculture along primary roads and where transportation modes connect.

Conservation plans. Conservation plans will be developed and approved by ADNR in consultation with ADF&G prior to farm development. The plans will incorporate soil, water and wildlife conservation practices as developed by the SCS and ADF&G. Points to be addressed will include, but are not limited to: retention of wildlife habitat, method of timber salvage, method of disposal of vegetation material from clearings, width of undisturbed buffer strips and windbreaks, and identification of woodlots.

Buffers. Along public and navigable waterbodies and waterbodies containing fish, around wetlands, and for specified fish and wildlife habitats of endangered or protected species or species sensitive to human disturbance buffer of public land will be retained from the ordinary high water mark on each side of the waterbody to cleared land. See Criteria for Protective Buffer Zones on State Lands; Riparian land guidelines; wetland guidelines. Management of lands within buffers will be coordinated with ADF&G, ADEC, and ADNR, Division of Parks.

Public access through agricultural lands. Public access will be preserved to adjacent public lands and to and along navigable and public waters. Parcels will, to the extent feasible and prudent, be laid out so that parcel boundaries follow existing trails and roads. Adjacent landowners should be consulted. A strip of land a minimum of 100 feet in width will remain uncleared and in public ownership, to the extent feasible and prudent, along trails. Section line easements will not be vacated unless appropriate and physically useable public access can be relocated, in consultation with ADNR, Division of Parks, and ADF&G.

The ADF&G should inform hunters that vandalism and trespass often result in loss of hunting opportunities on private lands, and result in access conflicts.

Land Clearing

Timber salvage. Marketable timber, including cordwood, sawtimber and house logs, will be salvaged from lands to be cleared for agricultural or other purposes. Any method of assuring salvage which does not preclude reservation of forested areas for buffers, windbreaks and woodlots may be used. Development plans for large scale agricultural projects will address timber including: techniques, timing and the effect on the regional forestry industry. Examples of methods to assure salvage include, but are not limited to:

1. Inclusion in the agricultural rights disposal contract.

2. Inclusion in the Farm Conservation Plan by:

    a. Agricultural rights holder specifies areas to be reserved in the Farm Conservation Plan. Timber on areas to be cleared is sold to the highest bidder, and the agricultural rights holder may match the highest bid.

    b. Use of economic incentives: the value of timber on areas to be cleared will be added to the sale price of the land and exempted from agricultural loan programs.

    c. Sale of timber rights prior to agricultural rights. In this case areas to be reserved will be laid out in advance by the state. Non-marketable timber and brush will be utilized or burned to prevent buildups of spruce beetles.

Use of fire. Cooperative agreements as to the use of fire during clearing will be made among the Division of Agriculture, Division of Forestry, Matanuska-Susitna Borough, ADF&G, and other affected agencies. These will be in accord with regional fire management policies.

Woodlots. Private woodlots will be managed according to the Forest Resources and Practices Act.

Construction and Use of Facilities

Location on farm. Headquarter sites and other facilities should be located on the perimeter of farms and on soils of Class 4 or lower (when present), to maintain the integrity of lands with soils capable for agriculture.

Storage of hazardous materials. Prior to handling hazardous materials, plans and procedures will be submitted to ADEC, ADNR, and ADF&G for approval. Storage, transfer, and handling areas for petroleum products or hazardous substances should be diked or bermed to contain 110% of the capacity of the storage facility. Notification of spills will be made according to federal and state law. It is the policy of the state of Alaska that there should be no discharge of hazardous substances into or on state lands or waters. The SCS should inform new owners of agricultural parcels of the toxicity of urea and of other agricultural chemicals to wildlife.

Fencing. Fences will, to the extent feasible and prudent, be designed to minimize entanglement of moose. Gates should be used wherever fences cross section lines or other easements in order to preserve practical, physically useable public access.

Conditions under which fencing is recommended to protect fish and wildlife or their habitat are discussed under the headings of: Water Use and Quality - Pollution, and Predator Control.

Liquid and solid waste systems, garbage, and trash. Liquid and solid waste systems should be designed, and garbage and trash should be removed or disposed of in a manner approved by ADEC, ADNR, and ADF&G.

Emissions. Facilities and equipment should be operated in such a manner as to avoid or minimize air pollution and ice fog. They will meet applicable federal, state, and local government emission and performance standards.

Cultivation

Crop residues. When consistent with sound agricultural practices, crop residues should be left in fields to provide food for wildlife.

Erosion. Cultivation methods requiring little or no plowing are recommended.

Chemical Use

Pesticides and herbicides. Only non-persistent and immobile types of pesticides and herbicides registered by the Environmental Protection Agency pursuant to the Federal Insecticide, Fungicide, and Rodenticide Act will be used. Application of pesticides and herbicides will be in accordance with applicable regulations of ADEC and the United States EPA. Each chemical to be used and constraints on its application will be approved by ADEC, and ADNR, in consultation with ADF&G, prior to use. Monitoring for biocide residues should be performed, and new owners of agricultural parcels should be informed of the importance of proper use of biocides.

Fertilizers and other chemicals. Application rates should conform to recommendations by the SCS for specific crops and soils, and application should be limited to areas in which crops are being grown. Runoff is discussed under Water Use and Quality - Pollution.

Water Use and Quality

Activities in waterways. All development activities proposed in waterbodies, or active floodplains will be reviewed by ADF&G for Title 16 compliance, and by ADEC for 401 certification. All activities proposing the use of explosives in or adjacent to the above areas will be subject to review and approval by ADF&G.

Instream flow. The removal of irrigation water from lakes, streams, and subterranean aquifers may have a severe impact on both aquatic and terrestrial wildlife species. Alaska Statutes 46.15 and 16.05.870 provide the necessary authority for reservation of water to maintain fish and wildlife productivity.

To preclude avoidable conflicts, the effects on fish and wildlife of removal of water for irrigation purposes will be considered by ADNR, after consultation with ADF&G, during the planning stage of agricultural disposals. In areas proposed for large-scale agricultural disposals, to the extent feasible and prudent, baseline hydrological studies will be performed by DGGS or USGS. Prior to final approval of water appropriation permits, ADNR will, in accordance with AS 46.15.080(b)(3), determine whether the proposed appropriation is in the public interest. The proposed appropriation may be approved by ADNR if it does not conflict with water use requirements for fish and wildlife or public recreation unless the commissioner of ADNR makes a finding that the competing use of water is in the best public interest and that no feasible and prudent alternative exists. Notwithstanding this finding, a determination of best public interest and the approval of water appropriations for irrigation will not be construed as limiting the authority of ADF&G to request an instream flow reservation sufficient to protect fish and wildlife habitat, migration and propagation.

Pollution, including sedimentation and erosion. Agricultural and logging activities will be conducted so that runoff water is maintained at the preexisting quality, volume, and rate of flow. Operators will 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 EPA's National Pollutant Discharge Elimination System waste discharge permit program and Alaska's Waste Disposal Standards. Operations should be closely regulated and monitored by ADF&G, ADEC, and/or EPA as appropriate to ensure that erosion, sedimentation and toxic runoff including that from biocides and thermal pollution do not occur.

Activities performed within the buffer zones around waterbodies should be conducted so as to minimize vegetation removal and surface disturbance. On a site-specific basis, revegetation or facilitation of natural revegetation by scarification will be performed.

Riparian areas should be protected from damage by livestock through the use of fences, or provision of alternative sources of water, or salt.

Predator Control

The ADF&G favors the use of nonlethal means of predator control. The most effective of these is removal of attractants including not classifying lands for agriculture or not allowing attractive crops to be grown where it is likely that depredation by wildlife will cause significant conflicts. Fencing designed so as to minimize entanglement of moose and other wildlife is recommended for lands where a low potential for conflict exists. The ADF&G is not responsible for compensating farmers for losses due to predation. If, contrary to the above recommendation, lands with significant potential for depredation conflicts are identified for agriculture, the following guidelines apply:

Depredation of crops. The ADF&G should respond to complaints of crop depredation and educate farmers on ways to avoid depredation. The ADF&G will provide technical assistance to farmers considering leasing hunting rights on their land or allowing regulated public hunting.

Depredation of grain fields by waterfowl is not serious now in Alaska, but is in other areas, and waterfowl distribution has changed in response to grain production in other areas. Other than not locating major grain farming projects near large wetlands, and growing crops not subject to depredation, the following measures are helpful (from Preston, 1983): grow early maturing crops; combine without swaths; leave high stubble; cultivate only after adjacent fields have been harvested; increase hunting pressure.

See: Transportation Guideline
Guideline for Protection of Special Fish and Wildlife Areas - Wetland Guidelines, Riparian Land Guideline
Criteria for Protective Buffer Zones on State Lands

Grazing

The ADF&G is opposed to the classification of lands to allow open-range livestock grazing. Extensive livestock grazing will be at the expense of big game (as well as other wildlife), as all suitable land is now being utilized by big game. Unless confined, livestock concentrate in riparian areas, highly important for fish and wildlife, competing directly with wildlife for food, cover, or space, and causing erosion through overuse.

Dietary overlaps occur between most big game ungulates and livestock. Even the best management of ranges for sustained forage production results in significant changes in vegetation composition. Except for brucellosis introduced in some areas by imported reindeer, Alaska wildlife has had little exposure to major livestock pathogens. The potential for severe, uncontrollable losses of wildlife, particularly Dall sheep, from such pathogens is high (discussion summarized from Preston 1983). If grazing is allowed, the following measures could mitigate some of the effects.

Range Management Plans

Range management plans should be designed to maintain or enhance native species of fish, wildlife and vegetation. Management priority shall be given to wildlife, fisheries and vegetation. The maximum rate of stocking or percent utilization of a key forage species should be low enough to provide a margin of safety during years when forage production is below average. RMP's should identify the amount of vegetation necessary to provide adequate watershed protection, maintain or enhance plant vigor and assure soil stability. The carrying capacity of the rangeland, combining both wildlife and livestock use, should be determined prior to leasing. ADNR will consult with ADF&G before approving any grazing operation plan.

Range management plans should recognize the values of riparian lands and the impacts livestock have on riparian lands. Livestock should be kept a minimum of 400 feet from waterbodies. This can only be accomplished through fencing. If fencing conflicts with other wildlife values or if fencing is not economically feasible a grazing lease or permit should not be issued. Stock driveways should also be located a minimum of 400 feet from waterbodies.

Suitable lands. The only non-agricultural lands which will be classified to allow livestock grazing are those on which native vegetation capable of supporting livestock is present according to 11 AAC 55.080. The following lands will not be considered suitable even if capable vegetation occurs: alpine and subalpine areas in or near Dall sheep range, and areas with high grizzly bear populations, river corridors and tributaries supporting or contributing to the support of anadromous fish populations and/or moose populations. Grazing leases should not be issued in areas with high recreational values.

Before any lands are opened to grazing, an economic feasibility study will be performed including the consideration of losses of livestock to predators. See improved pasture below for agricultural lands.

Vegetation manipulation. On non-agricultural lands, native vegetation will not be replaced by species more suitable for livestock grazing.

Other uses of grazing lands. Public access to lands leased for grazing will not be limited, in order to protect hunting, fishing, trapping and public recreational opportunities. Attempts by the lessee to limit or prohibit public access or use of state land under lease, should be grounds for immediate revocation of the grazing lease or permit. No private property rights shall be given with grazing leases or permits.

Improved pasture. Lands classified for agriculture with Class 2 or 3 soils may be leased for development of improved pasture. Agricultural soils used for pasture should be those of limited extent or otherwise marginal for production of food crops, located in areas with low potential for predation problems.

Stocking density, domestic species and seasonal limitations. Carrying capacities of lands leased for grazing will be determined at the time of leasing. Included in this will be sampling of the quality of available grasses to determine the period of time during which protein levels are high enough to supply the nutrient requirements of livestock without the latter competing with moose for browse. Lands will be stocked to ensure sustainable forage production and minimize disturbance of soils potentially erodable by wind or water. ADNR will consult with ADF&G during evaluation of applications for grazing leases or permits, including renewals.

Predation of livestock. Livestock predation, and responses to it, are a serious concern of ADF&G. As Preston (1983) states, "Large predators and livestock are incompatible. Legal and/or illegal predator control will follow livestock losses." The amount of predation is a function of livestock availability rather than predator density. Predators rapidly become habituated to taking livestock, so killing of predators is not effective, short of extirpation.

Predation of livestock in pasturelands (see Agriculture Guidelines).

In the Susitna Planning Area, black bear, grizzly bear, wolf, coyote, wolverine, lynx, bald eagles, and ravens are expected to cause livestock losses. It is not sufficient for livestock operators to comply with ADF&G regulations for salvage of wildlife killed in defense of property; all measures feasible and prudent will be taken to avoid killing of predators. As discussed below, ADF&G is opposed to leasing of state lands for grazing in areas of potential wildlife conflict. If this is done, or in cases in which livestock are grazed on agricultural lands, these guidelines will partially mitigate conflicts (from Preston 1983): livestock will not be allowed to pasture or calve (or lamb) in wooded or brushy areas; livestock that have died will be located and properly disposed of as rapidly as possible; grazing will not be allowed in areas with high grizzly populations; and livestock grazing will be allowed only on an absorbed cost basis. A record of the lessee's proposed management activities for predator control should be included in grazing operation plans.

Disease transmission. "If Alaskans do not learn from experiences elsewhere, or they fail to prevent importation of disease, (then) reduction in numbers and/or vigor of some wildlife populations is a certainty" (Preston 1983). Precautions to minimize the risk of infection of wildlife populations include:

1. Imported animals must be disease-free. The state veterinarian will actively support implementation of disease regulations. The ADF&G and ADEC will enter a cooperative agreement to ensure this, review grazing permit applications, and exchange information.

2. Surveillance of wildlife populations for exposure to livestock pathogens should be continued.

3. Dall sheep (like other wild sheep) are particularly vulnerable to livestock pathogens. Grazing will be prohibited in areas in and adjacent to Dall sheep range.

4. Susceptible livestock will not be grazed on ranges used by caribou herds infected with brucellosis.

If grazing leases are issued and these in turn prove to be in conflict with fish and/or wildlife values as determined by ADF&G, grazing leases should be modified or revoked if necessary. As stated in the ADNR, draft 1983, Statewide Natural Resources Plan, ADNR shall enter into consultation with ADF&G for developing range management plans for all grazing lease or permit applications. This should include any lease or permit renewals. Leases or permits should be terminated due to non-use.

See: Transportation Guidelines
Guidelines for Protection of Special Fish and Wildlife Areas - Wetland Guidelines, Riparian Land Guidelines
Criteria for Protective Buffer Zones on State Land

Settlement Guidelines

Fish and wildlife are important to the lifestyle and economy of Alaska. Consequently it is essential that settlements be designed to minimize adverse impacts on local plant and animal populations and not interfere with existing public use of fish and wildlife. For all land disposal programs, fish and wildlife habitat requirements should be influential in the siting and design of the disposal. Planners must recognize that location, design and occupant density will affect fish and wildlife populations and the quality of life of local residents. Siting and design should facilitate wildlife movement through and around the settlement, avoid human/wildlife interactions that may lead to conflicts, avoid conflicts between public users and private landowners, and avoid environmental impacts that adversely alter habitat to the detriment of fish and wildlife. Designers need to understand both general principles and guidelines regarding fish and wildlife habitat protection as well as specific concerns associated with the site under consideration. Identification of site specific fish and wildlife concerns requires the assistance of biologists and naturalists familiar with the site. It is recommended that the Habitat Division of the Alaska Department of Fish and Game be consulted for assistance in identifying the values of specific sites for fish and wildlife. The Criteria for Protective Buffer Zones on State Lands should also be used as a guide when planning development.

After initial site selection the two most important criteria to be included in the planning process for settlements are allowing for public open space and determination of an optimal density of inhabitants. In addition to planning for the present, a good design will consider the need for future growth and expansion of a community. Planning for the future without needlessly sacrificing existing values requires both foresight and hindsight. Past disposals should be evaluated to determine how open space and density have altered the characteristics of the site. No project feasibility designs should be accepted without adequate public open space for the specific area under consideration.

If the historical levels of productivity of fish and wildlife populations and the carrying capacity of their natural habitat is to be maintained and if the state is to provide for optimum commercial, subsistence, and recreational use of fish and wildlife resources, (FY 83 statewide Natural Resources Plan) the following guidelines should be incorporated into the state's land disposal program.

Open Space Design

Publicly owned open space must be included in and around all settlements including subdivisions, remote parcels and homesteads. The amount of open space and optimal densities of residents should be evaluated collectively. Open space should be adjusted to meet the needs of a particular population, species or habitat in order to best maintain existing or historical levels of use. In determining the amount of open space and optimal number of residents, the following concerns should be evaluated:

1. The specific habitat requirements of and existing populations of fish and wildlife in the area.

2. The amount and diversity of available habitats and the presence of any unique or scarce habitats.

3. The status of the species occupying those habitats, especially the presence of any rare, threatened, endangered or sensitive species and the tolerance of these species to disturbance caused by human activities.

4. The identification of limiting habitats which can control population size and productivity such as moose winter range, calving grounds, caribou migration routes, waterfowl and raptor nesting areas.

5. Existing hunting, fishing, trapping and other recreational and subsistence use, including previous settlement in the area and the demand for fish and game and firewood.

6. The available water supply with consideration for previous appropriations in the watershed.

Open space may be designated as corridors (migration, recreation, wildlife etc.), greenbelts, trails, common areas, buffer strips, public use areas etc. Open spaces must be incorporated into site design according to the aforementioned considerations and the following guidelines:

1. Provide for interconnecting wildlife/recreation corridors through the settlement. Consider juxtaposition of habitats, adjacent land use and access to adjacent lands and design open space system to link habitats, connect the open space system with undeveloped areas adjacent to the site and provide ample access. Provide as many corridors as possible through the site. Corridors should approximate a dendritic pattern with primary, secondary and tertiary pathways. Primary corridors should be of sufficient width (minimum 1,000 feet) to provide for freedom of movement by large mammals and minimize disturbance to landowners from recreationists. Corridors (through settlements) should allow for unrestricted movements of big game animals along historical. Secondary and tertiary corridors should be a minimum of 200 feet and 100 feet wide, respectively.

2. Traditional public access routes should not be transferred to private ownership and access corridors should be wide enough to prevent conflicts between public users and private landowners.

3. If existing or historical populations of fish and wildlife are high relative to other sites within the study area, then the number of disposals in the area (i.e. densities) should be kept to a minimum and open space should be maximized.

4. If highly sensitive, limiting or unique habitats exist, then disposals should be confined to the periphery of these areas with an ample buffer strip of sufficient distance (as determined in consultation with ADF&G) to negate detrimental effects on the specie(s) in question from human activity. Buffer strips should

be measured from the edge of the habitat (see Guidelines for Protection of Special Fish and Wildlife Areas and Criteria for Protective Buffer Zones on State Lands). Open space corridors should provide unrestricted wildlife access to and from these areas.

5. A sufficient water supply should be present that even in dry years will accommodate the potential human population in a settlement without depleting the instream-flow needs of fish and wildlife or the needs of downstream human users (see Instream Flow Guidelines Appendix E).

6. Public lands within the 100-year floodplain should remain in public ownership except where a regulatory floodway and regulatory flood fringe have been identified through detailed hydrologic studies.[1] When such studies have been done, disposals of public lands within the flood fringe may occur if outside of the 200 foot buffer zone. Disposals within the flood fringe should be for low density development, for example, private recreational residences, rather than urban density subdivisions. In drainages where the 100-year floodplain has not been identified, the best available information will be used to determine a flood hazard zone to remain in public ownership (see Guidelines for Protection of Special Fish and Wildlife Areas - Riparian Lands and Criteria for Protective Buffer Zones on State Lands).

7. Within and adjacent to lands designated for settlement, retain lands in the open space system not suitable for development because of topography, landform or potential natural hazard. These include floodplains, steep slopes (greater than 15%), avalanche zones, wetlands and geologically unstable sites.

8. Wetlands and riparian ecosystems around waterbodies should be included in a publicly owned protective buffer zones (see Guideline for Protection of Special Fish and Wildlife Areas - Wetlands and Riparian Lands and Criteria for Protective Buffer Zones on State Lands). No disposal or staking of land should occur within this zone.

9. All lakes and ponds bordering settlement lands should be surrounded by a publicly owned protective buffer zone of not less than 200 feet (see Criteria for Protective Buffer Zones on State Lands). For remote parcels and homesteads no parcel or parcels may enclose more than 50% of a waterbody over 20 acres in surface area and all parcels must leave a minimum 200 foot publicly owned

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[1] The floodway is the unobstructed portion of floodplain which can convey a 100-year flood and keep it within a specified height and velocity. The floodway carries the fast-moving and deep water of the flood. The flood fringe is that part of the 100-year floodplain outside of the limits of the floodway. The flood fringe carries the more shallow and more slowly moving flood waters.

buffer zone between the property line and the ordinary high water mark of any water body greater than 20 acres (See - Guidelines for Protection of Special Fish and Wildlife Areas - Wetlands and Riparian lands). Subdivisions and lands open to staking or aliquot parts should be confined to that portion of a waterbody where the least impacts to wildlife or recreationists will occur, as determined by consultation with ADF&G. For subdividion disposals no more than 50 percent of the area surrounding any lake or pond inland of the buffer zone and within 1,500 feet of the ordinary high water mark should be transferred to private ownership. Lots should be situated on only one side of the lake or clustered at points around the lake.

10. Mineral closing orders for all "leasable" and "locatable" minerals should be implemented by the ADNR for all open space and buffer zone lands.

An area of sufficient size to meet present and future demands for personal-use forestry (fuelwood, houselogs) should be designated. This may be incorporated into an open space system but should not be included within a 200 foot riparian buffer zone or within 200 feet of any other area protected by a vegetated buffer zone. The area should be accessible to all members of the community.

The Alaska Department of Natural Resources should provide technical assistance to owners and users of private and public forest lands to help meet local demands for fuelwood and houselogs (see Forestry Guidelines).

Within valuable fish and wildlife production or use areas, unless otherwise approved by ADF&G, for remote parcels, homesteads and remote cabin permits, whether staked, or disposed in aliquot parts, entries should be limited to a maximum of two contiguous sections per township with no township bordered on more than two sides by another township containing disposals. For each 160 acre quarter section allocated to disposal, a minimum of 40 acres should remain in public ownership as part of an open space design. This may be in the form of one large contiguous tract, several smaller tracts of a minimum of five acres or a corridor. However, all tracts or corridors must be connected to the nearest tract of public land by a public tracted trail, a minimum of 300 feet wide. In addition all homesteads must be separated from neighboring homesteads by a public corridor a minimum of 300 feet wide.

Deed restrictions on future subdividing of parcels into smaller lots should be included in the sale condition for all categories of disposals. Deed restrictions are necessary to protect fish and wildlife populations from unplanned community expansion and maintain the lifestyle for which a disposal is intended (i.e. remote, recreational, low density subdivision).

Right-of-ways over 60 feet wide to remote parcels or homesteads should be limited to existing methods of transportation at the time of the initial land disposal. No road construction should be allowed until conducting a review. Approval of both the road location and design will be done in consultation with affected agencies and interests including ADF&G.

Through consultation with the ADF&G, support facilities for settlement, i.e. generation and transmission structures or cables, sewage and water lines, garbage dumps, community buildings and transportation systems should be located to minimize adverse impacts with wildlife. In designing a subdivision, an area of sufficient size to accommodate these future community needs should be reserved in open space. This should be in addition to and not interfere with the open space reserved for wildlife habitat protection, public access and personal-use forestry.

Additional guidelines applicable to settlement are found in the following sections: Guidelines for Protection of Special Fish and Wildlife Areas, Transportation Guidelines.

Forestry Guidelines

If state forests are to be managed for multiple-use, then along with the production of commercial and personal-use wood products the objectives of fish and wildlife management and public recreation must be met. When deciding the best use of state forest lands, and planning the timing and nature of silviculture operations the effects of such decisions on fish, wildlife, soil, water, and associated recreational activities must be given due consideration. Forest management must be aware of and responsive to ecological relationships in terrestrial and aquatic environments. Wildlife respond to the structure, topographic orientation and distribution or arrangement of forest sites; fish respond to any change in the aquatic system. Timber harvesting activities alter the structure and distribution of wildlife habitat and depending on topography and type of cut, may increase soil erosion and surface runoff, adversely affecting several water quality and instream flow parameters including temperature, sediment load, nutrients, flow rates and streambed and streambank stability.

By manipulating several variables, impacts to fish and wildlife populations can be avoided or mitigated, and/or habitat enhanced. Among these are 1) Scheduling and timing of silviculture operations, 2) design and placement of roads, 3) method of harvest and length of rotation period between harvests, and 4) size and location of the logging operation relative to both topography and adjacent land type and/or land uses, and 5) methods of forest regeneration.

The following guidelines are intended to supplement the Alaska Forest Resources and Practices Regulations (1981) and reduce the potential adverse effects of forestry practices on fish and wildlife populations.

Management plans. On all lands classified or designated for forestry as a primary or secondary use, ten-year management plans should be prepared as a cooperative effort between the ADNR-Division of Land and Water Management, ADNR-Division of Parks, ADNR-Division of Forestry, Alaska Department of Fish and Game, the Matanuska-Susitna Borough, or any other agency with management interest in the area. These plans should address actions under consideration during the ten-year period and determine long-range objectives with sustained yield timber harvest and protection or enhancement of wildlife habitat as the two main goals.

An interdisciplinary team (IDT) of professional resource specialists i.e. forester, silviculturist, fisheries biologist, wildlife biologist, soils scientist, hydrologist, engineer, etc. representing ADF&G, ADEC, and ADNR should review proposed timber sales to make recommendations on protecting or enhancing habitat values during harvesting and all related operations. The IDT should address site-specific problems and stipulations should be incorporated into each sales contract. Timber harvests should be monitored by the IDT to facilitate compliance with the stipulations, adjust any inappropriate requirements, help with unforeseen problems, and document the effectiveness of specific forest management practices.

Management guidelines should be prepared that address road construction, site preparation, harvest method, log storage and transport, size, shape and arrangement of cut area(s), special habitat features and wildlife considerations, slash disposal and reforestation. Where forestry and fish and wildlife are both designated as the primary uses, all timber harvest operations and related activities must accommodate the needs of fish and wildlife as determined by ADF&G. Each proposed timber sale should identify fish and wildlife management objectives and concerns and contain stipulations to meet the objective and accommodate the concerns.

Habitat protection. In order to reduce erosion, reduce surface runoff, protect recreational values and protect fish and wildlife values, no commercial forestry operation should occur within 400 feet of the ordinary high water mark of any lake, river or creek without an approved streamside management plan (SMP). The SMP should describe in detail all aspects of the proposed timber harvesting operation and must be approved in advance by the ADF&G. Timber harvesting within the management zone should only be allowed if shade, bank stability, cover, and habitat can be maintained. Disturbance to vegetation and to soils within the zone should be kept to an absolute minimum. No roads should be constructed within this 400 foot buffer zone except for stream crossings which must be approved in advance by ADF&G (see Transportation Guidelines and Guidelines for Protection of Special Fish and Wildlife Areas - Riparian Lands).

Commercial timber harvest will not be permitted within 400 feet of Class I and Class II wetlands and within 200 feet of Class III wetlands (see Guidelines for Protection of Special Fish and Wildlife Areas - Wetlands).

In areas of highly sensitive habitat or in any habitat necessary to threatened, endangered, or sensitive species, no harvests are allowed which are likely to have negative impact on the on the habitat or the species. Determination of sensitive areas, and design and approval of harvest techniques in these areas shall be conducted jointly by ADNR and ADF&G. No timber harvesting will occur within one mile of peregrine falcon nesting cliffs or within ¼ mile of active or historic bald or golden eagle nesting areas or within ¼ mile of currently or historically occupied nesting areas of trumpeter swans.(see Guidelines for Protection of Special Fish and Wildlife Areas - Endangered and Protected Species).

Timber operations should be confined to a single drainage at a time. Adjacent drainages should not be logged simultaneously.

No timber cuts should occur within 1/2 mile of alpine tree line except with approval and design consultation of ADF&G.

In order to minimize erosion in clearcut areas, seeding or planting with native species adapted to disturbed sites should take place at the earliest date following the harvest operation that will ensure the best chances of growth and survival of the planted or seeded species and minimize erosion. Timber cutting on commercial forest lands should not occur on any slopes which cannot be adequately revegetated within a reasonable time period to prevent soil damage. Reforestation plans should be approved by the State Forester prior to harvesting and should be implemented as soon as possible after cutting. Where artificial replanting is unfeasible, harvesting methods should facilitate natural regeneration of the stand.

Logging roads. Location and design of logging roads should be approved by ADF&G.

1. Roads should be located in the periphery of important habitat and be minimized in areas with big game populations.

2. To ensure the usability of meadows, clearcuts and other forage areas for big game a minimum 200 foot buffer zone of natural vegetation should be left between all roads and any openings.

3. Cuts and fills along roads should not block travel routes for wildlife.

4. Roadside vegetation; which provides hiding cover should be maintained wherever possible.

5. To increase cover value for big game avoid locating straight stretches of road of more than ¼ mile in forested areas (see Transportation Guidelines).

Habitat enhancement. In areas designated by ADF&G for primary consideration for moose habitat enhancement the following criteria should apply.

1. The area should be a minimum of 2,400 acres.

2. Fifty-percent should be clearcut.

3. Adequate escape cover (vegetation) should be available within 300 feet of any point within a clearcut. Adequate escape cover should be trees greater than 30 feet tall a minimum canopy closure of 70 percent and a minimum of 20 acres.

4. Slash should be windowed, piled or disposed (including burned) so that it does not create an impediment to wildlife movement.

In areas of overmature birch or aspen stands, clearcuts up to 15 acres are encouraged as long as adequate escape cover (vegetation) is available within 300 feet of any point within a clearcut. This does not apply to those areas within protective buffer zones unless approved by the ADF&G (see Criteria for Protective Buffer Zones and State Lands and Guidelines for Protection of Special Fish and Wildlife Areas). Clearcuts generally will not be allowed in floodplains or riparian lands.

See: Settlement Guidelines (Personal Use Forestry)
Transportation Guidelines (Roads)
Guidelines for Protection of Special Fish and Wildlife Areas (Riparian Lands)
Guideline for Protection of Special Fish and Wildlife Areas (Wetlands)

Oil and Gas Guidelines

To minimize environmental disturbances from primary and secondary oil and gas development activities the following guidelines for mitigating impacts should be adopted and implemented. With consideration for the needs of fish and wildlife in the siting and design of facilities and scheduling of activities the impacts to fish and wildlife populations can be lessened. The following guidelines are consistent with ADF&G Guidelines for the Upper Cook Inlet Oil and Gas Lease Sale No. 40.

General Mitigating Measures for Resource Protection

Comprehensive planning at the project conception stage can aid considerably in ensuring that facilities are sited and designed, and activities scheduled, to lessen the impacts on fish and wildlife populations. This approach is also beneficial to developers by reducing or eliminating delays in the permitting process, and minimizing the cost of environmental protection.

Unitization proposals that include tracts, or portions of tracts, within a sale area must include a surface management plan that provides for the maintenance of fish and wildlife resources and habitats. Surface management plans must be developed with the cooperation of the Department of Natural Resources, Division of Land and Water Management, the Department of Fish and Game, and the Department of Environmental Conservation, prior to submission of plans to the Commissioner of Natural Resources.

Habitat alteration is frequently one of the most important factors contributing to displacement and/or declines in fish and wildlife populations. Fish and wildlife can also be impacted significantly by noise and disturbance associated with oil and gas development activities. Maintaining the integrity of productive or sensitive habitats, such as fish spawning areas, moose wintering grounds, and key wetlands, is especially important to the continued survival of local populations.

Development activities. Habitat alterations and disturbance of fish and wildlife populations should be avoided to the maximum extent possible, particularly during the exploratory phase when it is not known whether commercial reserves of hydrocarbons will be discovered. If it is absolutely necessary to site facilities in productive or sensitive fish and wildlife habitats, or along migration routes to and from these areas, development activities should be controlled strictly to minimize the environmental impacts of the proposed activity.

1. Exploration activities will be restricted to the period November 1 to March 31 and shall be supported only by ice roads, winter trails, exiting road systems and air service. The Director, Division of Minerals and Energy Management, may allow exploratory operations outside of this time period if the Division of Land and Water Management and the Department of Fish and Game determine that such operations will not damage soils or the vegetative mat, or significantly disturb fish and wildlife populations.

2. Exploration facilities, with the exception of drill pads, will be temporary and will not be constructed of gravel. Reuse of existing abandoned gravel structures may be permitted on a case-by-case basis by the Director, Division of Minerals and Energy Management, after consultation with the Department of Fish and Game. Approval for reuse of abandoned structures will depend on the extent and method of restoration needed to rehabilitate surface disturbance.

3. All lease activities will be conducted, and structures will be designed and sited, to maintain natural water flow and drainage patterns, and to allow free movement and safe passage of fish and large game species.

4. Plans of operations and unit agreements will be reviewed to ensure that the minimum number of facilities required to safely and efficiently develop the field are not exceeded, and that all facilities are consolidated to the maximum extent feasible.

5. The Director, Division of Minerals and Energy Management, will require that lease facilities be sited away from sensitive fish and wildlife habitats, where feasible and prudent, as identified by the Department of Fish and Game.

Vehicular traffic across wetlands (For definition see - Guidelines for Protection of Special Fish and Wildlife Areas - wetlands) and other sensitive habitats can cause severe damage to vegetation, lead to permafrost degradation, and disturb wildlife populations during critical life stages.

The use of ground contact vehicles for off-road travel must be limited to those areas where an average snow depth of 12 inches is maintained. Exceptions to these requirements may be granted on a case-by-case basis by the Director of the Division of Land and Water Management or his designee in consultation with the Alaska Department of Fish and Game.

Seismic exploration can cause long-term alterations of habitat, result in disturbance to wildlife through noise and activity, and create unwanted access into sensitive fish and wildlife habitats.

Clearing of forested areas, through bulldozing or other means, for the sole purpose of seismic exploration will be strongly discouraged and may be prohibited. Clearing of forests will be permitted only if existing data available to the applicant from previous seismic lines can not meet the needs of the applicant, and if it is demonstrated to the satisfaction of the Director, Division of Minerals and Energy Management, after consultation with the Department of Fish and Game, that this technique is an acceptable environmental alternative. If so, the use of hydroaxes and the treatment of soils to encourage regrowth by willow and other woody plants may be required for cleared areas.

<u>Gravel mining</u>. Gravel mining can result in numerous adverse impacts on fish and wildlife populations. Although the use of upland sources can result in habitat loss through surface disturbance and interference with natural drainage patterns, upland sites are generally preferable over mining within

active floodplains and wetlands. Gravel removal from rivers and streams can disrupt flow patterns leading to channel diversions, increased sedimentation of waterbodies, fish blockages and entrapment, an increased potential for aufeis, and other channel alterations that generally reduce habitat quality. The appropriation of large quantities of gravel needed for development and production from active floodplains significantly increases the probability of adversely changing the habitat characteristics of streams.

The following standards should be instituted in order to minimize the environmental impacts of gravel mining operations:

a. In meeting gravel needs for all phases of oil and gas development, reuse of gravel from nearby abandoned drill pads, roads, or airstrips will be the first sources exploited, unless it is demonstrated to the satisfaction of the Director, Division of Minerals and Energy Management, after consultation with the Department of Fish and Game and the Alaska Oil and Gas Conservation Commission, that reuse of such sources is not feasible or prudent.

b. Gravel mining sites for exploration activities will not be allowed within the active floodplains of watercourses, as defined in Gravel Removal Guidelines Manual for Arctic and Subarctic Floodplains (United States Fish and Wildlife Service, Woodward Clyde Consultants, 1980), unless it is demonstrated to the Director, Division of Land and Water Management, after consultation with the Department of Fish and Game, that a floodplain source is the preferred environmental alternative. If gravel mining within an active floodplain is deemed necessary, the site must be approved by the Department of Fish and Game pursuant to AS 16.05.870 prior to any gravel removal. Mining site development within active floodplains must follow the procedures outlined in the above referenced report.

c. During development and production, gravel mining within active floodplains will be prohibited. Upland mining sites will be restricted to the minimum number necessary to efficiently develop the field with minimal environmental damage. Where feasible and desirable, upland gravel sites will be designed and constructed to function as reservoirs for winter water supplies.

Aquatic habitat protection. Hydrocarbons can be toxic to aquatic vegetation, fish, mammals, and birds and can cause the direct mortality of organisms or result in adverse physiological and behavioral responses.

The following protective measures should be instituted to prevent hydrocarbon contamination of waterbodies and facilitate cleanup of spilled products in aquatic environments:

1. Stationary fuel storage facilities and most vehicle refueling will be prohibited within active floodplains. Exceptions may be allowed during the Title 16 permitting process for the refueling of slow moving construction equipment within active floodplains, upon approval by the Department of Fish and Game.

2. Onshore pipelines will be located on the upslope side of roadways and construction pads.

Construction activities and siting of facilities in close proximity to rivers and lakes can lead to shoreline erosion and sedimentation of waterbodies, widespread pollutant transport, loss of public access to state waters and shorelines, and loss or alteration of riparian habitats important to birds and mammals. Riparian habitats in the Susitna Basin are particularly important moose wintering range, and displacement of moose from these areas could result in increased mortalities and eventually lead to declines in local populations.

The mitigating measures listed below should be adopted in order to minimize the impacts of industrial development on aquatic and riparian habitats:

1. All facilities, with the exception of approved road and pipeline crossing aligned perpendicular to watercourses, will be prohibited within ½ mile of all fishbearing streams and lakes, unless otherwise approved by ADF&G.

2. Operation of equipment within riparian habitats will be prohibited, unless approved by the Department of Fish and Game.

3. Alteration of the banks of watercourses will be prohibited except in a manner approved by the Department of Fish and Game.

The detonation of high explosives can cause direct mortality of fish and result in abnormal behavioral responses among fish and marine mammals.

The following measures should be instituted to avoid the detrimental impacts of explosives on fish and marine mammals:

1. Seismic activities that utilize high explosives in marine waters will be prohibited.

2. Onshore detonation of high explosives will be prohibited within the minimum acceptable offsets of fish-bearing waters.

No person should discharge explosives within the distance from an anadromous fish stream specified in the following table for each charge weight and substrate type.

Relationship between explosive charge weight in various substrates and distance from a waterbody which will produce up to 2 psi hydrostatic overpressure on the swim bladder of anadromous fish.

The required distances for charge weights not set forth in the table should be computed by linear interpolation between the charge weights bracketing the desired charge. For charge weights greater than 1,000 pounds, the required distance may be determined by linear extrapolation. The relationship set forth in this section applies to single shots of a given weight of explosive or single shots in multiple charges if each shot is separated by eight milliseconds or longer.

TABLE 54. Relationship Between Explosive Charge Weight in Various Substrates and Distance from a Waterbody

Unfrozen Substrate	Explosive Charge Weight in Pounds 1	2	5	10	25	100	500	1,000
Rock	60	90	140	200	320	630	1,420	2,000
Stiff Clay, Gravel	50	70	110	160	250	510	1,130	1,600
Clayey Silt, Dense Sand	40	60	100	140	220	430	970	1,370
Medium to Dense Sand	40	60	90	120	190	390	870	1,230
Medium Organic Clay	30	40	60	80	130	250	550	780
Soft Organic Clay	20	30	50	70	120	230	520	740

Frozen Substrate	Explosive Charge Weight in Pounds 1	2	5	10	25	100	500	1,000
Aeolian Sand	60	90	130	190	300	600	1,340	1,890
Silt, Gravel	60	90	130	190	300	600	1,340	1,890
Silt, Organic	60	80	130	180	290	580	1,300	1,840
Alluvial Clay	60	80	130	180	290	580	1,300	1,840
Ice-4 C°	50	70	120	170	260	530	1,180	1,670

Refuge disposal. Refuse disposal sites can alter important wildlife habitat and pollute ground water and adjacent waterbodies. Solid waste also serves to attract predators (e.g. bears and foxes) to industrial sites. Nuisance animals can threaten human safety and often have to be destroyed.

All garbage and refuse, particularly human food, will be thoroughly incinerated and disposed of at an approved upland site. No new solid fill disposal sites will be approved during the exploratory phase.

Public access. Sportsmen, subsistence users, and recreationists may utilize lands within or near the proposed sale area. Restricting public access and the discharge of firearms will preclude use of the sale area for harvesting and other traditional uses.

Current resource users should be guaranteed continued public access to lands and resources within the proposed sale area through implementation of the following measures:

1. No restriction of public access to, or use of, the area will be permitted as a consequence of oil and gas activities, except for small limited areas in the immediate vicinity of drill sites, buildings, other related structures.

2. Surface use will be restricted, as necessary, to prevent unreasonable conflicts with local subsistence harvests.

Environmental training. Many workers associated will oil and gas exploration and development will not be aware of the environmental and social considerations essential to proper development of the sale area.

Lessees shall include in any exploration and/or development plans a proposed environmental training program for all personnel involved in exploration or development activities (including personnel of the lessees' contractors or subcontractors) for review and approval by the Director, Division of Minerals and Energy Management. The program shall be designed to inform each person working on the project of specific types of environmental, social, and cultural concerns that relate to the individual's job. The program shall be formulated and implemented by qualified instructors experienced in each pertinent field of study, and shall employ effective methods to ensure that personnel understand and use techniques necessary to preserve archaeological, geological, and biological resources. The program shall also be designed to increase the sensitivity and understanding of personnel to community values, customs, and lifestyles in areas in which these personnel will be operating.

Lessees shall also submit review and approval a continuing technical environmental briefing program for supervisory and managerial personnel of the lessee and its agents, contractors, and subcontractors.

Mitigating Measures for Species and Habitats Requiring Additional Protection

Refuges and Critical Habitat Areas. The management of state game refuges and critical habitat areas is the responsibility of the Department of Fish and Game under AS 16.20.010-.080 and AS 16.20.220-.270, respectively. Development operations within the Refuges and Critical Habitat Areas will be required to comply with the terms and conditions previously outlined under both General Mitigating Measures and Protection of Fish-Bearing Streams. The department will also require compliance with the measures listed below, which were developed specifically for the Refuges and Critical Habitat Areas.

The following mitigating measures should be incorporated into all appropriate development plans. Special requirements for industrial operations within these areas may affect how development within the Refuges and Critical Habitat Areas will occur. In addition, the review and approval of plans of operations and permit applications will be expedited if applicants incorporate required mitigation into their initial project proposals.

1. The Refuges and Critical Habitat Areas were established by the legislature for two primary reasons: 1) to protect fish and wildlife habitats and populations, and 2) to ensure public access to, and use of, these resources. Oil and gas development and other land-use activities may be allowed within these areas, provided that they are compatible with the primary management objectives.

In order to be consistent with the legislative intent for establishing state game refuges and critical habitat areas, oil and gas lessees will be required to comply with the following general measures:

a. Applicants will be required to obtain a permit from the Department of Fish and Game, which will specify the terms and conditions of lease operations. Permits will be issued upon receipt and approval of detailed plans of operations for all applicable phases of oil and gas development projects.

b. No drilling will be permitted until the lessee demonstrates the capability to expeditiously detect, contain, and clean up any hydrocarbon spill that may result from lease activities before the spill significantly impacts fish and wildlife populations or their habitats. This includes the capability to drill a relief well in the event of a loss of well control.

c. All lease facilities must be designed and constructed to prevent the spread of hydrocarbons and facilitate cleanup, both above and below ground.

d. Lease facilities must include all available design features to minimize the possibility of accidental oil spills or fires resulting from vandalism or hunting accidents.

e. Disposal of produced waters shall be by commonly practiced subsurface disposal techniques. Surface discharge of produced waters will be prohibited.

f. Disposal of drilling muds and cuttings will be allowed only at approved upland sites. Disposals will not be permitted within Goose Bay State Game Refuge. Onshore dump or reserve pits must be bermed and rendered impermeable, or otherwise fully contained through diking or other means.

g. Upon abandonment or expiration of a lease, all facilities must be removed and the sites rehabilitated to the satisfaction of the Department of Fish and Game, unless the department determines that it is in the best interest of the public to retain some or all of the facilities.

2. Coastal wetlands and nearshore waters within the Susitna Flats State Game Refuge provide critical staging, nesting, and feeding habitats for large numbers of waterfowl and shorebirds. These areas also receive the greatest hunting pressure within the refuges. Industrial operations could significantly impact fish and wildlife resources and public use of these areas if activities result in extensive habitat alterations and wide spread noise and disturbance during the period when waterfowl and hunters are present.

   Compliance with the following measures will be required within the Susitna Flats primary waterfowl areas.

a. All surface exploration and development activities within primary waterfowl areas will be allowed only between November 1 and March 31, unless an extension is approved by the Department of Fish and Game. Routine maintenance and emergency repairs will be permitted on a year-round basis during the production phase. A detailed plan describing routine maintenance activities to be conducted between April 1 and October 31 must be submitted to the Department of Review and Approval.

b. Gravel pads and wellheads are the only permanent above ground structures that will be allowed within primary waterfowl areas. The design and construction of gravel pads and wellheads must utilize the best available technology to minimize the visual impacts of these structures.

c. Low flying aircraft frequently disturb nesting and staging waterfowl, and can cause an increase in bird mortalities. Eggs and chicks can be knocked from their nests, crushed, or preyed upon when adults are alarmed and flushed from their nests. Aircraft disturbances can also displace adults and fledglings from preferred feeding habitats, which may prevent them from acquiring the fat reserves necessary for the fall migration.

From April 1 to October 31, aircraft overflights over the primary waterfowl areas within the Susitna Flats State Game Refuge, will maintain a minimum altitude of 1,500 feet or a horizontal distance of one mile.

3. Surface entry will be prohibited within Goose Bay State Game Refuge. Directional drilling will be allowed from adjacent sites.

See: Guidelines for Protection of Special Fish and Wildlife Areas - Wetlands, Riparian Lands, Threatened and Endangered Species
Transportation Guidelines
Criteria for Protective Buffer Zones on State Lands

Subsurface and Mineral Guidelines

Mining operations working on lode deposits, coal seams, upland gravel deposits or in support of placer mining activities are often responsible for the degradation of the aquatic and terrestrial habitats. Disruption of productive habitats and degradation of water quality result in reduced fish and wildlife populations. Disturbance to hillsides and loss of vegetation can increase erosion and siltation, alter drainage patterns, produce erratic stream flows and dry up lowland ground water reservoirs. Construction of roads, compaction of soils and creation of other impervious surfaces reduces groundwater percolation and increases surface water runoff. Acid mine waters and leachates from tailing mounds can degrade water quality, rendering downstream rivers and lakes unsuitable for fish habitat or human use.

Water appropriations from streams or lakes necessary for mining operations can exceed instream flow requirements for fish and other important aquatic life. Excavations of placer deposits in important fish habitat causes downstream siltation and disrupts spawning beds. Physical encroachments and noise from construction and operation of heavy equipment or blasting may disturb wildlife in nesting, feeding and resting areas.

Because the elimination or alteration of habitat creates long-term impacts to aquatic and terrestrial systems, habitat maintenance and restoration must be given primary consideration during mining activities.

While it may not be feasible to conduct mining and mineral processing activities without affecting fish and wildlife habitat, the planning, design and operation of all mining activities should reflect the maintenance of existing ecological processes. Every effort should be made to maintain water quality and quantity, natural drainage patterns, vegetative cover and minimize disturbances to productive areas.

Development Guidelines

The following guidelines apply to all mining operations. For coal mining these guidelines are to be referenced in preparation to the requirements listed in the Alaska Surface Coal Mining and Reclamation Act (AS 41.45).

If mining is to occur on state lands, then during and subsequent to mining operations and all related activities, the loss or degradation of important fish and wildlife habitat will be avoided or minimized. In addition to avoiding or minimizing impacts to fish and wildlife during the operation of the mine following mining the land should be returned to its former or greater productivity. At a minimum the land should be restored to a condition capable of supporting the uses which it was capable of supporting prior to mining and the land should be restored to the approximate original contour unless otherwise approved by ADF&G. All surface areas should be stabilized and protected to prevent surface and ground water degradation, and speed up the revegetation process.

It is the responsibility of the leasee to inform all persons engaged in construction, development or related activities of all applicable state laws, regulations, and requirements.

All construction, development, or related activities should be designed, constructed, and maintained so as to allow unrestricted passage and movement of fish and wildlife.

Prior to the start of construction, development or related activities applications for permits and lease plans of operations should be submitted for review to ADNR, ADEC, and ADF&G. At a minimum plans for the following issues will be addressed:

Timing and methods of access (including for roads the proposed route, and dates and methods of construction), handling fuel and hazardous chemicals, including plans for storage and spills, air quality, disposal of combustible and non-combustible wastes, disposal of sewage and waste water, erosion and sediment control, stream crossings, material removal, disposal of overburden and tailings, clearing, blasting, restoration/rehabilitation of disturbed sites, and protection of fish and wildlife. Guidelines and stipulations for each activity that avoid or minimize disturbance both directly and indirectly to fish, wildlife and habitat should be included for each lease or permit.

Mining of gravel or related material or mining of material such as coal, oil shale, etc. should not occur within 800 feet of a river, stream, lake, Class I or Class II wetlands, or sensitive, critical or special wildlife habitat areas unless otherwise approved by ADNR in consultation with ADF&G (see Criteria for Protective Buffer Zones on State Lands, and Guidelines for Protection of Special Fish and Wildlife Areas - Riparian Lands and Wetlands, Oil and Gas Guidelines - gravel mining).

Stipulations in mining permits or in plans of operations associated with leases will insure that anadromous fish streams are protected from siltation and the introduction of toxic substances or other disturbances caused by mining activities.

Construction, development, and related activities should be conducted so as to minimize disturbance to surface areas.

The design of all facilities should provide for the control of erosion and reduction of sediment production or transport.

On a case-by-case basis, with the consultation of the Department of Fish and Game the following guidelines, where applicable, should be incorporated into all mining permits:

1. Stream banks shall not be mined or otherwise disturbed.

2. Applicable state water quality standards specified in regulations of the Department of Environmental Conservation (18 AAC 70.010-110) shall be maintained at all times.

3. There shall be no vehicles or equipment operated within a river or stream at any time except that vehicles may cross the river or stream solely for purposes of claim access and equipment may be operated within the river or stream to connect water diversion

structures. All stream crossings shall be made directly from bank to bank in a direction perpendicular to the water flow.

4. All cuts and slopes not actively being mined shall be stabilized prior to the end of each mining season to prevent erosion. In addition, all tailing piles shall be leveled to prevent erosion and encourage revegetation.

   Erosion control measures should be employed to limit induced and accelerated erosion, to reduce sediment production or transport, and to lessen the possibility of forming new drainage channels.

5. Settling pond outlets shall be screened with heavy gauge wire mesh to prevent adult fish entrance.

6. Each water intake structure shall be designed to prevent fish entrapment, entrainment, or injury.

7. The entrance to any water diversion ditch is to have a well maintained headgate which is to be regulated to block water flow during non-operating periods. The headgate intake shall be fitted with a screen on which the effective screen opening may not exceed 0.04 inch. It is recommended that the headgate intake screen be placed in a slack water area or parallel to the stream flow.

8. Streams may not be diverted or realigned without the specific written approval of the Alaska Department of Fish and Game.

9. Fish spawning beds, rearing and overwintering areas should be protected from sediment. Settling basins or other sediment control structures should be constructed to intercept silt before it reaches rivers, streams, lakes, wetlands, or marine waters.

   Alterations of fish or spawning beds, rearing and overwintering areas should be avoided. if alterations cannot be avoided, the proposed alterations should be designed to minimize negative impacts to fish and wildlife.

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 during periods of denning, insect relief, breeding, nesting, spawning, lambing and calving activity, overwintering, and during major migrations of fish and wildlife (see Guideline for Protection of Special Fish and Wildlife Areas).

Excavated materials should not be stockpiled in rivers, streams, lakes, floodplains, tidelands, subtidal lands, or wetlands. Excavated materials in excess of that required for backfill should be disposed in sites approved by ADNR.

All activities that may create new lakes, drain existing lagoons, lakes, or wetlands, significantly divert natural drainages, increase sediment transport, and surface runoff, permanently alter stream or ground water hydraulics or disturb significant areas of stream beds, tidelands or marine lands should be prohibited unless approved by ADF&G and ADNR.

Adequate means should be provided for repair, replacement or rehabilitation of natural resources (including but not limited to revegetation, restocking fish or other wildlife populations, and re-establishing their habitats) that are damaged or destroyed as a result of construction, development, or related activities. Appropriate means of restoration should be determined by the Commissioner of the Department of Fish and Game.

Access for Mineral Development

Access to tundra, wetlands, and other environmentally sensitive areas should occur in a manner at a time that minimizes damage (See Guidelines - Transportation).

Existing roads and trails should be used to provide access to mine sites wherever possible.

Trail and road access to recreation, fish and wildlife, and other public resources should be maintained at or above pre-mining levels, during the mining operation. Access should be designed to minimize the potential for trespass, vandalism, or other public nuisance in the mining area.

Mineral Closures

Mineral closures for habitat protection or if needed to protect fish and wildlife during critical stages of the life-cycle should be implemented when it is necessary to protect a habitat or species which would be significantly harmed by mining activities in spite of existing state statutory or regulatory authorities. Lands to be considered for mineral closures include:

Areas supporting protected, threatened or endangered species of fish, wildlife or plants. Nesting and feeding areas for peregrine falcons are included in this category. Also included are those habitats which have been given special protection through state and federal legislation or international treaty (e.g., anadromous fisheries streams, migratory bird habitat, marine mammal habitat, etc.).

Lands supporting production of recognized valuable species. Lands and waters which support the production or population maintenance of fish or wildlife species which have significant economic, recreational, scientific, educational or cultural values. Nesting, brood rearing, molting and staging areas for trumpeter swans, and nesting and feeding areas for bald eagles and golden eagles are included in this category.

Legislatively designated habitat lands. State of Alaska game refuges, critical habitat areas, and sanctuaries.

Lands with unique or large assemblages of fish or wildlife. Other areas (not included in 1 through 3 above) which support unique or large assemblages of fish or wildlife (moose winter range, caribou calving grounds, caribou migration corridors, brown bear feeding areas).

Lands providing high or unique recreational values. Areas which provide opportunities for the human use and engagement of outdoor recreation including hunting, fishing, hiking, photography and wildlife viewing.

See: Oil and Gas Guidelines for Applicable Phases of Development Roads
Transportation Guidelines
Guidelines for Protection of Special Fish and Wildlife Areas
Criteria for Protective Buffer Strips

Transportation and Utility Guidelines

If transportation or utility systems are to have a minimal impact on fish and wildlife populations then the location, design, construction and maintenance, use of the system and the impact of development induced by the system must be considered in the planning stage.

The most critical aspect is the location of the transportation or utility system. The location will affect both the degree of habitat alteration and the degree of secondary impacts which accompany construction and operation. In addition to the primary impacts, a transportation system can generate residential, commercial, industrial, and recreational development, any of which result in activities far more detrimental to fish and wildlife than the system itself.

Roads may also interfere with natural drainage patterns and flow of surface and ground water, interfere with both fish and wildlife movements, create runoff that effects water quality, removes important habitat by dredging or filling during the construction process and directly disturbs wildlife by increased noise or activity.

Cooperative planning between engineers, wildlife biologists, hydrologists and contractors is necessary for locating and designing transportation and utility systems that maintain habitat value and provide long term public benefits for transportation and utility needs.

Location, Design and Construction

The following guidelines will assist in location, designing, and constructing transportation and utility systems.

Roadways should be located so they conform to existing topography, require a minimum alteration of soils and vegetation, do not disrupt natural drainage patterns and avoid important wildlife habitats.

Transportation and utility routes should avoid moose, brown bear, caribou, and waterfowl habitats, which if disturbed, could cause declines in local populations. When it is not feasible and prudent to avoid important habitat, transportation and utility routes should be sited, designed and constructed to minimize conflicts with wildlife and avoid unnecessary habitat alteration (see - Forestry Guidelines).

Public land disposals allowed by this plan as well as development projects should be designed to maximize the use of existing road and utility corridors.

All road or utility crossings of anadromous fish habitat need prior approval by ADF&G. Road and utility crossings of rivers, lakes and streams will avoid obstructing stream flow and impairing water quality and streambank stability.

To minimize streambank disturbance, crossing of rivers and streams and other flowing waters should be aligned at right angles to the direction of flow where feasible and prudent.

All bridges and culverts requiring a Title 16 permit will be large enough and positioned to avoid changing the direction and velocity of stream flow, or otherwise interfere with the migration or spawning activities of fish and wildlife unless ADF&G determines deviation from this guideline will not have a significant impact on the fish resources. In addition, all bridges and culverts will, to the extent feasible and prudent, be large enough to accommodate the best available estimate of 25 year peak discharge without interfering with volume, velocity, and sediment transport or substrate characteristics of the stream. Bridges and culverts should provide adequate clearance for boat, pedestrian, and large game passage whenever these uses occur or are anticipated.

Roadbed and utility corridors should avoid alignments which closely parallel or lie within the floodplain of rivers or streams. Buffer strips of natural vegetation of a minimum width of 200' or more if necessary to filter surface runoff, should be retained between the roadbed or utility corridor and any waterbody or wetland (See Criteria for Protective Buffer Strips).

Roads and utility lines should be routed around wetlands. If no alternative exists and roads must cross wetlands then roads should be elevated to allow natural circulation of water and free passage of aquatic life. Avoid solid fill causeways and other obstructions which impound or divert water. Where solid fill roadways must occur they should be aligned parallel to the direction of natural drainage, allow for free passage of aquatic life and provide for peak flows. Utility crossings of rivers, lakes and streams should either be buried or elevated to avoid obstructing streamflow. Heavy machinery should not be driven up or down a streambed.

Necessary work in or adjacent to biologically important wetlands and tideflats should be scheduled during the least sensitive time periods. Disturbances to wildlife should be avoided during calving, nesting, molting or migration.

Transmission lines will use existing or designated transportation corridors where feasible and prudent. The siting and construction of transmission lines will, to the extent feasible and prudent, avoid creating permanent access corridors and causing significant damage to the land. Transmission lines will not be sited in critical or important waterfowl habitat. Transmission lines will be designed to prevent electrocution of raptors.

For winter roads or winter access, snow ramps, snow bridges, cribbing or other methods should be used to provide access across frozen rivers, lakes or streams to avoid the cutting, eroding, or degrading of banks. Snow bridges will be removed or breached and cribbing will be removed immediately after final use.

Airports or landing strips should be located in areas which will minimize interference with fish wildlife and their habitats. Avoid fills into rivers, streams, or lakes to create airport space. Avoid locations where birds will interfere with safe take-off and landings. Retain vegetated buffer zones around airport surfaces to filter oil and dust from surface runoff (See - Criteria for Protective Buffer Zones).

Where road corridors contact streams, appropriate areas should be retained in public ownership to accommodate the expected recreation use, including parking. The size of these areas will vary but should generally be 20-80 acres. Exceptions to this size may be made for sites anticipated to have very low or high use. These river access/recreation sites should be located to be readily accessible from the highway without being visible. Typically, this will require a short section of access road to a parking area screened from the highway by vegetation or topography. A 200 foot buffer zone should be left between any parking or camping areas and the stream (see Criteria for Protective Buffer Zones).

See: Settlement Guidelines
Oil and Gas Guidelines
Minerals Guidelines
Forestry Guidelines

Guidelines for Protection of Special Fish and Wildlife Areas

The Alaska Legislature recognizes that, due to economic growth and natural resource development, certain species or subspecies of fish and wildlife are now and may in the future be threatened with extinction. AS 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 habitat of species or subspecies of fish and wildlife that are recognized as threatened with extinction.

No activity should be conducted that will jeopardize the continued existence of an endangered species or result in modification or destruction of habitat required by such species. A qualified Alaska Department of Fish and Game or United States Fish and Wildlife Service biologist should review specific cases and determine appropriate protective measures.

The peregrine falcon is protected under both federal and state endangered species acts. Trumpeter swans are protected under the Migratory Bird Treaty Act of 1918 and international treaties with Mexico and Canada. Bald and golden eagles and their habitat are protected under the Bald Eagle Protection Act.

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 destruction 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.

<u>Endangered Species</u>

<u>Peregrine falcon</u>. For all currently or historically occupied nesting cliffs of the peregrine falcon, <u>Falco peregrinus anatum</u> and <u>Falco peregrinus tundrius</u>:

1. Land use practices and/or development that will alter or eliminate natural habitat conditions within one mile (1.6 km) of nesting cliffs should be prohibited.

2. All ground level activities (unless specifically authorized) within one mile of nesting cliffs between April 15 and August 31 should be prohibited.

3. The state should protect and/or retain nesting habitat in public ownership.

4. The state should make provision for purchase or otherwise ensure protection for nesting habitat in private ownership.

5. All aircraft overflights within 1500 feet of the surface and within a horizontal distance of one mile of nesting cliffs should be prohibited between April 15 and August 31.

6. Permanent facilities within two miles (3.2 km) that have high noise levels or sustained human activity or that altering large acreages should be prohibited.

For all areas within a minimum of fifteen (15) miles of active nesting cliffs.

1. Land use practices and/or developments that will detrimentally alter or eliminate the habitat or food source of peregrine falcons should be prohibited. (This guideline does not advocate a prohibition of all development activities around nesting sites, rather it requests consultation with ADF&G to insure that adequate peregrine feeding areas are protected around the nesting sites.)

2. The use of harmful pesticides and other environmental pollutants detrimental to the peregrine falcon or its food source should be prohibited.

3. The state of Alaska should retain key feeding habitats in public ownership or make provision for protection or purchase of these habitats on private land.

Protected Species

Trumpeter swans. For all currently or historically occupied nesting areas of trumpeter swans:

1. Land use practices and/or developments that will alter or eliminate natural habitat conditions within one mile should be prohibited.

2. The state should protect and/or retain staging and reproductive habitat in public ownership.

3. Activities which cause or create visual or noise disturbance within one mile of swan nesting ponds, marshes or lakes from May 1 through September 10 should be prohibited. These same activities should be prohibited within one mile of major staging areas between April 1-30 and September 10 - October 1.

4. All aircraft overflight within 1500 feet of the surface and within a horizontal distance of one mile of documented trumpeter swan nest sites between May 1 and September 10 should be prohibited.

Eagles. For all currently or historically occupied nesting areas of bald and golden eagles including forests, cliffs, and sea stacks:

1. Land use practices and/or development including but not limited to removal or disturbance of natural habitat within one-quarter mile should be prohibited.

2. Along coastal or riparian shorelines a nondevelopment zone of at least one-quarter mile should be retained in public ownership.

3. A continuous zone of uncut timber of at least 500 feet (152 m) should be maintained around nesting sites on public lands of the state.

4. On private lands eagle nesting sites should not be removed, felled, or in any way disturbed.

5. On state lands, all ground level development activities (unless specifically authorized) within 500 feet (152 m) of active bald eagle nests should be prohibited between March 1 and August 31.

Alteration or disturbance of the habitat in marine mammal and migratory seabird rookeries or migratory waterfowl and shorebird nesting or staging areas should 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 should be avoided. If avoidance is not possible, other mitigative measures including compensation should be required.

Wetlands Guidelines

Wetlands have intrinsic natural values. In addition to their important contribution to fish and wildlife productivity and associated recreational and scientific use, wetlands perform a far broader spectrum of biological and physical functions. Wetlands act as natural water management systems. Wetlands serve to filter nutrients and sediment from upland run-off, stabilize the water supply by retaining excessive water during flooding and by recharging groundwater during dry periods. Wetlands serve as important breeding, nesting, feeding or calving areas for many species including waterfowl, moose and caribou. Wetlands support migratory birds of national and international significance. Coastal and estuarine wetlands and tideflats with their high primary productivity and energy export potential are the ecological basis of much of our commercial seafood industry.

Unplanned and uncontrolled development has been responsible for converting wetlands to subdivisions, landfills, airports, transportation corridors, shopping centers and industrial sites without concern for their natural benefits. The costs to long-term community interests, both economic and environmental, may exceed the short-term benefits of converting wetlands to alternate land uses.

The value of various types of wetlands to fish and wildlife species may vary considerably. The following guidelines provide some initial considerations for the protection of wetlands. Since no classification or determination of fish and wildlife value for general types of wetlands is currently available for most of Alaska, evaluations of specific sites and project areas should provide the basis for determining wetland values and permissible development standards.

Definition. For the implementation of wetland policies and management guidelines, the following definition of wetlands shall apply: Wetlands are lands where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface. The single feature that most wetlands share is soil or substrate that is at least periodically saturated with or covered by water.[1] Generally, these are land areas which, at least periodically, support predominantly hydrophytes[2] and in which the substrate is predominantly very poorly drained or undrained hydric soil[3].

For purposes of these management guidelines, wetlands are divided into three classes: Class I, wetlands larger than 100 acres and all wetlands with a locatable stream outlet (the stream shall be considered part of; the wetland); Class II, wetlands between 40 and 100 acres with no outlet; and Class III, wetlands less than 40 acres with no outlet.

Development Guidelines Adjacent to Wetlands

Agricultural development adjacent to wetlands. Class I wetlands and certain surrounding lands (buffers) should remain in public ownership whenever feasible. A Class I wetland buffer shall include all soils of Class IV or lower agricultural capability (e.g. Class V, VI, etc.) which lie adjacent to the wetland or a minimum 400 foot buffer zone as measured from the periphery of the wetland - whichever provides the greatest width (see-Criteria for Protective Buffer Zones).

Restrictive use covenants and public access easements rather than public ownership may be used to protect Class I wetlands and associated buffers under conditions specified in 4 below.

Class II wetlands and certain surrounding lands (buffers) should remain in public ownership whenever feasible. A Class II wetland buffer shall include all soils of Class IV or lower agricultural capability which lie adjacent to the wetland, or a 200 foot buffer zone adjacent to the wetland - whichever provides the greatest buffer width.

Restrictive use covenants and public access easements rather than public ownership may be used to protect Class II wetlands and associated buffers under conditions specified in 4 below.

Class III wetlands may be sold as part of a farmstead. Draining, clearing, or other modifications must conform to applicable permit requirements (e.g. Army Corps of Engineers "Section 404" Permit). When feasible, Class III wetlands should remain in public ownership.

Forestry management adjacent to wetlands. Winter access only should be used in or across wetlands whenever feasible.

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[1]Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. USFWS, Office of Biological Services, FWS/OBS-79/31. Washington D. C. 103 pp.

[2]Hydrophyte: Any plant growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content.

[3]Hydric soil: Soil that is wet long enough to periodically produce anaerobic conditions, thereby influencing the growth of plants.

Selective timber harvest only, will generally be permitted within 400 and 200 feet respectively of Class I and II wetlands. This guideline may be changed for specific locations by ADNR with the approval of ADF&G (see Forestry Guidelines).

Other land uses adjacent to wetlands. Maintain wetland processes when adopting practices on adjacent lands such as protecting water quality and quantity, minimizing disturbances to nesting molting and calving areas, not obstructing migratory pathways and careful applications of pesticides and herbicides.

On all lands adjacent to public wetlands adequate buffers (see-Criteria for Protective Buffer Zones on State Lands) will be preserved in a natural state to protect the hydrologic, recreation and habitat functions of the wetlands. These buffers should be retained in public ownership whenever feasible.

Restrictive use covenants and public access easements rather than public ownership may be used to protect wetland buffers under conditions specified below.

The following standards shall apply when publicly-owned wetlands or parts there of or publicly-owned lands adjacent to wetlands are sold to private parties for non-agricultural use:

1. Class I wetlands and land within 200 feet of Class I wetlands will remain in a natural state.

2. Class II wetlands and land within 400 feet of Class II wetlands will remain in a natural state.

3. Class III wetlands will be dealt with on a case-by-case basis through public land disposal processes or applicable public land management plans.

Restrictive use covenants and public access easements. Class I and II wetlands (including outlet streams) and associated buffers should remain in public ownership whenever feasible. Restrictive use covenants and public access easements may be used rather than public ownership under the following conditions:

1. Where the configuration of the wetland is such that survey along the meander of the wetland would be excessively expensive. In this case an aliquot part (rectangular) survey rather than a meander survey may be used along the edge of the wetland. This may result in portions of the wetland being conveyed to private ownership. Restrictive use covenants and public access easements shall be applied to ensure that those portions of the wetland and associated buffer conveyed to private ownership remain in a natural state and that public access and use are maintained.

2. For Class II wetlands where the wetland is entirely included with a parcel of land to be sold for private use. In this case the wetland and associated buffer may be conveyed to private ownership with restrictive use covenants which ensure that the wetland and

associated buffer remain in a natural state. This does not apply to Class I wetlands. Class I wetlands shall remain in public ownership except as in 1.

Dredging and filling wetlands. Wetlands that are hydrologically important to fish and/or wildlife should be identified prior to any development activities in order to avoid negative impacts on fish and/or wildlife.

Dredging, filling and other permanent alterations of wetlands should be avoided or strictly limited. Where dredging or filling must occur, stringent stipulations should be adopted as to the type of fill, the season of activity, the type of structure or activity to occur on the fill and other habitat changes resulting from the dredging or filling. Enhancement of wetland habitats is encouraged where compatible with local wildlife management goals. Modifications should only be allowed if it can be demonstrated to the satisfaction of ADF&G that they will not impair long-term fish and wildlife production.

Site preparation activities in wetlands should be scheduled during winter when the least biological damage will occur.

See: Transportation Guidelines
Oil and Gas Guidelines
Subsurface and Mineral Guidelines
Foretry Guidelines
Settlement Guidelines
Agriculture Guidelines
Criteria for Protective Buffer Zones on State Lands
Guidelines for Protection of Special Fish and Wildlife Areas

Riparian Land Guidelines

Introduction. Riparian ecosystems are a highly productive public resource. They support a greater abundance and diversity of fish and wildlife than surrounding habitats. Their wildlife values provide numerous recreational opportunities as well as contributing to the economy.

The following lists several important attributes of riparian ecosystems:

1. Riparian vegetation regulates the energy base of the aquatic ecosystems, thus determining the quality of aquatic habitat for fish resources;

2. The structural diversity and complexity of riparian vegetation supports greater numbers and diversity of terrestrial wildlife populations than any other habitat;

3. It provides a vegetative buffer zone which acts as a mechanism for flood control, pollution abatement, erosion control, streambank stabilization, ground water recharge and the maintenance of water quality;

4. It attracts and supports many recreational, subsistence and educational activities including hunting, trapping, fishing, camping, photography and nature study and;

5. It has a high aesthetic value due to the combination of water, land, attractive and unique vegetation types and abundant fish and wildlife populations.

The removal of streamside vegetation directly affects the habitat for fish, wildlife and other aquatic resources. Loss of riparian vegetation can lead to changes causing increased erosion and increased sedimentation in rivers, streams and lakes, changes in water temperature, nutrient supply, available food and cover for fish, and stream flow and fluctuations in discharge. The quality of the aquatic habitat and its productivity is a result of the interaction of the riparian vegetation with the aquatic system. Adverse alterations in the vegetation will affect the quality and quantity of fish habitat and cause a decline in productivity.

For moose riparian habitats are essential for maintaining a stable population. Riparian areas play a critical role in overwinter survival, especially in years with deep snow accumulation. Moose travel long distances to reach river bottomlands where snow is less deep and food more accessible.

Any conflicting use of the resource must be weighed against the resources inherent values and be designed to best maintain those values. If we are to maintain productive, healthy riparian ecosystems then we must adhere to management practices that reduce impacts to fish and wildlife and protect public recreational values. The importance and value of riparian wildlife habitats calls for especially protective measures. A more detailed account of the values of riparian ecosystems is presented in a report in Appendix C. The following guidelines are necessary to protect these resources.

Definition. Riparian lands are composed of plant communities along rivers and streams and around lakes, ponds, springs or bogs, whose vegetative structure and function is primarily determined by influences from the adjacent aquatic system, including a high water table or overbank flooding. Along rivers and streams, riparian lands are those which are located within the boundaries of the active floodplain.[1]

Development Guidelines. All persons conducting operations on state land should be informed of and comply with the Water Quality Standards of the state of Alaska, Department of Environmental Conservation (18 AAC 70.010-110), 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.

Natural vegetative buffer zones, retained in public ownership should be left along all shorelines, sloughs, bays, rivers, streams and other surface water in order to trap sedimentation and pollutants, control storm water flow, protect important fish and wildlife habitat and provide public recreational opportunities. The width of the buffer strip should be determined by the slope of the land, severity of erosion, vegetation type, importance to fish and wildlife, extent of the 100-year floodplain and proposed development. Generally, public land disposals for remote parcels, recreational parcels, subdivisions, homesteads and similar low density residential or recreational development should have a minimum buffer of 200-400 feet landward of the ordinary high water mark. Generally buffers on public lands adjacent to commercial or industrial uses should have a minimum buffer width of 800 feet landward of the ordinary high water mark or 200 feet landward of the boundary of the 100-year floodplain. (see Criteria for Protective Buffer Strips).

For all areas within a protective buffer zone (minimum of 200 feet landward of the ordinary high water mark) adjacent to a waterbody which will be closed to mineral entry the state should issue mineral closing orders that include the entire width of the protective buffer zone (See Subsurface and Mineral Guidelines).

For private property along all shorelines, sloughs, bays, rivers, streams and other surface water where feasible and prudent the state should attempt to purchase private land within the designated riparian buffer zone or negotiate conservation easements equivalent to a minimum width of 200 feet. Stipulations should be attached that assure a tract remain in its natural state. Easements are not considered as desirable as fee-simple acquisition. Except for low density public use recreational cabins permanent structures should not be built within the 100-year (active) floodplain of any flowing body of water.

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[1] Active floodplain: The flood prone low lands and relatively flat areas adjoining inland and coastal waters including contiguous wetlands and floodplain areas of offshore islands; this will include, at a minimum, that area subject to a 1% or greater chance of flooding in any given year (100-year floodplain).

For any activity within Riparian lands:

1. Free passage and movement of fish must be assured both upstream and downstream of the permitted activity of construction as may be provided through conditions of the permit.

2. Scheduling of instream activities will be determined by ADF&G on a site-specific basis so as to avoid or minimize adverse disturbance to fish during migration, spawning, incubation, rearing or overwintering.

3. Blasting is prohibited within minimum acceptable offsets of fish-bearing water (see Oil and Gas guidelines).

The hydrological patterns of many streams preclude the use of culverts as adequate fish passage structure. When a majority of a streams annual flow occurs within a short period, large culverts are necessary to safely pass water flow. Even large culverts can constrict water-flow, however, and result in increased water velocities. High water velocities can cause scouring at the downstream end of a culvert, which elevates the culvert and blocks fish movements. During other periods of the year, low water flow and the large cross sectional area of the culvert can make water depths in the culvert too shallow to pass fish.

During development, bridges will be used as watercourse crossings of fish habitat wherever feasible and practical. Culverts shall be used in fish habitat only when absolutely necessary, and where it can be demonstrated they will not block fish passage. The placement of bottomless arch culverts are preferable over either round or elliptical culverts, which are optimally buried one-fifth of the diameter of the culvert into the thalweg of the stream.

The operation of equipment in streams can cause sedimentation of waterbodies, disrupt fish migrations, and restrict or eliminate spawning grounds and overwintering habitat.

The operation of equipment, excluding boats, in open water areas of fish-bearing streams will be prohibited, unless approved by the Department of Fish and Game pursuant to AS 16.05.870.

The removal and compaction of snow cover overlying fish-bearing streams can cause abnormally thick ice formation, which may reduce available fish overwintering habitat. Winter water appropriations from fish-bearing waterbodies during winter can dewater fish overwintering areas. Reductions in overwintering habitats can ultimately increase winter fish mortalities.

Compaction and/or removal of snow cover from fish-bearing waterbodies will be prohibited, with the exception of perpendicular crossings approved by the Department of Fish and Game. If ice thickness is not sufficient to facilitate a crossing, ice and/or snow bridges will be required.

Unscreened, high velocity water intakes can entrain and kill fish and other aquatic organisms.

Water intakes used to remove water from fish-bearing streams and lakes must be surrounded by a screened enclosure to prevent fish entrainment and impingement. Pipes and screening shall be designed and constructed so that the maximum water velocity at the surface of the screened enclosure is not greater than 0.1 foot per second, and screen mesh size shall not exceed 0.04 inch, unless an alternate design is approved by the Department of Fish and Game.

Development activities in or adjacent to fish habitat will, to the extent feasible and prudent, not alter the natural stream course or channel.

Rivers, streams or lakes that support important commercial, subsistence, or recreational fish species will not be dammed, diverted or drawn down by hydroelectric projects unless the project will be designed or mitigated so as to cause no net loss to fish production.

Materials toxic to aquatic life should not be stored in floodplains.

Prior to disposing lands around lakes or streams a shoreland management classification scheme for public waters should be developed. District planners are encouraged to identify rivers, streams and lakes within their jurisdiction which are important to fish and wildlife resources as well as community aesthetics, recreation, water sources and other amenities. Lakes and streams and their shorelands should be classified into categories (i.e. Natural Environment-no development, Recreational development, or General development) and for each category minimum shoreland use standards (zoning) should be addressed. These may include pollution control, protection of wildlife, prevention of land use conflicts, wetlands protection, protection of scenic beauty and protection and enhancement of recreational values. Various standards may also apply to lot size, water frontage, open space, and building set backs.

It is recommended that the borough provide financial incentives to riparian landowners in the form of tax incentives. These should be designed to encourage landowners to dedicate riparian lands to fish and wildlife values. No development may occur within a predetermined buffer zone without prior approval by the Borough and ADF&G. Any tax relief law should have stipulations to recover back taxes from landowners who develop their lands.

Riparian habitats along the Susitna, and Yentna rivers, and Alexander Creek support particularly high concentrations of moose during severe winters. If development activities are conducted within critical moose wintering habitats when animals are present, increased winter mortalities are likely to result due to the additional stress created by development operations.

During severe winters, activities with a high potential for noise or visual disturbance will be restricted or prohibited between November 15 and April 30, as necessary, in critical moose wintering areas within one-half mile of the Susitna, and Yentna rivers and Alexander Creek. Specific areas where winter operations may be restricted will be identified by the Department of Fish and Game within 60 days of the date a plan of operation is submitted for approval.

See: Settlement Guideline
Forestry Guideline
Transportation and Utility Guidelines
Subsurface Resources Guidelines
Instream Flow Guidelines
Criteria for Protection of Special Fish and Wildlife Areas
Criteria for Protective Buffer Zones on State Lands
Agricultural Guidelines

Criteria for Protective Buffer Zones on State Lands

Introduction

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 ordinary 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, wildlife and their habitats by:

a. 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.

b. Preventing pollutants from reaching a waterbody.

c. 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.

d. Avoiding disruption of fish or wildlife populations during sensitive life history stages.

e. 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' 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. Mineral closures should be implemented in all buffer zones to prevent activities the buffer zone is designed to protect.

Flexibility can 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. Hydrologists, 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.

In many cases an adequate buffer between a waterbody and development can only be established after on-site review. The recommended buffers listed below are general standards which may not be applicable in all cases. Depending upon hydrology, topography, soils and floodplain characteristics the buffer zone may need to be enlarged. In certain instances the buffer zone may be sufficient to protect the river from development but may be insufficient to protect development from the river. When the width of the 100-year floodplain exceeds the width of the recommended buffer zone width, the former should serve as the set-back or buffer zone. Development will not be allowed within the 100-year floodplain.

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.

Recommended buffer widths are given for each category in the ADNR land classification system. 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 river, lakes, streams, marine waters and contiguous wetlands. Specific recommendations follow:

Current Land Classifications (from Natural Resources Title 11, Chapter 55, Land Planning and Classification)

<u>Agricultural Lands - 800 Feet</u>

Agriculture can have detrimental effects upon waterbodies through nutrient overloading, contamination from pesticides, erosion, or draining. "Agriculture" can span a wide spectrum of activities ranging from small-scale homesteading to large-scale agribusiness. The actual distance between fish streams and agricultural land clearing should be based on the size of the agricultural project, terrain, natural vegetation, and other factors specific to each project. The Habitat Division recommends a minimum standard 800 foot buffer zone around major streams, rivers and lakes for major agricultural projects. This buffer zone width is suggested in order to provide adequate protection from potential surface soil erosion and runoff from fertilizers and pesticides; to maintain adequate riparian habitat for moose, furbearers, and other species.

In some cases, agricultural projects are located near waterbodies for the express purpose of water utilization. A narrower buffer may be acceptable for small scale agricultural projects to protect water courses and still allow agricultural activities close enough to the stream or lake to remove water. A narrower buffer width would be acceptable if it can be shown that the proposed activity will not compromise the stated purpose of the buffer.

Plans for water removal would have to be reviewed to ensure that the instream flow requirements of the fish populations are not affected, that pumps are adequately screened to prevent adverse impacts to fish, and that fueling is conducted to prevent spillage of toxic chemicals into the water.

Above the Point of a Stream Where Fish Have Been Identified

A 400 foot buffer width is recommended for stream reaches above the point where fish have been identified where there is reasonable concern that potential surface soil erosion or runoff from fertilizers and pesticides into those systems would affect downstream anadromous and fresh water resident fish streams.

Grazing Lands - 400 Feet

Intensive grazing in the riparian zones has severely degraded streams, lakes, rivers, and coastlines, particularly in the lower 48 states. This has resulted in increased erosion, denudation and breakdown of the banks. Degradation of the riparian zone and of the stream banks can be minimized by establishing and maintaining buffer zones between the grazing lands and the waterways. Pumping water for livestock would be subject to the same restrictions discussed under Agricultural Lands.

Forest Lands - 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 breaks 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.

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.

Mineral Lands/Coal 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 or appreciate the harm that unregulated mining can have on habitat.

Oil and Gas Lands/Geothermal Lands - 800 Feet

Construction activities and siting of facilities in close proximity to rivers and lakes can lead to shoreline erosion and sedimentation of waterbodies, widespread pollutant transport, loss of public access to state waters and shorelines, and loss or alteration of riparian habitats important to birds and mammals. Riparian habitats in the Susitna Basin provide particularly important moose wintering range, and displacement of moose from these areas could result in increased mortalities and eventually lead to declines in local populations.

Fish and wildlife can also be impacted significantly by noise and disturbance associated with industrial activities. Maintaining the integrity of critical habitats, such as fish spawning areas, moose wintering grounds, and key wetlands, is especially important to the continued survival of local populations.

Public Recreation Lands - 200 Feet

In most cases, public recreation will have minimal effects upon waterbodies if located outside a narrow buffer. Campground 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 accommodate 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 (Oncorhynchus kisutch), king salmon (O. tshawytscha), and steel head (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.

Reserved Use Land - 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.

Settlement Lands

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.

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.

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.

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.

Transportation Corridor Land - Variable

The most critical aspect is the location of the transportation system. The location will affect both the degree of habitat alteration and the degree of secondary impacts which accompany construction and operation. In addition to the primary impacts, a transportation system can generate residential, commercial, industrial, and recreational development, any of which result in activities far more damaging than the system itself.

Roads may also interfere with natural drainage patterns and flow of surface and ground water, interfere with both fish and wildlife movements, create runoff that effects water quality, removes important habitat by dredging or filling during the construction process and directly disturbs wildlife by increased noise or activity.

When intended for specific uses the transportation system should adhere to the most stringent buffer of the activities intended for (i.e. transportation systems to private recreation lands should have a buffer of 200 feet. A road to a commercial site should have an 800 foot buffer while a road intended for use by both commercial development and private recreation should have an 800 foot buffer.

Water Resources Land - 800 Feet

Since one of the goals 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., a maximum buffer should be implemented.

Wildlife Habitat Lands

Does not apply.

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APPENDICES

APPENDIX A

SUSITNA AREA PLAN
HUMAN USE AND ECONOMIC EFFECTS
SPORT FISHING

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INTRODUCTION

Sport fishing is an activity of major significance to land use planning in Southcentral Alaska. The continued growth and centralization of a recreationally oriented population has resulted in pressures on fish populations so great that nearly every river and lake system has required special regulatory protection, such as gear restrictions and emergency closures. These systems are often the first to exhibit the effects of habitat degradation associated with increased growth of the human population and numerous resource development efforts such as mining, road construction, agriculture, forestry, and the like. In addition, sport fishing is very popular in Southcentral Alaska. The vicinity map included in Atlas Map C4 identifies the major fishing locations, levels of effort in terms of days fished, and the major access modes to these fisheries.

To establish reliable estimates of the human use and economic effects presently associated with sport fishing in the Susitna basin, it is necessary to first assemble a profile of this activity basin-wide. The data base assembled under the Alaska Statewide Sport Fish Harvest Studies[1] will be used for this purpose. Next, a more in-depth look will be taken at how sport fishing is pursued in the basin by selecting a sample of streams and lakes demonstrating typical patterns of harvest, access, travel mode, equipment, time requirements, and the types of users served. Economic values will be attributed to these systems and, by inference, to the entire basin through application of a simplified version of the travel cost method. Finally, the fisheries potential of the region is considered.

PRESENT USE PROFILE

Three types of information provide the basis for a profile of sport fishing in the Susitna basin: 1) angler days, 2) number of fish harvested, and 3) the residency of anglers. This information is organized by species, by area, and by fishery, and has been systematically collected by the Sport Fish Division since statehood. Formal questionnaires of a large sample of the sport fishing population (nearly 8,400 completed questionnaires were returned in 1981) have been used since 1977. This effort has resulted in one of the most carefully designed, consistently managed, and statistically accurate data bases available for any resource use in the state.

Table 1 summarizes sport fishing days, total harvests, and averages for the five-year period 1977-1981 for the principle river and lake systems in the Susitna basin.[2] Figure 1 displays these same data graphically. The fisheries referred to are generally well known. Excluding the Willow sub-basin area, fishing days range from 7 to 9% of the statewide total over this period. Only a small portion of the Glennallen area fisheries are included in the Susitna area: the Lake Louise complex and the fisheries off the Denali Highway. The eastside Susitna drainage is dominated by the fisheries north of Little Willow Creek, which are easily reached from the Parks Highway. The entire westside Susitna drainage is included, with effort and harvest concentrated in four main river systems that are generally reached by aircraft and boat. The available data on effort and harvest in 1980 for all Susitna basin fisheries are listed in Table 2. 1980 is taken as the typical year for purposes of this study.

Table 3 summarizes the residency of the users of Susitna basin fisheries in terms of fishing days at each location.

A review of these tables serves to verify several important features of the sport fishery in the Susitna basin.

> Sport fishing is indeed a widespread and popular activity. For 1980, effort in the Susitna basin totaled 118,590 fishing days. At 1980 population levels (Anchorage: 174,431, Mat-Su Borough: 17,816), nearly every resident in the area could have participated sometime during the year.
>
> A high percentage of effort (over 30%) is concentrated on a very limited number of small creeks clustered along the Parks Highway. This pattern is reinforced by the inclusion of Willow sub-basin data: taken together, these small drainages account for 89,694 fishing days, or 35% of the area total in 1980.[3] Target species in these extremely popular drainages are primarily salmon.
>
> A near one-to-one relationship between the number of days fished and the total harvest appears common. For the anadromous fisheries, harvest rates appear to be a little lower, whereas for the resident fish species rates are higher. Since the usual fishing limit is three fish per day, the 1980 harvest level required to satisfy every fisherman every day would be about 356,000 fish (118,590 days fished X 3) or 3.6 times the 1980 harvest.

TABLE 1. Sport Fishing Days and Total Harvests, Susitna Basin 1977-1981 (Willow Sub-basin Area excluded)

Fisheries	1977 Days	1977 Harvest	1978 Days	1978 Harvest	1979 Days	1979 Harvest	1980 Days	1980 Harvest	1981 Days	1981 Harvest	Average Days	Average Harvest
Glennallen Area												
Lake Louise, Lake Susitna & Tyone Lake	14,899	10,624	13,161	8,419	12,199	8,953	10,539	15,386	14,397	15,941	13,039	11,865
Other Waters (X 35%)	7,746	10,308	4,667	7,914	6,613	11,909	5,823	9,191	5,354	9,231	6,040	9,711
Eastside Susitna Drainage												
All waters except Willow Creek & Little Willow Creek	38,044	33,163	57,641	67,598	54,140	38,561	54,103	54,340	41,949	35,884	49,175	45,909
Westside Susitna Drainage												
All Freshwater Areas	31,946	39,606	37,971	48,287	50,374	49,392	48,125	52,272	37,335	36,110	41,310	45,043
Total	92,635	93,701	113,440	132,218	123,326	108,815	118,590	131,189	99,035	97,166	109,565	112,528
(Total Less Pink Salmon)		(73,727)		(97,300)		(89,972)		(103,963)		(91,774)		(99,242)
Percent of Statewide Totals	7.7	9.6	8.8	12.7	9.0	8.3	7.9	10	7.0	10	8.1	10.1

Source: Mills, Michael J. 1977-1981. Statewide Harvest Studies. Selected from appropriate tables. "Days" are days of active fishing, all anglers. "Harvest" denotes all fish taken, all species included, but does not include catch and release fisheries.

TABLE 2. 1980 Susitna Basin Sport Fishing Effort and Harvest by Fisheries and Species

Fisheries	Days Fished	KS	SS	LL	RS	PS	CS	RT	DV AC	LT	GR	NP	WF	BB	Other	Total Harvest
		Species Harvested														
Glennallen Area																
Lake Louise, Lake Susitna, Tyone Lake	10,539	0	0	0	0	0	0	0	0	2,609	4,477	0	1,688	6,612	0	15,386
other waters (x 35%)	5,823	145	57	75	301	0	0	461	292	784	5,985	0	63	687	341	9,191
Total	16,362	145	57	75	301	0	0	461	292	3,393	10,462	0	1,751	7,299	341	24,577
Eastside Susitna River Drainages																
Caswell Creek	4,963	215	1,124	0	77	1,663	19	154	83	0	353	0	0	26	26	3,740
Montana Creek	19,287	559	2,684	0	257	8,230	571	854	167	0	655	0	0	13	13	14,003
Sunshine Creek	5,208	13**	1,534	0	116	2,408	225	193	39	0	0	0	0	39	0	4,567
Clear (Chunilna) Creek	4,388	172	661	0	6	622	385	950	751	0	1,348	0	0	32	32	4,959
Sheep Creek	8,041	45**	430	0	0	6,362	648	385	83	0	725	0	0	45	0	8,723
Others	12,216	45**	2,234	1,663	257	3,403	1,445	2,658	790	267	4,854	0	0	212	520	18,348
Total	54,103	1,049	8,667	1,663	713	22,688	3,293	5,194	1,913	267	7,935	0	0	367	591	54,340
Westside Susitna River Drainages																
Kroto Creek (Deshka)	19,364	3,685	2,290	0	0	689	0	4,305	0	0	1,817	0	0	224	69	13,079
Lake Creek	8,325	775	2,351	0	267	2,101	69	2,144	121	0	1,972	103	0	0	0	9,903
Alexander Creek	6,812	1,438	999	0	52	809	121	1,945	353	0	1,145	0	0	0	0	6,862
Talachulitna River	2,542	121**	491	0	112	276	17	379	982	0	1,713	0	0	0	0	4,091
Chuit River	614	17**	258	0	0	69	0	301	146	0	0	0	0	0	0	791
Theodore River	700	17**	370	0	0	232	0	250	129	0	0	0	0	0	0	998
Lewis River	43	0	0	0	0	0	0	9	0	0	0	0	0	0	0	9
Other Rivers	4,998	129**	6,010	0	34	362	284	1,722	603	181	1,808	0	0	448	0	11,581
Shell Lake	414	0	0	0	198	0	0	103	0	69	0	0	0	0	0	370
Whiskey Lake	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hewitt Lake	471	0	0	0	0	0	0	9	0	0	0	0	0	0	0	9
Judd Lake	814	0	0	0	267	0	0	86	723	0	232	0	0	0	0	1,308
Other Lakes	2,999	0	0	0	181	0	0	2,092	43	198	560	129	0	34	34	3,271
Total	48,125	6,182	12,769	0	1,111	4,538	491	13,345	3,100	448	9,247	232	0	706	103	52,272
GRAND TOTAL	118,590	7,376	21,493	1,738	2,125	27,226	3,784	19,000	5,305	4,108	27,644	232	1,751	8,372	1,035	131,189
Total Poundage		171,000/968	125,000	1,740	12,500	89,800	27,600	19,000	5,300	10,300	30,400	696	2,280	29,300	1,000	527,000

Source: Mills, Michael J. 1981. Statewide Harvest Study - 1980 data. ADF&G, Division of Sport Fish, Juneau. Extracted from Tables 42, 44 and 45.

Species Harvested and average weights (lbs): Chinook salmon (KS) 24.4/2.2, Coho salmon (SS) 5.8, Landlocked Coho salmon (LL) 1.0, Sockeye salmon (RS) 5.9, Pink salmon (PS) 3.3, Chum salmon (CS) 7.3, Rainbow trout (RT) 1.0, Dolly Varden/Arctic char (DV/AC) 1.0, Lake trout (LT) 2.5, Arctic grayling (GR) 1.1, Northern pike (NP) 3.0, Whitefish (WF) 1.3, Burbot (BB) 3.5. (Source for poundages: ADF&G, Division of Commercial Fisheries, and ADF&G, Division of Sport Fish, Pers. Comm., L. Engel 3/83; and, Morrow, James E., 1980. _The Freshwater Fishes of Alaska_. Alaska Northwest Publishing Company, Anchorage.

** King salmon less than 20 inches.

TABLE 3. 1980 Fishing Days by Residency of Users

Fisheries	Days Fished	Non-Resident Days Fished	Anch. Area	Mat-Su Bor.	Fbks. Area	Balance of State
Glennallen Area						
Lake Louise, Lake Susitna, Tyone Lake	10,539	1,875	5,360	1,254	245	1,805
Other Waters (x 35%)	5,823	1,142	2,177	220	784	1,500
Total	16,362	3,017	7,537	1,474	1,029	3,305
Eastside Susitna River Drainages						
Caswell Creek	4,963	446	2,871	1,499	88	59
Montana Creek	19,287	3,106	13,128	1,967	1,026	60
Sunshine Creek	5,208	422	3,700	822	245	19
Clear (Chunilna) Creek	4,388	439	2,596	843	500	10
Sheep Creek	8,041	870	6,202	754	186	29
Others	12,216	2,398	6,075	3,086	343	314
Total	54,103	7,681	34,572	8,971	2,388	491
Westside Susitna River Drainages						
Kroto Creek (Deshka)	19,364	2,635	14,034	2,581	75	39
Lake Creek	8,325	1,140	6,291	807	25	62
Alexander Creek	6,812	1,104	4,877	360	161	310
Talachulitna River	2,542	536	1,608	25	50	323
Chuit River	614	93	447	12	0	62
Theodore River	700	37	534	54	0	75
Lewis River	43	0	43	0	0	0
Other Rivers	4,998	841	2,816	472	211	658
Shell Lake	414	0	414	0	0	0
Whiskey Lake	29	0	29	0	0	0
Hewitt Lake	471	0	457	14	0	0
Judd Lake	814	181	633	0	0	0
Other Lakes	2,999	455	1,986	472	12	74
Total	48,125	7,022	34,169	4,797	534	1,603
Grand Total	118,590	17,720	76,278	15,242	3,951	5,399

Differences in odd and even-year pink salmon harvests account for most of the annual fluctuations in harvest shown in Figure 1.

There may be a correlation between lower harvest rates and fisheries showing important King Salmon harvests. The Kroto, Montana, Caswell and Alexander creeks express this effect.

A surprisingly high level of effort takes place in the westside Susitna fishery, which is dominated by four particularly important streams. Most of these are in remote areas and demonstrate that the Alaskan angler is willing to undergo the extra time and expense to fly or boat into productive fishing areas.

It is possible to select fisheries for which access, use, and harvest patterns are typical for the basin. In the following section, use patterns of selected fisheries are discussed, including background data required for a preliminary economic analysis.

Use Patterns

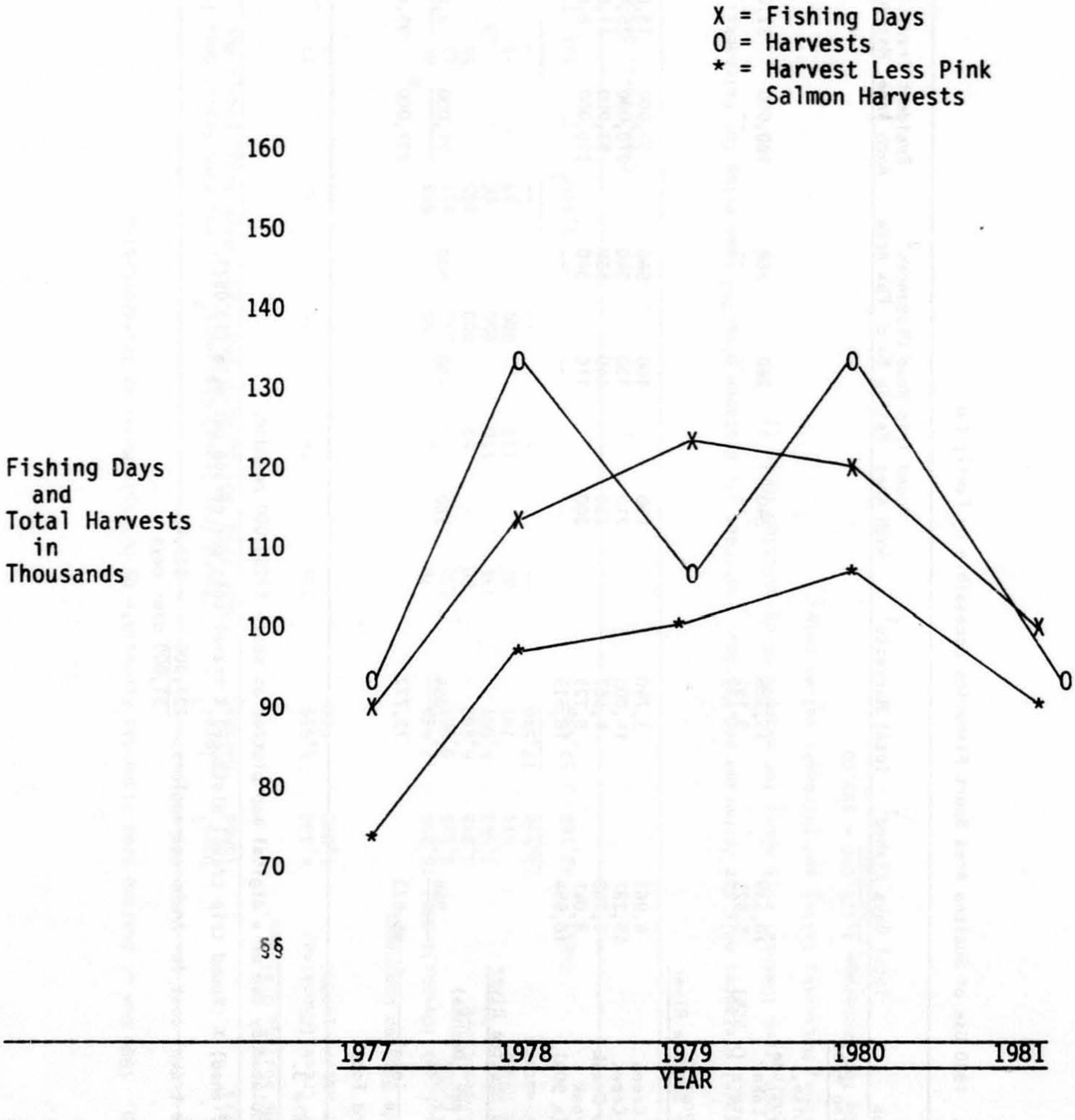
Rather than treating the Susitna basin as a homogeneous region, the approach taken here is to select and describe specific fisheries that typically share the same patterns of use. For this purpose the most common modes of access have been chosen as the basis for selection: family car, fly-in, and multiple modes for which combinations of road, air, and water transportation are required.

Fisheries accessible by family car. Table 4 summarizes the sport fisheries accessible by family car for which harvest and effort data are available. These fisheries are near major highways and characteristically serve as day or weekend fisheries. Target species are primarily salmon. Only the Lake Louise system and 35% of "other waters" occur within the Susitna basin. "Other waters" refers to numerous locations, primarily near the Denali Highway. The eastside Susitna drainages are relatively small, with only a small portion of these creeks accessible to anglers. Data in Table 2 for 1980 (our typical or indicator year) show about half of the fishing effort and half of the harvest (55%) occurring in these easily accessible fisheries. Overall success rates are 1.1 fish/day and somewhat lower for drainages dominated by anadromous salmon (0.8 fish/day). Of the westside Susitna drainages only the Kroto Creek - Deshka River system is accessible by road.

Fisheries accessible by air or multiple modes of transportion. In Table 5 a selected group of fisheries for which access is more difficult are listed. More equipment, time, and expense is required to reach these drainages: the distances travelled are greater, and very often the assistance of commercial operators is required for a portion or all of the trip. Data in Table 3 show residency of users. Frequency of use of the eastside and westside systems appears remarkably similar for non-resident and for Anchorage fishermen, but the westside fisheries appear less preferred by Mat-Su and Fairbanks fishermen. This is an effect created by the exclusion of Willow sub-basin fisheries from the analysis: total days fished for all eastside fisheries is 91,300 (1980, including Willow sub-basin, Table 1 and Table 6), or nearly double that of the westside fisheries. The importance of Montana and Kroto creeks is obvious.

That these streams can maintain productivity year after year under such enormous fishing pressure attests to their very high value as a resource.

FIGURE 1. Sport Fishing Days and Total Harvests, Susitna Basin 1977-1981



Source: See Table 1

TABLE 4. 1980 Use of Susitna Area Sport Fisheries Accessible by Family Car

Fisheries	Total Days Fished[1]	Total Harvests[1]	Round Trip Road Distances[2]			Resident Travel Cost ($)[3]			Average Travel Costs/Day
			Anch Area	Mat-Su Boro	Fbx Area	Anch Area	Mat-Su Boro	Fbx Area	
Glennallen Area									
Lake Louise, Lake Susitna, Tyone Lake	10,539	15,386	340	260	360	180,000	32,000	9,000	$32.00
other waters (x 35%)	5,823	9,191	--	--	--	--	--	--	--
Eastside Susitna River									
Caswell Creek	4,963	3,740	190	100	560	53,000	15,000	5,000	$28.00
Montana Creek	19,287	14,003	210	130	540	270,000	25,000	54,000	$29.00
Sunshine Creek	5,208	4,567	230	140	530	83,000	11,000	13,000	$30.00
Sheep Creek	8,041	8,723	200	110	560	120,000	8,000	10,000	$28.00
Others (x 90%)	10,994	16,513	--	--	--	--	--	--	--
Westside Susitna River									
Kroto Creek (Deshka) (x 5%)	968	654	280	190	500	21,000	2,000		$23.00
Total	65,823	72,777				727,000[4]	93,000	91,000	
Grand Total							911,000		

[1]See Table 3.

[2]As calculated by use of a digital map plotter at scale 1/250,000 rounded.

[3](Days fished) X (Round trip travel distance) X travel cost per person per mile ($0.097).

[4]Average travel cost for Anchorage anglers: $\frac{727,000}{31,000 \text{ user days}} = \$23.45$

TABLE 5. 1980 Use of Susitna Area Fisheries Accessible by Multiple Modes of Transportation

Fisheries	Days Fished[1]	Total Harvest[1]	Round Trip Travel Distances[2] Anch Area	Mat-Su Boro	Fbx Area	Resident Travel Cost ($ x 1000)[3] Anch Area	Mat-Su Boro	Fbx Area	Average Travel Cost/Day
Eastside Susitna Drainages									
Clear Creek (Chunilna)	4,388	4,959	250	160	570	37	17	15	$20.50
other waters (x10%)	1,222	919	--	--	--	--	--	--	
Westside Susitna Drainages									
Kroto Creek (Deshka)(x95%)	18,396	12,425	76	40	790	695	64	5	40.00
Lake Creek	8,325	9,903	120	90	830	281	23	1	40.00
Alexander Creek	6,812	6,862	80	50	800	265	15	7	45.00
Talachulitna River	2,542	4,091	134	110	850	66	.8	3	46.00
Chuit River	614	791	86	110	800	32	1	-	80.00
other waters	10,468	17,546	--	--	--	--	--	-	
Total	52,767	57,496				1,376[5]	121	31	

Grand Total $1,528,000[4]

[1] See Table 3.

[2] Air travel distances only for Anchorage and Mat-Su. Anchorage air distance plus 716 road miles for Fairbanks.

[3] See Kroto Creek (Deshka) work sheet for example of calculation (Note 7).

[4] Anchorage, Matanuska Valley and Fairbanks values only.

[5] Average for Anchorage $\frac{1,376,000}{15,400}$ = $89.00

TABLE 6. 1980, Willow Sub-basin Sport Fishing Effort and Harvest by Fisheries and Species

Fisheries	Days Fished	KS	SS	LL	RS	PS	CS	RT	DV AC	LT	GR	BB	Other	Total Harvest
Knik Arm Drainage														
Little Susitna River	22,420	646	6,302	0	2,127	3,918	465	852	1,748	0	181	9	1,059	17,307
Wasilla Creek (Rabbit Slough)	5,726	0	3,555	0	0	310	9	121	189	0	0	0	0	4,184
Cottonwood Creek	9,268	0	3,375	0	2,660	0	0	1,085	439	0	0	0	0	7,559
Wasilla Lake	1,642	0	0	43	0	0	0	2,084	181	0	0	0	0	2,308
Finger Lake	6,483	0	0	10,685	0	0	0	0	0	0	0	0	0	10,685
Kepler Lake Complex	8,597	0	0	2,807	0	0	0	5,906	0	0	1,061	0	0	9,729
Lucille Lake	3,798	0	0	3,633	0	0	0	0	0	0	0	0	0	3,633
Big Lake	12,195	0	0	189	43	0	0	5,398	7,585	594	0	43	0	13,852
Nancy Lake Recreation area, including Nancy Lake	9,153	0	0	146	69	0	0	2,540	327	749	0	34	43	3,908
Others	23,248	0	2,798	1,997	775	473	60	11,382	20,015	775	8,317	224	34	28,850
Total	102,530	646	16,030	19,500	5,674	4,701	534	29,368	12,484	2,118	9,514	310	1,136	102,015
East Side Susitna Drainage														
Willow Creek	29,011	289	1,207	0	83	23,638	989	1,168	636	0	1,863	0	116	29,989
Little Willow Creek	8,190	32	494	0	77	6,420	270	353	122	0	1,156	0	13	8,937
GRAND TOTAL	139,731	967	17,731	19,500	5,834	34,759	1,793	30,889	13,242	2,118	12,533	310	1,265	140,941

Source: Mills, Michael J. 1981. Statewide Harvest Study - 1980 Data. Extracted from Tables 44 and 46. Alaska Department of Fish and Game, Division of Sport Fish, Juneau.

Species Harvested and average weights (lbs): Chinook Salmon (KS) 24.4/2.2, Coho salmon (SS) 5.8, Landlocked Coho salmon (LL) 1.0, Sockeye salmon (RS) 5.9, Pink salmon (PS) 3.3, Chum salmon (CS) 7.3, Rainbow trout (RT) 1.0, Dolly Varden/Arctic char (DV/AC) 1.0, Lake trout (LT) 2.5, Arctic grayling (GR)1.1, Burbot (BB) 3.5 (Source for poundages: ADF&G, Division of Commercial Fisheries, and ADF&G, Division of Sport Fish, Pers. Comm., L. Engel 3/83; and, Morrow, James E., 1980. The Freshwater Fishes of Alaska. Alaska Northwest Publishing Company, Anchorage.

**King salmon less than 20 inches.

ECONOMIC VALUES

Access is among the most important factors determining patterns of use. In addition, access is of central importance to the economic analysis, in which a simplified version of the travel cost method is used. The primary assumption of this method is that the net dollar value of a recreational fishery may be estimated by taking the cost of travel as a substitute for the price of a fishing trip. In other words, payment of the costs to travel to a specific location may be taken as an expression of "willingness to pay" to use that location and represents the net value, or worth, of that site to the user. Therefore, if the number of trips taken per year to a fishing area is known, the costs of travel may be estimated from standard sources and a dollar value determined. This is no more than a short-hand method of arriving at a preliminary determination of recreational use values "at zero price." Without preparation of a demand function for the fishing trip and with no prediction of the use of a site at increased costs, it is not possible to estimate willingness to pay the "margin above cost of sport fishing which measures the real monetary value which would be lost if the fishery were to disappear."[4] The present effort is a first step towards application of the travel cost method to a large geographic region for the purpose of estimating net benefits from private recreational uses. Commercial operations of significant size serve the sport fishery and represent a significant additional source of value; but they are not included here, nor is any measure of consumer's surplus attempted.[5]

Fisheries Accessible by Family Car

Resident travel costs of $911,000 (Table 4) portray a general perspective of the annual "value," or net benefit to the economy in general, of the fisheries identified. This analysis is driven by the use of two sets of data and a single cost factor: angler days, residency of fishermen, and the cost/mile of automobile travel. The cost of $.097/mile used is derived from United States Department of Transportation data for 1977, updated for Alaska by use of the Alaska consumer price index and assuming that there are an average of 2.5 persons per car.[6] The cost figures in Table 4 are generated by simply multiplying (days fished by origin of fishermen) X (round trip distance to site) X $.097. It is assumed that all fishing trips are one-day trips.

The data shown in Table 4 may be used to estimate the value of all road-accessible fisheries. Anchorage, Mat-Su Borough, and Fairbanks residents spend over $900,000 annually ($911,000) in travel costs to sport fish in the six most popular fisheries in the Susitna basin. Using the appropriate averages, travel costs for unidentified fisheries may be estimated as follows:

<u>Glennallen other waters</u>
5,823 days X $32/day = $186,000

<u>Eastside other waters</u>
10,994 days X $29/day = <u>$319,000</u>

Total = $505,000

Residents from elsewhere in the state (see "Balance of State" column, Table 3) used these waters, and estimates of their travel costs may also be made under the assumption that these users incur a travel cost similar to Anchorage users, plus a nominal air fare ($150), and that they mostly take two-day fishing trips.

Balance of state

Glennallen
$$\frac{3{,}305 \text{ days}}{2 \text{ day/trip}} \text{ X } (\$150 + \$32)/\text{day} = \$301{,}000$$

Eastside
$$\frac{481 \text{ days}}{2 \text{ day/trip}} \text{ X } (\$150 + \$29)/\text{day} = \$\ 43{,}000$$

Westside
$$\frac{2 \text{ days}}{2 \text{ day/trip}} \text{ X } (\$150 + \$23)/\text{day} = \$\ \underline{173}$$

Total $340,000

In addition, considerable use of these fisheries occurs by non-residents (see Table 3), who generally fly to Anchorage and incur travel costs thereafter similar to Anchorage residents. If half of a round trip air fare from Seattle may be attributed to fishing and two-day fishing trips are assumed, the following costs are derived:

Non-residents. Glennallen area
$$\frac{3{,}017 \text{ days}}{2 \text{ day/trip}} \text{ X } \left(\$263 + \frac{\$33.60}{\text{day}}\right) = \$\ 448{,}000$$

Eastside Susitna
$$\frac{7{,}242 \text{ days}}{2 \text{ day/trip}} \text{ X } \left(\$263 + \frac{\$29}{\text{day}}\right) = \$1{,}050{,}000$$

Westside Susitna
$$\frac{132 \text{ days}}{2 \text{ day/trip}} \text{ X } \left(\$263 + \frac{\$30}{\text{day}}\right) = \$\ \underline{20{,}000}$$

Total $1,520,000

In summary, the total value of fisheries accessible by road (excluding the Willow sub-basin) is as follows:

"Big Six" fisheries	$ 911,000
other waters	$ 505,000
Balance of State	$ 340,000
Non-residents	$1,520,000
Total	$3,276,000

Fisheries Accessible by Air or Multiple Modes of Transportation

The analysis of economic value of systems requiring multiple modes of access goes well beyond the usual application of the travel cost method. A number of assumptions are required concerning distances travelled, the preferred travel mode, residency of users, the number of days per trip, and the variable costs incurred. It may be useful therefore to describe the analysis[7] of one fishery: the Kroto Creek - Moose Creek - Deshka River system.

Access to the Deshka River system is available at five locations: by air to the mouth of the river, Neil Lake, and Butterfly Lake; by car and boat at the Petersville road crossing; and from the Kashwitna River dock on the Susitna River. It is estimated that 5% fish by car access along the Petersville road area, another 45% by boat access from the Kashwitna dock, and the remaining 50% by aircraft to the mouth of the river. It is further assumed that half the fishing on the Deshka is day fishing, the other half consisting of two-day trips. It is further assumed that all users resident in the Mat-Su Borough and Fairbanks areas access the fishery by car and boat from the Kashwitna dock and that their fishing trips last two and two-and-one-half days respectively. Travel cost is then calculated from Anchorage, the Mat-Su Borough, and Fairbanks, based upon round-trip miles by each mode of transportation, costs per mile, and the number of users grouped by residency. Travel cost for the remaining users (balance of state) is determined using an averaged value.

Travel costs for fisheries requiring multiple modes of transportation are shown in Table 5. Data may be used from this table in the same manner as above to estimate costs for "other waters" and the balance of state and non-resident costs.

Eastside "other waters"

1,222 X $29 = $ 35,400

Westside "other waters"

10,468 X $50 = $523,000

Total = $558,000

Users from elsewhere in the state (Balance of state, Table 3) show:

Eastside

$$\frac{208 \text{ days}}{2 \text{ days/trip}} \times (\$150 + \$89) = \$\ 24{,}900$$

Westside

$$\frac{1603 \text{ days}}{2 \text{ days/trip}} \times (\$150 + \$89) = \$192{,}000$$

Total = $216,900

For non-residents, the approach is similar to that taken in Table 5:

Eastside Susitna

$$\frac{679 \text{ days}}{2 \text{ days/trip}} \times (\$263 + \$89) = \$120{,}000$$

Westside Susitna

$\frac{7022 \text{ days}}{2 \text{ days/trip}}$ X ($263 + $89) = $1,236,000

Total = $1,356,000

In summary, the total net "value" of fisheries requiring multiple modes of transportation is as follows:

"Big Six" fisheries	$1,528,000
other waters	$ 558,000
Balance of State	$ 217,000
Non-residents	$1,356,000
Total	$3,659,000

Total Willingness to Pay

Our current estimate of the total 1980 net "value" of these fisheries is in the range of $7,000,000.

Willingness to Sell

One of the purposes for calculating the economic value of fish and wildlife resources is to assist in determining whether a project requiring the limitation or loss of these resources can be justified economically. In these situations, "willingness to pay" to enjoy the use of these resources is not the appropriate measurement. In cases where loss of a resource or an activity is the management option under consideration, the correct measure of value is the willingness of the users to sell or relinquish their right to use the resources in question.

The ADF&G Sport Fish Division has included hypothetical questions regarding the willingness of anglers to give up their right to fish pink salmon as part of a larger study of the values of sport fishing on Willow Creek (see Workman, William G. 1983. Valuing Outdoor Recreation Opportunities. Agroborealis. Fairbanks, p.29ff), with the following results:

Fishery: Willow Creek Pink Salmon
Sample: 504 anglers
Question: "What is the smallest amount you would accept to give up your rights to fish pink salmon on the Willow Creek in 1980?"
Net willingness to sell: $2,685,740
Days fished pink salmon 1980: 19,121
Net willingness to sell/day: $140.46
Days fished all species in 1980: $29,989
Extention to all species fished: $4,212,255

As has repeatedly occurred in other studies, it appears that values based upon estimates of "willingness to sell" are considerably higher than based upon "willingness to pay." Using the figures for a pink salmon fishing day for the entire region ($140.46), and using the five year average days fishing for the entire basin (see Table 1), 109,565 days fishing results in a total average value of $15,400,000.

ENHANCEMENT POTENTIAL AND PROJECTED USE

The enhancement objective for the recreational fisheries of the Susitna basin is to produce an additional 106,000 salmon and steelhead by 1988. Using a 2.3% annual growth rate, an increase of 87,000 angler days over 1979 is expected, or 522,000 angler days by 1988. To maintain the current catch rate of .35 salmon/day the total catch must therefore increase to 124,000 fish (Alaska Department of Fish & Game, Division of Sport Fish. 1981. Plan for Supplemented Production of Salmon and Steelhead for Cook Inlet Recreation and Fisheries. Juneau, Alaska.).

Enhancement of Access and Public Facilities

Because the road system and population centers are on the eastside of the Susitna River, access to the major sport fishing streams located on the westside is difficult. Since most eastside streams are intersected by (other than parallel to) the highway, access is limited by private land holdings (pp. 20-31). Given this situation, provision of any new access and facilities is expected to result in significant increases in fishing effort.

NOTES

[1]Mills, Michael. Statewide Harvest Survey, 1977-1981 Data. Volume 19-23, Federal Aid in Fish Restoration and Anadromous Fish Studies. Alaska Department of Fish and Game, Division of Sport Fish. Juneau, Alaska. 1979, 1980, 1981, 1982.

[2]Sport fishing activities within the Willow sub-basin area are excluded from this study. This area has already been treated under an area plan (see Alaska Department of Natural Resources, et al. Willow Sub-Basin Area Plan. Division of Research and Development, Anchorage. 1982.) For reference, sport fishing activity in this area for the 1980 indicator year is summarized in Table 6.

[3]Fisheries of this type for the Susitna basin are:

Creek	Days Fished 1980	Miles of River Accessible to Angler
Willow Creek	29,011	1.5
Little Willow Creek	8,190	1.5
Wasilla Creek	5,726	2.0
Cottonwood Creek	9,268	2.3
Montana Creek	19,287	.5
Caswell Creek	4,963	.5
Sunshine Creek	5,208	.5
Sheep Creek	8,041	1.5
Total	89,694	10.3

angler days/mile/day: $\frac{89,694}{10.3 \times 60} = 145$

(assume 60 day season, all species)

[4]Crutchfield, J. A. 1962. Valuation of Fishery Resources. Land Economics, 38(5): 148.

[5]A procedural guide and primary source for the travel cost method is provided by: Dwyer, J.F., J.R. Kelly, and M.D. Bowes. 1977. Improved Procedures for Valuation of the Contribution of Recreation to National Economic Development. Final Report to the Office of Water Research and Technology Grant No. 14-34-001-6237

[6] cost/mile, standard auto determined as follows:

Item	¢/mile		
Variable Costs	1976[a] U.S. National Average	Nov. 1982[b] U.S. National Average 1976 X 1.8	Nov. 1982[c] Alaska Costs 1982 USA X 1.24
Maintenance			
Parts & Tires	4.2		
Gas & Oil	3.3		
Subtotal	7.5	13.5	16.7
Fixed Costs			
Depreciation	4.9		
Insurance	1.7		
Taxes	1.6		
Subtotal	8.2	14.76	18.3
Total	15.7	28.26	35.0

cost/mile, Recreation Vehicles assumed 20% above standard auto or $\$.35 \times 1.20 = \$.42$;

assume 70% family car use, 30% recreational vehicle use:

$$\frac{(70 \times 16.7) + (30 \times 42)}{100} =$$

$$11.70 + 12.60 = \frac{24.30}{2.5} = 9.7^{d}$$

Source

[a] Federal Highway Administration. 1977. Transportation Trends and Choices. Tolls and parking fees excluded.

[b] Pers. Comm., Neal Freid, Alaska Department of Labor, 1/13/83, based upon United States Transportation CPI update factor:

$$\frac{\text{Nov. 1982}}{1976}, \quad \frac{297.4}{165.5} = 1.8$$

[c] Ibid, 1/13/83, 11/82 Transportation Index for Alaska:1.24 or 24% higher in Alaska.

[d] For comparison see use of 7¢/mile in Nicholson, A.J. 1957. Summary of Sportsmen's Expenditures, Missouri River Basin. Spec. Sci. Report: Wildlife #35. United States Department of Interior Fish and Wildlife Service, Washington, D.C. Surveys from 1940's.

For comparison see also use of 30¢/mile for reimbursable cost of private auto use by State of Alaska.

[7]Work Sheet - Fishing Recreation Values - Non-Road Accessed Areas

Fishing Location Kroto Creek (Deshka)
Point of Origin Anchorage

Two alternative methods of access:

1. Auto/Air Taxi

a) Auto Round trip miles to air taxi = 25 miles
b) Auto Miles in a) above x $.097 = $2.45
c) Air taxi round trip miles to fishing location (river mouth) = 180 miles
d) Air taxi miles in c) above x $.640 = $115.20
e) Total cost per person = b) $2.45 + d) $115.20 = $117.65
f) Assumed % of people using this access method 50%
g) % in f) = .50 x e) $117.65 = $59.00 weighted cost

2. Auto/Boat

a) Auto miles round trip to stream which accesses fishing location 185 miles Kashwitna
b) Auto miles in a) above x $.097 = $17.95 Kashwitna
c) Boat round trip miles to fishing location 60 miles Kashwitna
d) Boat miles in c) above x $.338 = $20.28
e) Total cost per person = b) $17.95 + d) $20.28 = $38.23
f) Assumed % of people using this access method 45% Kashwitna
g) % in f) = .45 x e) $38.23 = $17.20

User day value

Weighted cost from 1. g) above = $59.00

Weighted cost from 2. g) above = $17.20

Total Cost = $76.20

User day value = Total Cost $76.20 ÷ average # of days/trip 1.5 = $50.80

Total Value = User day value $50.80 x Anchorage user days 14,034 = $712,927.00

APPENDIX B

AN ECONOMIC ANALYSIS OF MOOSE, CARIBOU, SHEEP, BEAR AND WATERFOWL HUNTING IN THE SUSITNA BASIN

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August 1983

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TABLES PAGE

EXECUTIVE SUMMARY

The human use of wildlife hunting areas in the Susitna basin is analyzed from an economic perspective. Value is demonstrated in terms of expenditures by big game and waterfowl hunters, under the assumption that these expenditures would not occur in the Alaska region were wildlife resources absent.

In addition, an application of the travel cost method of resource valuation is attempted for recreational moose, caribou, and Dall sheep hunting in nine selected areas of the basin. The values derived are underestimates, since important elements of the method, such as quality variables, site fees, opportunity costs, and availability of substitutes have not been included. However, the relative contributions to the general economy of hunting in these areas is indicated. No effort has been made to establish consumer surplus values, since a required assumption (that higher costs of travel result in reduced rates of use) is apparently not valid for Alaska (Burgess, S.M., 1983. A Comparison of the Net Benefits of Livestock Grazing and Moose Hunting in the Headwaters of the Little Susitna River. State of Alaska, Department of Fish and Game, Anchorage).

Values demonstrated are summarized in Table 1, which follows.

TABLE 1. Annual Economic Values of Recreational Hunting in the Susitna Basin

Source of Value	Moose, Caribou, Dall Sheep, Bear, Waterfowl TOTAL VALUE ($)
Licenses & tags[1]	193,000
Leisure time estimate[2]	580,000
Estimated total expenditures[3]	5,000,000

[1] See Table 26

[2] 43,440 hunter days X 8 hr/day X $\frac{\$28{,}406/\text{yr}}{2{,}080\ \text{hr/yr}}$ X 1/3 = $579, 760

[3] See Table 2

INTRODUCTION

The purpose of an economic analysis of recreational hunting in the Susitna basin is to establish dollar values to the economy for these activities. If reliable, these values may 1) demonstrate that hunting does in fact bring dollars to the economy of the state and therefore represents economic value to its citizens; 2) allow comparisons with the extent and magnitude of economic values of other land extensive, resource-based industries and the possible losses resulting from competing activities; and 3) define the sources of value so that they might be protected and increased through appropriate land management practices.

Southcentral Alaska supports a human population with densities comparable to many other urban/suburban areas of the country. Additionally, only a small portion of the land area of the Susitna basin is served by roads. The existing pressures upon accessible fish and wildlife resources are therefore extremely high in selected areas. As shown below, the economic values of these resources are likewise very high. It is the combination of relatively abundant fish and game resources in close proximity to population centers that gives rise to the high economic values found in the Susitna basin.

Several different methods are used in this report to establish economic value; in every case they are chosen to best match the data available to the department. In general, an effort is made to follow the guidelines provided by the Water Resources Council (CFR, Chapter VI, Subpart k. NED Benefit Evaluation Procedures: Recreation. November 4, 1980). Total expenditures basin-wide are estimated initially, based upon check station surveys of hunters (contingent valuation). In cases such as bear and waterfowl, where available data are minimal, estimates by staff experts are used (unit day value approach). Basin-wide values for total expenditures by hunters are included in the discussion of harvest data presented elsewhere. A travel cost analysis is attempted for those cases where travel data are available. Using these several different approaches, an estimate of the general level of the value of hunting to the economy of the state in the land areas considered should be possible.

Data Base

This report is dependent upon a broad array of data collection programs carried out by the department. The data base used for each species analyzed is described in the appropriate sections. The harvest ticket hunter report system provides data on the use of three major game species: moose, caribou, and Dall sheep. This report makes extensive use of this data base, which is therefore described below.

Harvest ticket hunter report system. Harvest tickets are issued to all hunters who participate in moose, sheep, and caribou hunts throughout the state. Forms are provided by the Department of Fish and Game and by vendors of hunting licenses (see Figure 1). Participants are requested to return completed tickets to the department regardless of the success or failure of the hunt. The only exception to this requirement occurs in the case of permit hunts, which are discussed below. The harvest ticket system constitutes one of the major data gathering systems used by the department for game management. Some 69,339 harvest ticket forms were issued for the

ALASKA DEPT. OF FISH & GAME
ANCHORAGE, AK 99502

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

WE ARE ASKING FOR LOCATION BY DRAINAGE. PLEASE GIVE THE NAME OF THE CREEK OR RIVER NEAREST YOUR HUNTING LOCATION. MOUNTAIN PEAKS AND LAKE NAMES ARE ALSO HELPFUL. IF YOU HUNTED ALONG A ROAD SYSTEM PLEASE PROVIDE MILEPOST INFORMATION.

THANK YOU FOR REPORTING PROMPTLY.

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 709 ANCHORAGE, ALASKA

POSTAGE WILL BE PAID BY ADDRESSEE

ALASKA DEPARTMENT OF FISH & GAME
333 RASPBERRY ROAD
ANCHORAGE, ALASKA 99502-9979

MOOSE HUNTER REPORT 1983-84

No. M83- 077027

NON-TRANSFERABLE

REPORT ONLY MOOSE ON THIS CARD

I HUNTED MOOSE YES ☐ NO ☐ A TOTAL OF ______ DAYS INCLUDING PLANNING AND TRAVEL ______ OF THESE DAYS WERE SPENT IN THE AREA HUNTED.

I HUNTED IN THE ____________ (DRAINAGE) NEAR ____________ (LANDMARK)

OF GAME MGMT. UNIT ____________ SUBUNIT ______

(SEE THE BACK OF THE HARVEST TICKET FOR INSTRUCTIONS ON SPECIFIC LOCALITY)

FOR ADF&G USE ONLY

I KILLED A MOOSE YES ☐ NO ☐ ON ____ / ____ / ____ (MO DA YR)

MY MOOSE'S SEX WAS MALE ☐ FEMALE ☐ AND ITS ANTLER SPREAD WAS ______ INCHES.

MY METHOD OF TAKE WAS BY ______ 1. FIREARM 2. BOW AND ARROW 3. OTHER

I TRAVELED TO WHERE I BEGAN WALKING BY ______ 1. AIRPLANE 2. HORSE 3. BOAT 5. SNOWMACHINE 6. OFFROAD VEHICLE 7. HIGHWAY VEHICLE

COMMENTS: ____________

M83- 077027

MOOSE

HARVEST TICKET (NON - TRANSFERABLE)

REGULATORY YEAR 1983-1984

UPON TAKING MOOSE VALIDATE THIS TICKET BY CUTTING OUT MONTH AND DAY OF KILL.

KEEP THIS HARVEST TICKET IN YOUR POSSESSION AT ALL TIMES UNTIL THE ANIMAL IS DELIVERED TO THE LOCATION WHERE IT WILL BE PROCESSED. . . SEE YOUR GAME REGULATIONS.

JAN FEB MAR APR AUG SEPT OCT NOV DEC

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

MOOSE HARVEST TICKET OVERLAY 1983-84

No. M83- 077027

PLEASE PRINT OR WRITE CLEARLY. NON-TRANSFERABLE

NAME: FIRST INITIAL LAST

MAILING ADDRESS: POST OFFICE BOX, ROUTE AND BOX NUMBER, OR STREET ADDRESS

CITY STATE ZIP CODE

RESIDENCY INFORMATION: ALASKAN RESIDENT ☐ NON-RESIDENT ☐ HUNTING LICENSE NUMBER

IF APPLICANT IS A RESIDENT UNDER 16 YEARS OF AGE, GIVE AGE.

FIGURE 1.
Harvest Ticket Report Form

VENDOR: Write number of this ticket on back of applicants license.

Detach This Card and Return To:

11-239 M **ALASKA DEPARTMENT OF FISH AND GAME**

1981-1982 season: 44,337 for moose hunts, 18,252 for caribou hunts, and 6,750 for sheep hunts. Three sets of information are requested on three separate parts of the ticket: the "overlay," the "hunter report," and the "harvest ticket." The overlay requests information about the hunter: name, residence, and, by reference, the information on the hunting license. This information is essential for the present review and is very likely the most specific and reliable information collected. This portion of the ticket is issued by and returned to the department. The "hunter report" requests information on the hunt itself (number of days, locality of hunt, and transportation used) and, in cases of successful hunters, the characteristics of the animal killed (date, sex, size, and method of kill). Lastly, the "harvest ticket" portion indicates the date of the kill and accompanies the animal until it is processed and stored.

This data is automated by the Game Division Statistics Section. The first step is entry of the data by harvest ticket number into a general or "sequential" file. The Habitat Division, Data Management Unit, through the cooperation of the Game Division, has developed summaries of hunter report data for the 1981 moose, caribou, and sheep hunts (see Data Supplement for general file harvest statistics for the planning area).

Permit hunts are designed for situations in which close control of the number of animals taken is necessary to meet the special needs of a given subpopulation and for hunter safety. Data on these hunts is normally tabulated by area biologists and maintained in respective regional offices.

There is at present no regular data collection program within the department regarding the economic aspects of wildlife uses.

Summary of Total Annual Expenditures

Cost information outlined below is summarized in Table 2. The summary of total annual expenditures by Susitna basin hunters for selected species approaches $5,000,000. An estimate of expenditures for numerous small game species was not attempted.

TABLE 2. Summary of 1981 Costs of Hunting in the Susitna Basin

Species	Hunters	Total Cost Estimate
Moose	4,594	1,089,000
Caribou	747	650,000
Dall Sheep	328	890,000
Bear	1,714	1,610,000
Waterfowl[1]	1,951	664,000
TOTAL	9,334	4,903,000

[1]Includes Willow subbasin area

HARVEST STATISTICS AND PATTERNS OF USE OF GAME IN THE SUSITNA BASIN

As outlined above, harvest statistics collected directly from hunters by the Alaska Department of Fish and Game provide data for estimating use of moose, caribou, and Dall sheep in the Susitna Basin. In the sections that follow, these statistics are summarized by species and linked with general descriptions of the patterns of hunting in the area, with "typical" hunts, and with other descriptive material designed to promote an understanding of the harvest statistics data base. Finally, an estimate of total expenditures by hunters for the entire planning area is made, based upon these harvest statistics and the expenditure data available. In all instances permit hunts are excluded from this discussion.

Moose Hunting Data Base

Moose hunting was described in Chapter I from a general perspective for the entire Susitna-Beluga basin. Information on the numbers and distribution of moose hunters is presented, as well as additional information on residency and travel modes. Similar information in a slightly different format is summarized for 1981 in Table 3. In Table 4 the same data is presented for selected Susitna basin harvest report code units where most moose hunting occurs.

Use patterns/typical hunts. There are several approaches to conducting a moose hunt in the planning area.

a. Road hunts. For areas accessible by road where moose are known to be present, weekend (2½ day) road hunts are common. A hunter will use a camper-equipped pick-up or light camping gear and, with binoculars, drive from lookout to lookout searching for moose. In a likely area, a hunter will park and leave the road area for perhaps a half-mile, but rarely further. Fully 80% of the hunting in the Petersville Road area is of this type. An important variation on the road hunt is the use of ORVs to extend the range of search possible during a half-day or one-day foray from the highway. Table 4 indicates the large number of hunters who consider ORVs primary transportation.

b. Fly-in hunts. Because of the limited road system, fly-in hunts are very common in the area. Since weight and space are important considerations in small aircraft, fly-in hunters often go light and store or locally secure ORV, boat, and camping equipment. In portions of the Beluga area (Unit 16-02-013) this system is used through the cooperation of local residents.

c. Boat hunts. Because of the demanding conditions met on the Susitna and tributary rivers, larger boats with a minimum of 50 hp (jet equipped) are most commonly used. Boat transportation is efficient since heavier weights can be accommodated. Most often a hunter will put in at a landing along the Parks Highway, then travel to a preferred hunting area, make camp, and then pursue the hunt, using the boat and the camp as a base.

TABLE 3. Susitna-Basin 1981 General File Harvest Statistics for Moose

	Game Management Unit (GMU)				
	13	14	16		
	Talkeetna Mts. Chulitna/ Watana Hills	Talkeetna Mts. to Chugach Mts.	Alaska Range	Deletions[1]	Total[2]
Hunters					
Total	999	1,834	2,195	434	4,594
Successful	258	272	567	53	1,044
Unsuccessful	741	1,562	1,628	381	3,550
Hunter Days by Residency					
Anchorage area	3,380	5,057	8,467	ND	16,904
Mat-Su Borough	1,055	4,192	2,117		7,364
Kenai-Homer	177	106	452		735
Fairbanks-Delta	492	42	289		823
Cordova-Tok	448	27	32		507
Southeast	53	13	26		92
Out-of-state	264	175	643		1,082
Foreign	30	7	88		125
Other state	21	119	184		324
TOTAL	5,920	9,738	12,298	2,598[3]	25,358
Hunter Days by Primary Mode of Transportation					
Air	948	447	3,974	ND	5,369
Boat	1,009	495	2,139		3,643
Off-road vehicle	1,487	1,523	1,273		4,283
Highway vehicle	1,201	4,166	2,634		8,001
Unknown	1,185	2,913	2,251		6,349
Horse	90	194	27		311
TOTAL	5,920	9,738	12,298		27,956

Source: Alaska Department of Fish and Game, Habitat Division, Data Management Unit. Greg Fischer, 1983. Special computer run completed 7/18/83.

[1] Required for reporting units partially outside the planning area

[2] Does not include hunters or days of unknown residency or unknown success

[3] Assume 10%

TABLE 4. 1981 Moose Harvest Statistics for Selected Susitna Basin Harvest Report Code Units (HRCU)

HRCU	Name acreage	Hunters[1] TL	Hunters[1] S	Hunters[1] U	Days Hunting[1] TL	Days Hunting[1] S	Days Hunting[1] U	Origin Of Hunters[2] Anch Area	Mat-Su Boro	other Alaska	out-of-state	Primary Mode of Transportation air	boat	off-road vehicle	highway vehicle	unknown	horse
16-01-002	Petersville Rd 400,000 acres	604	106	498	3,342	595	2,747	472	82	38	7	13	13	136	326	116	0
16-01-003	Susitna River/ Lower Yentna 270,000 acres	121	27	94	635	137	498	91	24	1	4	18	28	8	29	38	0
14-01-011	Moose Creek	79	13	66	429	40	389	50	28	1	0	0	0	18	44	16	1
-013	Reserve	52	12	40	244	37	207	36	13	1	1	0	0	10	32	10	0
-017	61,400 acres	190	36	154	871	130	741	118	65	3	2	1	1	14	21	48	5
subtotal		321	61	260	1,544	207	1,337	204	106	5	3	1	1	42	97	74	6
16-02-013	Beluga 630,000 acres	158	62	96	945	420	525	129	9	10	9	112	10	8	11	17	0
16-02-004	Mt. Yenlo/ mid-Yentna 630,000 acres	168	63	105	950	322	628	131	14	1	18	89	57	0	0	22	0
16-02-012	Alexander Creek Mt. Susitna 426,000 acres	200	54	146	1,037	225	812	163	11	10	11	108	53	1	1	37	0
14-01-016	Jim's Slough	69	17	52	283	70	213	37	31	0	0	1	1	14	121	48	5
14-01-024	Hunter Creek	62	14	48	353	65	288	20	39	1	0	4	16	8	22	12	0
subtotal		131	31	100	636	135	501	57	70	1	0	5	17	22	143	60	5
13-10L	Nelchina Basin	292	38	254	1,718	212	1,507	190	33	44	18	52	108	11	47	73	0
13-12L	1,900,000 acres	211	52	159	1,211	263	948	129	50	33	11	36	18	78	36	41	1
13-13L		74	10	64	356	47	309	24	19	1	1	3	0	19	22	25	6
13-14L		68	34	34	377	168	210	42	14	4	5	31	3	25	1	6	2
subtotal		645	134	511	3,662	690	2,974	385	116	82	35	122	129	133	106	145	9
14-01-001	W. Chickaloon R.	31	8	23	130	25	105	15	13	1	0	7	0	0	9	9	6
14-01-003	Castle Mt. 85,000 acres	11	3	8	54	3	51	9	2	0	0	0	1	0	7	1	0
subtotal		42	11	31	184	28	156	24	15	1	0	7	1	0	16	10	6
TOTAL		2,390	549	1,841	12,935	2,759	10,178	1,656	447	149	84	475	309	350	829	519	26

[1] TL=Total, S=Successful, U=Unsuccessful. Figures do not include hunters or days of unknown residency or unknown success.

[2] Anch Area = Anchorage, Chugiak, Eagle River, Elmendorf Air Force Base, Ft. Richardson, Eklutna.
Mat-Su = Palmer, Sutton, Wasilla, Big Lake, Talkeetna, Trapper Creek, Willow, Alexander Creek, Beluga.
Other Alaska = Fairbanks, Kenai, etc.

It is possible to define in more detail a few of the characteristics of moose hunting in the Susitna basin by a further look at Tables 3 and 4. An annual harvest of approximately 1,000 moose from the planning area, together with over 25,000 hunter days required to realize this harvest, is an activity of significant proportions. For example, taking the usual measure of the value of leisure time at 1/3 wage rate, $0.9 million in opportunity cost is represented by this activity:

$$\left(25{,}358 \text{ days} \times 8 \text{ hr/day} \times \frac{\$28{,}406}{2{,}080 \text{ hr/yr}} \text{ median AK income} \times 1/3 = \$923{,}000\right)$$

With 1,044 hunters of 4,594 reporting successful hunts we see success rate of 23% for the basin, or one in every five hunters, and about 24 hunter days required to take one moose. Rates of success vary from 14% in Unit 13-13L and 16% at Moose Creek, to 39% rates of success at Beluga and 50% in Unit 13-14L. Hunters from Anchorage dominate the field, although in terms of per capita participation rates, Matanuska Valley hunters dominate (19 per 1,000 to 68 per 1,000, using 1980 population figure of 174,431 and 17,816, respectively).

A fair balance exists (except for the occasional use of horses) among all modes of transportation reported as "primary" by basin hunters, indicating the complexity of travel requirements. This is particularly true in Unit 13. In Unit 14 the predominance of highway travel is obvious, as is the predominance of air travel in Unit 16. The large number of hunters not reporting a mode of transportation ("unknown") results from the difficulties in answering the question on the hunter report form ("What was your primary mode of transportation?") when multiple modes are almost always used.

Of the planning area, nine geographic units, comprising some 4,600,000 acres of the Susitna basin, have been selected for economic analysis (Table 4). These areas, or Harvest Report Coding Units (HRCU), are shown on Atlas maps A3a, A3b, A3c, and are selected on the basis of their importance to users and to the maintenance of fish and wildlife resources. These units are part of three major land areas: the Susitna lowlands (GMU 16), the rivers and foothills of the Knik Arm area (GMU 14A), and the southwestern portion of the Nelchina basin (GMU 13). The popularity of the Petersville Road, Moose Creek and the 10L and 12L Nelchina units is obvious.

Moose hunters spend 5.4 days hunting on the average, with a range of 4.2 for the West Chickaloon to 5.9 at Beluga. Successful hunters spend a little less time on their hunts (5.2 days) than unsuccessful hunters (5.4 days). Mode of transportation is important to an economic analysis. Obviously, those units accessible by road (Units 1, 3, 7, 8, 9) provide hunting opportunities to a larger group of people at lower cost than remote, fly-in areas (Units 2, 4, 5, 6). Problems in the use of this data are caused by the large "unknown" category.

Total expenditures. Data in Table 3 allows an estimate of expenditures for moose hunting in the planning area if linked with a survey of costs faced by hunters passing the Glenn Highway check station carried out by the department in 1979.

During nineteen days of operation of the check station a total of 1,195 hunters were contacted. Expenses averaged $237 each per hunt. Most hunters hunt in parties of two to five people. The non-resident hunters hunting alone or with another non-resident faced the highest costs: 34 interviewed from seventeen states showed average costs of $3,500 each per hunt (range $150-$10,000). The non-resident hunter apparently spends much less when hunting with a resident friend or relative. Nineteen mixed resident/non-resident parties were interviewed with average hunter expenses of $470 each per hunt (range: $50-$8,000). A large group of resident hunters interviewed (1,079) showed average expenses of $120.00 each per hunt. This data is summarized in Table 5.

TABLE 5. 1979 Moose Hunter Expenditure Survey at the Glenn Highway Check Station

Hunters	Parties	Residency	Average Cost($)	Expenses/Hunter Range ($)
34	24	non-resident	3,400	150 - 10,000
82	19	mixed parties	470	50 - 8,000
1,079	NA	resident	120	N/A
TOTAL 1,195	NA	All Groups	237	50 - 10,000

Source: Cunning, Tina and Sterling Eide 1979. Moose Hunter Expenditures, Glenn Highway Check Station. Unpublished data. Alaska Department of Fish and Game, Glennallen, Alaska.

This work was carried out for internal purposes and was not subject to formal validation procedures. The results, however, provide an indication of the range of expenses faced by the moose hunter in the Susitna basin and the important influence of residency on these expenses.

If the $237 average figure for resident and non-resident hunters is accepted, total annual expenditures for Susitna basin moose hunters exceed $1 million dollars (4,594 hunters X $237/hunt = $1,089,000). This assumes that each hunter engages in one hunt only, which results in a very conservative estimate.

Caribou Hunting Data Base

Most caribou hunting in Southcentral Alaska occurs in the Nelchina basin (GMU 13). As shown in Table 6, effort is light in GMU 14 and dominated by

TABLE 6. Susitna-Basin 1981 General File Harvest Statistics for Caribou

	Game Management Unit				
	13	14	16		
	Talkeetna Mts. Chulitna/ Watana Hills	Talkeetna Mts. to Chugach Mts.	Alaska Range	Deletions[1]	Total
Hunters					
Total	751	4	43	51	747
Successful	577	1	16	41	553
Unsuccessful	174	3	27	10	194
TOTAL Hunter Days	2,534	27	277	349	2,489
Hunter Days by Residency					
Anch area	1,228	0	51		1,279
Mat-Su Boro	611	1	3		615
Kenai-Homer	46	0	10		56
Cordova-Tok	132	0	0		132
Frbks-Delta	389	20	2		411
Southeast	18	0	0		18
Out-of-State	102	0	113		215
Foreign	0	0	24		24
Other state	8	6	74		88
TOTAL	2,534	27	277		2,838
Hunter Days by Primary Mode of Transportation					
Air	658	27	129		814
Boat	406	0	0		406
Off-road vehicle	855	0	25		880
Highway vehicle	479	0	62		541
Unknown	67	0	10		77
Horse	69	0	51		120
TOTAL	2,534	27	277		2,838

Source: Alaska Department of Fish and Game, Habitat Division, Data Management Unit. Greg Fischer, 1983. Special computer run completed July 13, 1983.

[1] Required for those reporting units partially outside the planning boundary

guided hunts in GMU 16. The discussion of caribou hunting presented in our chapter on demand may be summarized as follows.

The Nelchina caribou herd is located near the population centers of the state and is therefore an extremely valuable resource. Three Harvest Report Code Units in the Nelchina basin are particularly popular (13-10, 13-12, 13-14), accounting for over 50% of reporting hunters, who spend an average of 3.6 days per hunt and use aircraft as the primary mode of transportation most of the time (31%).

Other areas in the Susitna basin where caribou are occasionally taken include Yellow Jacket Creek (14-01F), the headwaters of the Talkeetna River, and the Rainy Pass area (16-04B) (see Atlas Map). Outside the Nelchina area the huntable population of caribou is very low. In Table 6, residency and travel mode information is presented for units selected for the economic analysis carried out below.

Use patterns/typical hunts. Caribou are hunted in Unit 13 in the fall (August 20-September 20) by the recreational hunter. The subsistence hunter hunts both in the fall and during a winter season January 1-March 31. As shown in Table 6 the caribou hunters in Unit 13 mostly reside in the Anchorage and Palmer areas. There is a strong contingent, however, from both the Fairbanks and Cordova-Tok areas (110 and 37, respectively). A large number consider the airplane their primary mode of transportation. Unit 13-10L leads all others in intensity of use (725 hunter days for 201 hunters for 141 caribou; see Table 7).

In 1982 the "typical" caribou hunter came to the Nelchina basin from Anchorage and spent 3½ days hunting caribou in hunting areas along the Denali Highway or in the Talkeetna Mountains. These areas are most often accessed by aircraft from Anchorage to any of a number of large lakes. No lodging or support facilities are sought to speak of, since most hunters enjoy wilderness camping. Moose hunting is available as a substitute for caribou hunting in cases of failure or cancellation of the fall hunt. The characteristics of a high quality hunt sought by the hunter are: 1) to encounter large groups of caribou and 2) to enjoy a wilderness experience without seeing a lot of other hunters.

Of course, there is more than one "typical" hunter for caribou in the Nelchina. The local Mat-Su Borough resident very often uses an off-road vehicle along the Glenn Highway, as does the Fairbanks resident. The rural resident in Unit 13 will use only a highway vehicle, without the use of aircraft or an ORV. Local residents are very often familiar with herd movements and do not require ORV support.

TABLE 7. 1981 Caribou Harvest Statistics for Nelchina Basin Harvest Report Code Units[1]

	13-10L Lake Louise	13-12L Little Nelchina R.	13-14L Oshetna R.	13-13L Anthracite Ridge
Hunters				
Total	201	188	82	21
Successful	141	135	72	13
Unsuccessful	60	53	10	8
Hunter Days by Residency Group				
Anch area	380	285	128	59
Mat-Su Boro	165	115	58	25
Frbks-Delta	5	11	5	0
Cordova-Tok	28	43	10	0
Kenai-Homer	117	65	39	9
Southeast	10	9	0	0
Other state	0	0	0	0
Out-of-state	20	26	19	0
Foreign	0	0	0	0
TOTAL	725	554	259	93
Hunter Days by Primary Mode of Transportation				
Air	118	95	169	1
Boat	349	5	5	9
Off-road vehicle	45	320	66	79
Highway vehicle	197	108	17	0
Horse	2	18	0	5
Unknown	14	8	0	12

[1] Does not include hunters or days of unknown residency or unknown success

Total expenditures. If costs of travel, food, lodging, hunting equipment, ammunition, and camping equipment are summarized for caribou hunters, expenditures range from $300 to $1,050 per hunter per hunt for the rural resident and Anchorage resident, respectively (Bob Tobey pers. comm. ADF&G Glennallen, Alaska). Data in Table 8 show 747 hunters, with 45% from the Anchorage area, 21% from the Matanuska Valley area, 15% from the Fairbanks area, and the remaining 20% divided between other state origins and non-resident hunters. Using a conservative approach values to non-residents total expenditures of $650,000 area estimated for the Susitna basin.

Once again, travel mode shows the greatest influence on cost of any single factor. More caribou hunters fly than moose hunters, resulting in a higher per hunt range of costs.

TABLE 8. Total Costs for Susitna Basin Caribou Hunters

Hunter Origin	Hunters	Cost/Hunt	TOTAL Dollars
Anchorage	335	1,050	351,750
Other state	74	1,050	77,700
Non-resident	74	1,055	77,700
Mat Valley	153	300	45,900
Fairbanks	111	878	97,125
TOTAL	747	NA	650,175

Sheep Hunting

Data base. As with moose and caribou, harvest data on Dall sheep are collected from all areas in the state by use of the Harvest Ticket Hunter Report System. The basic 1981 harvest statistics for Dall sheep have already been outlined in our chapter on demand. Table 9 summarized these data in a slightly different format. We see that 328 reporting hunters spent 1,532 days afield (4.6 days/hunter) to take 134 rams from the Susitna basin. In addition, this table indicates a willingness on the part of resident hunters to travel from outlying areas (Fairbanks, Delta, Homer, etc.) to hunt in the basin, as well as revealing the presence of a significant number of non-resident hunters.

Ten years of data on the number of hunters, harvest and percent success is available for the Talkeetna mountains in Table 10. This data indicates a diminution in hunting in the face of increasing rates of success, which is somewhat unexpected. Also, Department staff speculated that with changes in federal land status occurring since 1978, hunting pressure would markedly increase in areas remaining open to sheep hunting. This increase in pressure has not occurred. Sheep hunting is very demanding with longer trips common and a high level of effort usually required. It appears that with the loss of an area, considerable time is needed for a hunter to establish new hunting areas with comparable chances for success.

Use patterns/typical hunts. The Dall sheep is one of the most prized of all big game trophies. Hunting usually takes place between mid-August and mid-September. Except in controlled hunts where ewes may be taken, only rams with horns with 7/8 curl or larger are legal game. Hunting in rugged mountain country, considerable skill is required to approach these animals. In addition to the usual camping and support equipment, good binoculars or

TABLE 9. Susitna Basin 1981 General File Harvest Statistics for Dall Sheep[1]

	Game Management Units[2]				
	13	14	16	Deletions[3]	Total
Hunters					
Total	204	146	20	42	328
Successful	81	53	12	12	134
Unsuccessful	123	93	8	30	194
Res/Non-res	179/25	119/27	7/13	39/3	266/62
TOTAL Hunter Days	931	618	123	140	1,532
Hunter Days by Residency					
Anch area	507	285	18	112	698
Mat-Su Boro	235	147	0	20	362
Kenai-Homer	8	11	9	2	26
Frbks-Delta	45	0	0	5	40
Other state	32	20	20	0	72
Out-of-state	103	152	55	1	309
Foreign	1	3	21	0	25
TOTAL	931	618	123	140	1,532
Hunter Days by Primary Mode of Transportation					
Air	364	185	99	46	602
Boat	23	66	0	15	74
Off-road vehicle	107	49	0	10	146
Highway vehicle	267	197	0	51	413
Unknown	70	59	10	17	122
Horse	100	62	14	1	175
TOTAL	931	618	123	140	1,532

Source: Alaska Department of Fish & Game, Habitat Division, Data Management Unit. Greg Fischer, 1983. Special computer run completed 7/13/83.

[1] Does not include hunters with unknown residency or unknown success.
[2] Game Management Unit 13 = Talkeetna Mts. Chulitna and Watana Hills
Game Management Unit 14 = Talkeetna Mts. to Chugach Mts.
Game Management Unit 16 = Alaska Range
[3] Only 50% of units 13-26D and 14-25D, 10% of Unit 14-21D and 33% of unit 14-22D are within the planning area.

TABLE 10. Reported Harvest of Dall Sheep Rams, Numbers of Hunters, and Percent Success of Hunters for Talkeetna Mountain Range, 1971-1981, as Derived from Harvest Reports

	All Hunters[1]		
Year	No. rams harvested	No. hunters	% success
1971	85	240	35
1972	81	304	27
1973	61	277	22
1974	114	312	37
1975	109	281	39
1976	77	300	26
1977[2]	55	203	27
1978	77	304	25
1979[3]	65	269	24
1980[3]	80	244	33
1981[3]	96	236	41

[1] Data includes hunters of unknown residency.
[2] No reminder letters were sent to sheep hunters.
[3] Legal horn size increased from 3/4 to 7/8 curl.

spotting scopes, and rifles equipped with telescopic sights are necessary. The successful hunter receives an additional bonus, since sheep meat properly prepared is a gourmet item.

As shown in Atlas Map C2c HRCU are established for Dall sheep hunting in the higher elevations of the western and eastern portion of the Basin. The units showing activity to the west are 16-02, 16-03B, 16-04B (the Emerald Creek, Crystal Creek, Skwentna River and Happy River areas). Access to these areas is by aircraft while guiding operations out of Rainy Pass Lodge use horses for packing in. In GMU 14 (14-01 through 14-09), 53 animals were harvested in 1981 from a highly dispersed population which ranges over the higher elevations of the western portion of the basin. Nearly all access in this unit is by air. Occasionally a guide will use pack horses.

Total expenditures. The Department of Fish and Game is currently engaged in a cooperative research study in an effort to establish the economic characteristics of Dall sheep hunting statewide. Until such time as that study is completed only general estimates of hunter costs will be used here.

As a general rule, resident hunters spend about $1,000.00 on a sheep hunt, whereas non-resident hunters spend about $10,000.00. Statewide annual expenditures range from $7-10 million dollars.

Applied to 1981 data (Table 9), Susitna-basin hunts represent over $886,000 in total expenditures by the hunter (266 resident hunters X 1,000) + (62 non-resident hunters X 10,000).[1]

Bear Hunting

Data base. Table 11 summarizes the available harvest data for brown and black bear hunting in the Susitna basin. The Harvest Ticket Hunter Report System is not used for bear but rather a tag and sealing form system, as described in Chapter I. The lack of information on resident effort for black bear requires application of non-resident success rates to the resident harvest attributable to the basin, in order to estimate resident effort. We estimate that 1,714 hunters took 248 black and brown bear in the planning region and further estimate 9,400 hunter days for the 1981-1982 season.

Use patterns/typical hunts. It is hard to define a black bear hunter because very often black bear are taken incidentally to moose hunting or salmon fishing (42% reported harvest as incidental in the Nelchina, 1981). Those who hunt specifically for brown bear show a notably wide range of success rates, with harvests in the Nelchina basin dominating. Non-resident success rates are high, since a guide is required for these hunts. Resident success rates are low, since many hunters pick up brown bear tags for use in the event they encounter bear on their moose hunt.

Total expenditures. At present no data collection program relating to the economic aspects of bear hunting exists within the department. The individual interests of area and research staff occasionally lead to observations of potential interest (see e.g. Sellers, R.A. 1982 "Million Dollar Bears" Fish Tales and Game Trails, Summer 1982. ADF&G, Juneau, Alaska). Sellers estimates expenditures associated with brown bear hunting on the Alaska Peninsula at $1.5 million in 1981.

[1] Costs established with the assistance of Wayne Heimer, Game Division, Fairbanks office, May 1983.

TABLE 11. 1982 Bear Harvest Statistics for the Susitna Basin Bear Hunting[1]

AREA	Black Bear Resident	Black Bear Non-resident	Brown Bear Resident	Brown Bear Non-resident	All Bear Resident	All Bear Non-resident
STATEWIDE						
Tags issued	NA	1,247	5,049	813	5,049+	2,060
Harvest	NA	235	376	435		670
Success rates	NA	19%	7.4%	54%		
SAP AREA						
Tags issued	NA	122	824	52	1,540	174
Harvest	136	23	61	28	197	51
Success rates	19%[2]	19%[2]	7.4%	54%		

[1]File Data 1983. Alaska Department of Fish and Game, Anchorage, Alaska.
[2]Statewide non-resident rate.

All non-resident brown bear hunters in the planning region must use a professional guide. The willingness to pay in the range of $5,000.00 for a guided brown bear hunt in Southcentral Alaska (a minimum figure, according to area staff) establishes a substantial base for the valuation of this resource. For Unit 13, where most of the brown bear are taken, 47% of the harvest has been by non-residents since 1961. For the entire basin, 52 guided hunts in 1982 establishes an estimate of gross income to guides and related services of $260,000 (52 x $5,000). A high percentage of non-resident black bear hunts (46 of 122) are also guided and are often combined with other target species for a package deal. Allowing $2,000 for the black bear component of a multispecies guided hunt (these are never under $5,000 total), a total annual value of $92,000 (46 x $2,000) is realized.

The contribution to the economy of the non-guided, non-resident black bear hunter will not be much less. Half of the guided costs is used here, for a total of $76,000 (76 hunts x $1,000). Non-resident expenditures are nominal, and a total expenditure for bear hunting is therefore estimated at $1.6 million. Resident hunters of brown bear spend on an average of $1,000 a hunt, while resident black bear hunters spend an average of $500 per hunt. These costs are summarized in Table 12.

TABLE 12. Total Costs for Bear Hunting in the Susitna Basin

52 guided non-resident Br. Bear	@ $5,000	260,000
46 guided non-resident Bl. Bear	@ $2,000	92,000
76 non-guided non-resident Bl. Bear	@ $1,000	76,000
824 Resident Br. Bear	@ $1,000	824,000
716 Resident Bl. Bear	@ $ 500	358,000
	TOTAL	$1,610,000

Waterfowl Hunting

Data Base. The data base for recreational waterfowl hunting used by ADF&G includes information from USFWS National Hunting Surveys, USFWS annual duck stamp sales, postal questionnaires, parts collection surveys, seasonal bag checks, and ADF&G waterfowl hunter surveys conducted from 1974 through 1976. In addition, a study of the economic values of waterfowl hunting prepared in 1976 for the Federal-State Land Use Planning Commission by game division staff has been very useful to this report.

Use Patterns. While most of the planning unit is not noted for its waterfowl hunting, the Susitna Flats Refuge, which borders on Cook Inlet, is the most heavily hunted waterfowl area in the state (see Figure 2).- In the discussion which follows, Susitna Flats is therefore the focus of the analysis. Other areas where waterfowl hunting occurs in the planning unit (and for which data are available) are also included, even though these areas are part of the Willow subbasin (see Table 13). These data were not presented in the Willow Plan. A more compelling reason for including them here is that these areas constitute a continuous biogeographic unit that supports waterfowl.

TABLE 13. 1974-1976 Waterfowl Hunting in the Susitna Basin Average Values for Hunter Days and Harvests

	1974 - 1976 Average Values				
	Hunter Days	Ducks		Geese	
Area	All Waterfowl	Harvest	% Statewide	Harvest	% Statewide
Susitna flats Refuge	5,700	10,000	11.00%	350	3.40%
Palmer hay flats Refuge[1]	4,470	6,300	7.20%	119	0.80%
Goose Bay Refuge[1]	370	380	0.43%	ND	.01%
TOTAL	10,540	16,680	18.6%	469	4.2%

Source: Alaska Department of Fish and Game, Game Division. 1976, 1977, 1978. Survey and Inventory Reports, Waterfowl. Alaska Department of Fish and Game, Juneau, Alaska.

[1]These areas are within the Willow subbasin and are included here since these data were not presented in the Willow Plan.

Statewide harvest statistics over this period indicate that the average waterfowl hunter spends 5.4 days hunting ducks and geese, for an average trip length of 2.4 days.

Waterfowl hunting areas in the Susitna basin are both close to population centers and very popular. Good numbers of waterfowl are present, especially in the Susitna flats area, where typical annual harvests average 8 ducks and 0.4 geese per hunter, taken during an average 5.4 days afield. The Palmer hay flats and Goose Bay areas are accessible by road and trail, whereas access to the Susitna flats is primarily by air. This results in entirely different use patterns for these areas.

Other types of waterfowl harvest in the planning unit are associated with big game hunting and subsistence. Waterfowl hunter survey results indicate that a few ducks and an occasional goose are taken by big game hunters in both the lower Susitna and that portion of the Gulkana basin within the planning area. Since this harvest is random, the actual number of birds harvested is unknown but probably minimal. Local residents throughout the planning unit also harvest an unknown number of waterfowl for personal use.

Use of the Susitna flats. Trips hunters take to the Susitna flats are limited by access and effective season length. Even though the flats are only between 5 and 35 miles from Anchorage, primary access is by aircraft, with boat and road (from Beluga and Tyonek) access being minimal. The response of 13 hunters interviewed on opening day 1982 indicated an average of 2.2 trips to Susitna flats per year, with a range from 1-6 trips. While sample size was small, observations by ADF&G personnel over a period of years support these figures.

With access by air and most hunters overnighting, the typical hunter is facing a significant commitment of time and money to hunt waterfowl on the flats. About 155 cabins in the Susitna flats area are dedicated primarily to use for waterfowl hunting or set net fishing. A bag check survey conducted in 1982 (9/1-3/82) showed 71 hunters between the Beluga and Theodore rivers, with an average bag of 3.6 ducks and 0.43 geese. Twenty-one aircraft were parked on Seeley Lake on opening day.

In addition to hunters with private cabins and private aircraft, other hunters tent in the area, purchase package hunts from charter services and occasionally carry out day hunts from Anchorage, traveling by boat on a high tide to the eastern portion of the flats.

Total expenditures. The average Susitna flats waterfowl hunter spends an estimated $396.00 per year in pursuit of waterfowl, or approximately $73.00 per day. These expenses can be broken down into two basic classifications: 1) annual equipment expenses and 2) annual trip expenses. These expenses are listed below, based on 1982 prices (Table 14). Equipment expenses are self-explanatory.

Travel cost, food, and lodging constitute trip expenses. Without direct surveys of hunters these expenses can be estimated only on a nominal basis. Air travel expenses are determined by whether the aircraft is private or chartered. Since hunters chartering into an area typically go less frequently, stay longer, and travel with larger groups than those gaining access by private aircraft, actual travel costs between the two groups are

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TABLE 14. Annual Trip and Equipment Expenses per Waterfowl Hunter

Item	Annual Expense
Equipment Expenses	
Hunting license ($12.00 prorated at 22% for waterfowl only)	$ 2.65
Federal duck stamp	7.50
Shells ($15/box [mag] X .5 box/day, X 5.4 days)	40.50
Equipment maintenance	25.00
Subtotal	$ 75.65
Shotgun ($250.00 for 20 yrs.)	12.50
Decoys (2 doz. medium G&H @ $75.00/doz for 10 yrs.)	15.00
Gear (boots, raingear, camping equipment gun cleaning kit, etc.) ($150.00 for 5 yrs.)	30.00
Subtotal	$ 57.50
Total Annual Equipment Expense	$133.15
Trip Costs	
Transportation ($50.00 x 2.2 trips/yr.)	$110.00
Food ($20.00/day x 5.4 days)	108.00
Lodging	45.00
Total	$263.00
GRAND TOTAL	$396.15

Source: Campbell, Bruce 1983, pers. comm. Alaska Department of Fish and Game, Game Division, Anchorage, Alaska; and personal communications with hunters.

probably similar. Average transportation costs are therefore estimated at $50.00/trip for all hunters. Lodging also presents an unusual problem, with the majority of the waterfowl hunters using hunting cabins as mentioned. The estimated expense in constructing a cabin, including transportation, is about $3,000. Since most cabins have multiple ownership with two to six persons common, the individual's expense for a cabin is perhaps $750.00. Prorating this over the life of the cabin, which is estimated at 20 years, annual estimated expense, including upkeep, is at $60.00 per individual per year. This figure is offset by hunters who either purchase lodging as part of their charter or who tent camp. Annual lodging expense per hunter is estimated at $45.00.

Obviously, the birds bagged by area hunters have value as a highly nutritious centerpiece of a gourmet meal. In the past, estimates of this value have been based upon the current market price of the meats replaced by the waterfowl harvested. Table 15 estimates the meat value of the Susitna flats harvest at about $49,000 using current market prices in Anchorage for frozen domestic duck. This is a very conservative estimate, which could easily be doubled.

TABLE 15. Statewide and Susitna Flats Waterfowl Harvest and Its Economic Value

	Total	Ducks	Geese
1982 Waterfowl harvest statewide[1]	88,412	78,209	10,203
Waterfowl harvest attributable[2] to Susitna flats (%)	9,763	9,385 (12%)	378 (3.7%)
Market price[3] $1.69/lb.		$1.69	
TOTAL DOLLAR VALUE	49,498	47,582	1,916

[1]Campbell, Bruce H. & Daniel E. Timm 1983. Annual Survey and Inventory Report, Part V. Waterfowl. Table 2, p. 1280.

[2]Timm, Daniel E. 1976. Report to the Federal-State Land Use Planning Commission on Waterfowl. Alaska Department of Fish and Game, Anchorage, Alaska.

[3]Carr's Payless. 6/10/83. Anchorage, Alaska (Average dressed weight) is taken at 3lb/bird. Calculation: $1.69/lb X 3lb/bird X (9,385 + 378) = $49,498

In summary, waterfowl hunters on Susitna flats, which is the portion of the planning unit where most of the waterfowl hunting occurs, hunt an average of 5.4 days and spend an average of \$73.00 per hunting day, $\frac{(\$133.15 + \$263.00)}{5.4 \text{ days}}$.

An estimated 5,700 hunting days are spent on Susitna flats, for an annual expenditure of approximately \$416,000.00, virtually all of which is spent locally. The value of waterfowl meat is estimated at about \$49,000.

These figures may be extended to the basin-wide harvests estimated in Table 13. However, since travel to Goose Bay and Palmer Hay Flats is by road, travel costs must be reduced by 50%. The following basin-wide values result: Expenses per hunting day $\frac{(133 + 208)}{5.4} = \$63$

Total basin-wide expenditures (63 X 10,540) = \$664,000

Total value of waterfowl meat (17,149 X 3lb X 1.69) = \$86,945

TRAVEL COST ANALYSIS OF MOOSE, CARIBOU, AND SHEEP HUNTING IN SELECTED SUSITNA BASIN STUDY AREAS

The study areas selected for an analysis of travel cost are shown in the Atlas of maps. The purpose of the analysis is to indicate the relative contribution to the economy of the region of specific hunting areas by selecting one cost factor that reveals preference for these areas. In addition, net benefit to the economy at one point in time is indicated by combining site costs, including travel, site fees, and the cost of time (see Water Resources Council regulations cited above.) In the following sections, the assumptions used in the travel cost analysis are outlined, followed by the analysis itself. A summary is then attempted of all sources of net benefit for these units.

Work Sheet Assumptions and Applications

The following narrative explains the assumptions and provisions applied to the travel cost analyses of moose, caribou, and sheep hunting in the Susitna Basin. Each item refers to an item on the work sheet used for the analysis that appears in Table 16.

Travel destination. It is impractical to calculate the distance traveled to a hunting site for each individual hunter. Hunting occurs in many different sites over a large land area. In addition, the harvest ticket data base lacks sufficient precision to determine kill sites, although such data has been developed by the department under special studies programs. The hunting location is therefore designated as a single, centrally located and commonly used staging point, even though this procedure results in minimizing travel costs. For each Harvest Report Code Unit (HRCU) the following destinations are used:

Harvest Report Code Unit	Travel Destination (nearest place name)
13-10L	south shore of Lake Louise
13-12L	Nelchina (cabin sites)
13-14L	Oshetna River
13-13L	Chitna Creek
14-01-001	Moss Creek
14-01-003	Kings River
14-01-017	Moose Creek
14-01-013	Moose Creek
14-01-011	Moose Creek
14-01-016	Jim's Slough
14-01-024	Hunter Creek
16-01-002	Peters Creek
16-01-003	Shulin Lake
16-02-013	Beluga Lake
16-02-004	Bulchitna Lake
16-02-012	Alexander Lake

TABLE 16. Travel Cost Analysis Work Sheet

Work Sheet - Big Game Hunting Values

Hunting location ______________________________

Point of origin ______________________________

Round trip travel distances

______	______	______	______
AIR	AUTO	AUTO/BOAT	ORV

Hunters by travel mode

______	______	______	______	______
AIR	AUTO	AUTO/BOAT	ORV	TOTAL

TRAVEL COST

1) Air: ________ miles X \$1.67/mile X ________ hunters = \$ _______
   plus ORV local use: 25 mi X \$.90/mi X ________ hunters = \$ _______

2) Auto: ________ miles X \$.037/mile X _______ hunters = \$ _______
   plus ORV local use: \$22.50 X _______ hunters = \$ _______
   plus ORV access: ____ X \$.90/mile X _______ hunters = \$ _______

3) Auto: ________ miles X \$.037/mi = \$_______
   plus boat: ________ X \$1.14/mi X _______ hunters = \$ _______

   plus Boat:______ miles X \$.45/boat mile X ______ hunters = \$ _______

Total travel cost for this location = \$ ____________
1) + 2) + 3)

_____ Total kill

_____ Total hunter days

Travel Cost / Hunter Day = \$ ________

Point of origin. The same residency classifications are used for this analysis as those appearing in the general file harvest statistics (Data Supplement). Since the analysis requires use of a single point for calculating travel distances, a central location is chosen for each group of communities based upon the origin of the largest number of residents, as follows:

Area	Central Point Used
Anchorage-Girdwood	Lake Hood
Palmer-Skwentna	Palmer
Kenai-Homer	Kenai
Kodiak-Alaska Peninsula	Kodiak
Cordova-Tok	Chitina
Fairbanks-Delta	Fairbanks
Southeast	Juneau
Other Alaska	Anchorage
Out of state	Seattle
Foreigners	Hamburg, Germany

Round trip travel distances. Travel distances are calculated on a 1:250,000 scale USGS topographic map and 1:1,000,000 scale world aeronautical charts using a digital map plotter (see also Alaska Milepost for mileages). It is assumed that hunters make one round trip from their point of origin to the designated hunting location. Second trips and side trips are ignored, even though additional travel of this kind is common.

It is further assumed that hunters specifying air travel have available off-road vehicle transportation for twenty-five miles of local use. Air travel is assumed straight-lined, with only one round trip taken per hunt (two round trips are common for charters or parties). In areas where no road access exists (e.g., 16-02-013, Beluga), all hunters entering unknown or highway vehicle travel are entered under aircraft travel.

For local use of boat transportation, 40 miles is assumed.

It is also assumed that every hunter specifying off-road vehicles (motorbike, ORV, snowmobile, horse) as a primary mode of transportation also used a highway vehicle. A specific travel distance is entered for ORV in locations such as the Nelchina basin, where considerable off-road travel is required to reach the hunting site. Otherwise, only local use (25 miles) of ORVs is assumed.

Hunters. Hunters active in a specific HRCU are tabulated in the harvest ticket data base by the following modes of travel:

- airplane
- horse
- boat
- motorbike
- snowmachine
- off-road vehicle (ORV)
- highway vehicle or auto
- unknown

These categories are reduced to four for purposes of the travel cost analysis (airplane, boat, auto, and ORV), placing all specialized vehicles in the ORV category and assuming all "unknown" hunters travelled by auto only (again minimizing travel costs).

An assumption of major importance to this analysis is that the number of hunters is equal to the number of hunting trips taken (travel costs apply to hunting trips). Each hunter is assumed to take one trip, hunting alone. This is obviously not accurate, since most people hunt in parties. Moreover, most hunters also take more than one hunting trip per season. These actualities do not show up on the harvest ticket hunter reports, and it is assumed that these differences are roughly equal. These differences therefore cancel, leaving the number of hunters equal to the number of hunting trips taken.

Travel cost. Travel cost is calculated by the simple expedient of multiplying the number of hunters by the round trip distance travelled, by the cost per mile of travel. It is assumed that the levels of cost and the patterns of travel are similar for moose, caribou, and sheep hunting.

These costs are developed in the form of constants for each travel mode. Since these constants greatly influence the results of this analysis, they have been developed with some care (with the exception of ORV costs, which are highly variable and therefore set somewhat arbitrarily at $.90/mile). Table 17 specifies auto, boat, and air travel cost factors.

It is important to note that consistent with the assumption that each hunter takes one trip, hunting alone, cost constants are calculated on the basis of one person per vehicle (that is, a party of one).

Since nearly all foreign and out-of-state hunters travel to and from Anchorage, round trip fares calculated from the central point or origin (Seattle at $579.00; Hamburg at $1,021.00) may be used, together with Anchorage-origin travel costs, for these hunters.

For Matanuska Valley hunters, Anchorage origin travel distances may be used, less the round trip distance between Anchorage and Palmer.

In instances where the number of hunters from a given origin is small, travel costs from comparable origins or occasionally averaged values are used.

TABLE 17. Auto, Boat and Air Travel Cost Constants

Item	¢/mile		
AUTO TRAVEL			
Variable costs	1976[1] U.S. National Average	Nov. 1982[2] U.S. National Average 1976 X 1.8	Nov. 1982[3] Alaska Costs 1982 USA X 1.24
Maintenance, Parts & tires	4.2		
gas & oil	3.3		
Subtotal	7.5	13.5	16.7
Fixed costs			
Depreciation	4.9		
Insurance	1.7		
Taxes	1.6		
Subtotal	8.2	14.76	18.3
Total	15.7	28.26	35.0

Cost/mile, Recreation Vehicles, assumed 20% above standard auto or
$\$.35 \times 1.20 = \$.42$

Assume 70% family car use, 30% recreational vehicle use:

$(.70 \times 35.0) + (.30 \times 42.0) = 24.5 + 12.6 = 37.1$¢ per mile per trip

BOAT TRAVEL[4]

Fiberglass Hull - 22' w/125 hp Volvo inboard & trailer

a) Ownership cost/yr

- $23,000 new/15 yr life/10% interest rate
  cost = $3,023.90/yr

- hrs used/yr = 200
  cost/hr = $15.12

- avg speed = 20 mph
  ownership cost/mile = $15.12 ÷ 20 = 75.6¢/mile

b) Repair & maintenance cost

- established @ $400/yr
  400 ÷ 200 hrs = $2.00/hr
  $2.00 ÷ 20 mph = 10.0¢/mile

c) Operation

- 4 gal/hr @ 20 mph
- gas & oil = \$1.40/gal.
- $\frac{\$1.40 \times 4.0}{20} = 28.0¢/\text{mile}$

Total Cost = 75.6 + 10.0 + 28.0 = \$1.14/mile

AIR TAXI TRAVEL

Assume Cessna 185

cost/hour = \$200 hr

cruising speed = 120 mph

cost/mile = $\frac{\$200}{120 \text{ mph}}$ = \$1.67/mile

Sources

[1]Federal Highway Administration. 1977. Transportation Trends and Choices. Tolls and parking fees excluded.

[2]Pers. Comm., Neal Freid, Alaska Department of Labor 1/13/83, based upon United States Transportation CPI update factor:

$$\frac{\text{Nov. 1982}}{1976}, \quad \frac{297.4}{165.5} = 1.8$$

[3]Ibid. 1/13/83, 11/82 Transportation Index for Alaska:124 or 24% higher in Alaska.

For comparison see use of 7¢/mile in Nicholson, A.J. 1957. Summary of Sportsmen's Expenditures, Missouri River Basin. Spec. Sci. Report: Wildlife #35. United States Department of Interior Fish and Wildlife Service, Washington, D.C. Surveys from 1940's. For comparison see also use of 30¢/mile for reimbursable cost of private auto use by State of Alaska.

[4]Ward's Marina, Anchorage, Alaska

Susitna Lowlands (GMU 16)

Five harvest report code units making up most of the Susitna lowlands were selected for economic analysis. Only moose hunting occurs in these units. Table 18 summarizes the travel cost analysis for these units: 1,251 hunters expended $225,143 in travel costs to hunt 7,187 days and kill 312 moose. Theory and practice in economic valuation of recreational hunting allows the use of travel cost as a proxy for net economic benefit of this activity to society. Table 19 summarizes the travel costs contributed by Anchorage area hunters. Table 20 summarizes travel costs from all origins analyzed for the single most popular moose hunting area of the group: the Petersville unit (16-01-002). Work sheets for the Susitna lowlands area have been shown (Table 16) demonstrating the methods used and allowing further interpretations of the basic data if required.

TABLE 18. Area Summary of Travel Costs Analysis Susitna Lowlands (GMU 16) Moose Hunting

HRCU	Total Hunters (H)[1]	Total Harvest	Travel Cost (TC)	Total Hunter Days(H-D)[1]	TC / H/Day	TC / Hunter	Notes
16-01-002 Petersville Road	604	106	73,552	3,468	21.22	122	road accessible
16-02-012 Alex. Creek	200	54	42,250	1,115	37.89	211	
16-02-004 Yenlo Hills	168	63	50,965	967	52.70	303	remote
16-02-013 Beluga Lake	158	62	40,739	970	42.00	258	
16-01-003 Lower Yentna/ Lower Susitna	121	27	17,667	671	26.33	146	limited road access
TOTAL	1,251	312	225,143	7,191	31.33	180	

[1]Does not include hunters with unknown success or unknown residency

TABLE 19. Susitna Lowlands: Moose Hunting Travel Costs (TC) Contributed by Anchorage Area Hunters

HRC Unit	Total Hunters	Total Harvest	Travel Cost(TC)	Hunter Days	TC/ Hunter Day
16-01-002	476	71	53,181	2,516	21.14
16-02-012	168	45	30,435	935	32.55
16-02-013	125	46	25,137	684	36.75
16-02-004	135	44	34,436	775	44.43
16-01-003	91	19	12,991	462	28.12
TOTAL	995	225	156,180	5,372	29.07
	Travel Cost/Hunter = $157				

TABLE 20. HRCU Summary for 16-01-002 (Petersville): of Moose Hunting Travel Costs (TC)

Origin of Hunter	TL Hunters	Total Harvest	Travel Cost	Hunter Days	TC/ Hunter Day
Anchorage	476	71	53,181	2,516	$21.14
Mat Valley	82	24	7,677	644	11.92
Frbks-Delta	25	7	5,616	182	30.85
Balance of state	16	2	3,594	93	30.84
Out-of-state	5	2	3,454	33	104.67
Foreign	0	0	0	0	0
TOTAL	604	106	73,522	3,464	$21.22
		Travel Cost per hunter = 122			

Palmer Area (GMU 14)

Moose and sheep are hunted in the reporting units selected for analysis in the Palmer area. For these units only the Anchorage-origin hunter is selected for analysis. In addition, in order to compare similar geographic areas, moose harvest report code units are used also for sheep harvest data. Table 21 summarizes the travel cost analysis and shows Anchorage-origin moose and sheep hunters paying \$48.62 and \$63.92 in travel costs per trip, respectively. The data base indicates a large number of Matanuska Valley area hunters also use the area along with one out-of-state moose hunter and nine out-of-state sheep hunters. Anchorage values may be used for hunters for a conservative estimate of total travel costs as shown (moose: \$24,018; sheep: \$6,328).

TABLE 21. Palmer Area Summary of Travel Cost (TC) Analysis for Moose and Dall Sheep Hunting

Species HRCU	Total Hunters	Total Kill	Anchorage Area Hunters Hunters	Kill	TC($)	Hunter Days	($)TC/HD[1]	($)TC/Hunter
MOOSE								
14-01-011	79	13	not known					
14-01-013	52	12	not known					
14-01-017	190	36	208	40	9,318	946	9.85	
14-01-016	69	17	37	7	1,979	171	11.60	
14-01-024	62	14	20	5	1,105	84	13.15	
14-01-001	31	8	16	2	968	54	17.92	
14-01-003	11	3	9	2	730	38	19.21	
Subtotal	494	103	290	56	14,100	1,293	10.90	48.62
TOTAL Travel Cost:	494 X 48.62	=	\$24,018					
DALL SHEEP								
14-01-011	0	0	0	0	0	0	0	
14-01-013	0	0	0	0	0	0	0	
14-01-017	5	0	3	0	32	14	2.29	
14-01-016	32	7	16	2	1,063	107	9.93	
14-01-024	44	12	23	2	1,196	57	20.98	
14-01-001	18	11	8	4	906	45	20.13	
14-01-003	0	0	0	0	0	0	0	
Subtotal	99	30	50	8	3,197	223	14.34	63.92
TOTAL Travel Cost:	99 X 63.92	=	\$6,328					
TOTAL	593	133	340	64	17,297	1,516	11.41	51.17

Grand Total = \$30,346

[1]Travel cost/Hunter day

Nelchina Basin (GMU 13)

Moose, caribou, and Dall sheep hunting occurs in the southwestern portion of the Nelchina basin selected for analysis. Only the Lake Louise area (Unit 13-10L) has been selected for travel cost analysis of all user groups. Table 22 shows an area summary of all hunters and total harvest for all three species and a summary of the travel cost analysis for Anchorage area hunters. As in Table 21, Tables 22 and 23 moose, caribou and sheep coding units are translated into a common coding unit, this time based on caribou units. For the Lake Louise area results of the travel cost analysis for all moose and caribou hunters is shown in Tables 23 and 24. Averaged values for all hunters from areas other than Anchorage may be used to estimate travel costs for these hunters for other units in the area. Table 25 summarizes these estimates and shows a total estimate of $318,000 expended in travel costs for this area.

TABLE 22. Nelchina Area Summary of Travel Cost Analysis for Anchorage Area Moose, Caribou, and Sheep Hunters

Species	HRCU	Total Hunters	Total Harvest	Anchorage Area Hunters: Hunters	Harvest	TC($)	Hunter Days	TC/HD($)
MOOSE	13-10L	279	35	183	17	36,245	1,094	33.13
	13-11L	26	4	19	2	2,399	104	23.07
	13-12L	196	46	124	25	19,380	794	24.41
	13-13L	67	10	34	4	3,011	113	26.64
	13-14L	68	34	44	20	11,520	104	110.76
Subtotal		636	129	404	68	72,555	2,209	32.85
CARIBOU	13-10L	201	139	106	70	23,169	380	60.97
	13-11L	0	0	0	0	0	0	0
	13-12L	188	132	107	76	18,073	285	63.41
	13-13L	21	13	14	7	1,805	59	30.59
	13-14L	82	69	45	35	15,618	127	123.00
Subtotal		492	353	272	188	58,665	851	68.94
SHEEP	13-10L	0	0	0	0	0	0	0
	13-11L	0	0	0	0	0	0	0
	13-12L	5	1	2	0	227	7	32.43
	13-13L	102	38	42	22	9,185	248	37.04
	13-14L	7	1	4	1	1,544	20	77.20
Subtotal		114	40	48	23	10,956	275	39.84
TOTAL		1,242	522	724	279	142,176	3,335	42.63

Travel cost per hunter: $228.25

TABLE 23. Lake Louise Unit Summary for Moose Hunting

Origin of Hunter	Total Hunters	Total Harvest	Travel Cost(TC)($)	Hunter Days	TC/HD($)	TC/Hunter($)
Anchorage	183	17	36,245	1,094	33.13	198.06
Mat-Valley	35	4	6,111	294	20.79	
Fairbanks-Delta	14	2	5,724	143	40.00	
Cordova-Tok	21	5	3,670	90	40.78	356.02
Other state	12	2	6,444	102	63.18	
Out of state	13	4	11,010	64	176.88	
Foreign	1	1	1,219	3	406.00	
TOTAL	279	35	70,423	1,790		
Average					39.34	252.41

TABLE 24. Lake Louise Unit Summary for Caribou Hunting

Origin of Hunter	Total Hunters	Total Harvest	Travel Cost(TC)($)	Hunter Days	TC/HD($)	TC/Hunter($)
Anchorage	106	70	23,169	380	60.97	218.58
Mat-Valley	46	36	9,783	165	59.29	
Fairbanks-Delta	30	20	14,530	117	124.00	
Cordova-Tok	7	4	1,275	28	45.53	357.53
Other state	5	3	2,790	14	200.00	
Out of state	7	6	5,586	20	279.00	
Foreign	0					
TOTAL	201	139	57,134	724		
Average					78.91	284.25

TABLE 25. Nelchina Area Summary of Travel Costs for All Moose, Caribou, and Sheep Hunters

	Total Hunters	Hunters Anchorage	Travel Cost($)	Hunters Non-Anchorage	Travel Cost($)	Total Travel Cost($)
Moose	636	404	72,555	232	82,592[1]	155,147
Caribou	492	272	58,665	220	78,540[1]	137,205
Sheep	114	48	10,956	66	15,064[2]	26,020
TOTAL	1,242	724	142,176	518	176,196	318,372

[1]Based on Lake Louise sample showing $356/moose hunter/trip, $357/caribou hunter/trip

[2]Anchorage value of $228.25 used throughout

Summary

Table 26 summarizes the estimated travel costs faced by moose, caribou, and sheep hunters in the areas of the Susitna basin selected for analysis. Net benefits enjoyed by the general economy from these hunters is estimated at just over $500,000 for the 1981 study year.

TABLE 26. 1981 Travel Costs for Moose, Caribou, and Dall Sheep Hunters in the Susitna Basin

Area	Species	Total Hunters	Total Harvest	Travel Cost($)	TC/Hunter	Method
Susitna lowlands (GMU 16)						
	Moose	1,251	312	225,143	180	All residents analyzed.
	Caribou	0	0	0	0	
	Sheep	0	0	0	0	
Subtotal		1,251	312	225,143	180	
Palmer area (GMU 14)						
	Moose	494	103	24,018	48.62	Based upon Anchorage origin values.
	Caribou	0	0	0	0	
	Sheep	99	30	6,328	63.92	
Subtotal		593	133	30,346	51.17	
Nelchina basin (GMU 13)						All residents analyzed for Unit 13-10L only. Remainder based upon these values.
	Moose	636	129	155,147	243.94	
	Caribou	492	353	137,205	278.87	
	Sheep	114	40	26,020	228.25	
Subtotal		1,242	522	318,372	256.34	
TOTAL		3,086	967	573,861	185.95	

LICENSE AND TAG FEES

In most applications of the travel cost method (see Water Resources Council VI, K 11/1980) license and tag fees are among the costs faced by the hunter that can be included in an estimate of net benefit. The cost of a license to hunt game in the State of Alaska is $12.00 to residents and $60.00 to non-residents. In addition, non-residents are required to purchase a non-refundable big game tag at the following prices (see Alaska Department of Fish and Game, Board of Game. Alaska Hunting Regulation #22. July 1, 1981 - June 30, 1982. Juneau, Alaska):

Bear, black	each	$ 100.00
Bear, brown or grizzly	each	250.00
Bear, polar	each	250.00
Bison	each	250.00
Caribou	each	200.00
Deer	each	35.00
Elk	each	125.00
Goat	each	125.00
Moose	each	200.00
Muskoxen	each	1,000.00
Sheep	each	250.00
Walrus	each	250.00
Wolf	each	50.00
Wolverine	each	50.00

Costs to moose, caribou, Dall sheep, black bear, brown bear, and waterfowl hunters in the Susitna basin for licenses and tags is estimated in Table 27 at about $200,000.

These values are for those hunters who actually entered the field and submitted hunter reports.

TABLE 27. 1981-1982 Costs to the Hunter for Susitna Area Hunting Licenses Tags and Duck Stamps for Moose, Caribou, Dall Sheep, Bear, and Waterfowl

Species Hunted	Reporting Hunters[1] Resident Licenses	Non-Resident[2] Licenses & Tags	Gross[3] Dollar Value
Moose	4,416	178	99,272
Caribou	609[4]	37	11,447
Sheep	266[4]	62	20,018
Bear[5]	1,540	174	54,120
Waterfowl	1,050[4]	1,050 duck stamps[6]	7,875
		TOTAL	192,732

[1]Alaska Department of Fish and Game, Game Division. General File Harvest statistics, 1981, printed 08/05/82

[2]See text for tag prices

[3]Calculation example:
moose: (4,416 X \$12) + (178 X \$60) + (178 X \$200) = 99,272

[4]Use 25% only, since most resident caribou & sheep hunter also hunt moose

[5]Calculation: (\$1,540 X \$12) + (174 X \$60) + $\underbrace{(122 \text{ X } 100)}_{\text{black bear}}$ + $\underbrace{(52 \text{ X } \$250)}_{\text{brown bear}}$ = 54,120

[6]Federal Duck Stamps cost \$7.50

APPENDIX C

RIPARIAN ECOSYSTEMS: RESOURCE VALUES AND CONFLICTS WITH EMPHASIS IN THE MATANUSKA-SUSITNA BOROUGH

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EXECUTIVE SUMMARY

This report describes the values of riparian ecosystems and how these values are a result of complex interactions between riparian vegetation and aquatic systems. Impacts from land use activities and management practices can interrupt the functions of riparian ecosystems, diminishing their value. By understanding how and why riparian ecosystems are so valuable and using management practices that maintain these values, the public can continue to derive social and economic benefits from the riparian ecosystems.

Riparian ecosystems consist of a water body (river, stream, lake, etc.) and adjacent plant communities that are influenced by the presence of that water. Along rivers and streams riparian ecosystems, which include vegetation communities, streambanks, and the stream channel, are generally located within the riverine floodplain.

Ecological processes within riparian ecosystems result in high abundance, diversity, and production of wildlife. Floodplains, for example, provide important habitat for moose, birds, and furbearers. Overwinter survival of moose often depends on the availability of riparian vegetation, which also determines the quality of aquatic habitats for fish and functions as a buffer zone, providing a mechanism for flood control, pollution abatement, erosion control, streambank stabilization, ground water recharge, and the maintenance of water quality. Riparian lands attract and support many recreational, subsistence, and educational activities, including hunting, fishing, trapping, camping, and nature study.

Impacts from developmental activities (agriculture, grazing, settlement, forestry, oil and gas, mining, and road construction) alter ecological processes and have been responsible for degrading riparian and aquatic environments and reducing or eliminating existing resources and amenity values.

Soil erosion, water pollution, habitat loss, reduction in fish and wildlife populations, and loss of public recreational and private economic opportunities are often the consequences of developmental impacts. Development in or adjacent to riparian ecosystems has resulted in public expenditures of billions of dollars for water quality restoration, habitat rehabilitation, and disaster relief from flooding. Non-structural approaches (buffer zones) are the best managerial solutions for preventing riparian land and water degradation and maintaining a productive resource.

When river corridors come under multiple ownership, conflicts arise between landowners and public users. Trespass is the most serious riparian land owner-user conflict. Lack of public access results in overuse of the few available sites, increasing trespass, creating litter problems, and causing habitat degradation. Most riparian property owners oppose easements for regulating use and development, and they also oppose public agencies purchasing private riparian lands. In Alaska, many landowner-public user conflicts result from combinations of human population growth, changing landownership patterns, poorly marked access, limited or nonexistent access, and the absence of a clear definition of the rights and limitations of landowners and the public within access easements.

Conversion of floodplain forests and shrublands to alternate land uses has been responsible for making riparian ecosystems among the most severely altered landforms in the nation. In the contiguous 48 states, over 70% of the estimated original coverage of riparian ecosystems has been altered or eliminated. Recognizing the functions and important public benefits derived from riparian ecosystems, and alarmed over the rate of destruction, the federal, local, and state governments and private organizations have begun to exercise control over development in riverine corridors or to acquire private lands to protect riparian values and provide public recreational opportunities. Regulatory legislation, zoning, conservation easements, tax incentives, establishment of riverine corridors, and fee-simple acquistion of land are some methods currently being used to protect riparian ecosystems. Millions of dollars have been spent by Alaska, California, Oregon, Washington, and Idaho to purchase riparian lands for public access and fish and wildlife habitat protection.

INTRODUCTION

With an expanding population and ever growing demand for the use of Alaska's resources, the need for public awareness and planning in allocating resources is becoming increasingly important. This is especially so in Southcentral Alaska, the most rapidly developing area in the state.

Riparian ecosystems are one resource whose ecological, social and economic values to the people of Alaska must be recognized. In order to manage and maintain riparian river and stream ecosystems to best serve the public interest, the functions and values of the resource must be understood. It is the intent of this paper to develop an understanding of the relationships existing between river and stream ecology, riparian lands, fish and wildlife needs and the human uses and demands for these resources.

Riparian ecosystems are a highly productive public resource. They support a greater abundance and diversity of fish and wildlife than surrounding habitats. No ecosystem is more essential to the survival of the nation's fish and wildlife resources than riparian ecosystems (Council on Environmental Quality 1978). These high fish and wildlife values provide numerous recreational opportunities as well as jobs, both locally and regionally. The Council on Environmental Quality (1980) predicts that as travel becomes more costly, lakes and rivers near major population centers will provide even more important recreational opportunities. Any conflicting uses of riparian ecosystems must be weighed against the resource's inherent values and be designed to best maintain those values.

Allocating land and water in riparian ecosystems among various users and assessing the ecological, social, and economic impacts of such allocations are of great concern. How these resources are apportioned and managed will determine their future value to fish and wildlife productivity and its associated activities. Riparian ecosystems require only protection for them to yield consumables such as floodwater storage, water quality maintenance, and products from fish, wildlife, and timber.

Definition

Duff (1980) defines riparian ecosystems as wetland ecosystems that have a high water table because of proximity to an aquatic ecosystem such as a river or lake or to subsurface water. Plant species composition reveals the influence of the surface water (Franklin and Dyrness 1973).

Riparian ecosystems are distinguished by a linear band of distinct vegetation and soil characteristics situated between aquatic and upland ecosystems (Brown et al. 1978). Moisture requirements of riparian plant communities exceed those of adjacent upland ecosystems. Communities depend on high water tables or overbank flooding, which may vary from extended periods of seasonal flooding to periodic rises in subsurface ground water (Hirsch and Segelquist 1978). Plant communities may range from only a few meters wide along stream banks to several miles across in the floodplain of larger rivers. Riparian vegetation is usually dominated by trees or shrubs. The structure and function of these plant communities is primarily determined by the physical aspects of flooding, water flow, and the lateral transport of nutrients and sediments by the aquatic ecosystem.

Riparian communities are not restricted to river and stream systems. Thomas et al. (1979) divides riparian communities into standing water (lentic) habitats along the shorelines of lakes, ponds, and the periphery of bogs, and running water (lotic) habitats along rivers, streams, and springs. Lentic habitats often occur within the riverine floodplain.

For this report, the following definition will apply:

> Riparian ecosystems are composed of 1) plant communities along rivers and streams and around lakes, ponds, springs, or bogs, whose vegetative structure and function is primarily determined by influences from the adjacent aquatic system, including a high water table or overbank flooding, and 2) the adjacent aquatic system. Along rivers and streams, riparian plant communities are those located within or adjacent to the boundaries of the active floodplain.[1] These occur within or are often synonymous with the riverine corridor.

Vegetation types are not a good indicator of flood hazard (Miller 1982). The Soil Conservation Service has found that in most cases there are no measureable differences between plant life in the floodplain outside the three-to-five-year flood event. Vegetation in a floodplain that is flooded by a 10-year event will be the same as that flooded by a 25-year or 100-year flood.

Attributes of Riparian Ecosystems

The importance of riparian ecosystems to fish and wildlife and associated human activities cannot be overestimated. Riparian ecosystems maintained in a healthy condition should be recognized as a valuable natural resource and a legitimate land use. The following, modified from Duff (1980), lists several of the most important values of riparian ecosystems:

1.) Riparian vegetation regulates the nutrient input to aquatic ecosystems, thus determining the quality of aquatic habitat for fish resources.

2.) The structural diversity and complexity of riparian vegetation supports greater numbers and diversity of terrestrial wildlife populations than any other habitat.

3.) Riparian ecosystems support vegetative buffer zones that provide flood control, pollution abatement, erosion control, stream bank stabilization, ground water recharge and the maintenance of water quality;

4.) Riparian ecosystems attract and support many recreational, subsistence, and educational activities, including hunting, trapping, fishing, camping, photography, and nature study.

[1] Active floodplain: The flood-prone lowlands and relatively flat areas adjoining inland and coastal waters, including contiguous wetlands and floodplain areas of offshore islands; this will include, at a minimum, that area subject to a 1% or greater chance of flooding in any given year (100-year floodplain).

5.) Riparian ecosystems have a high aesthetic value due to the combination of water, land, attractive and unique vegetation types, and abundant fish and wildlife populations.

FUNCTIONS OF RIPARIAN VEGETATION

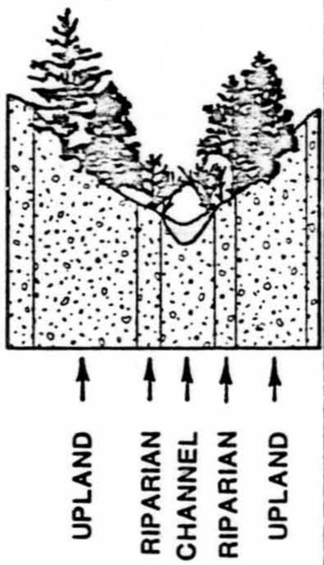
Fish Habitat

Fish habitat is directly related to and highly dependent on the conditions of the surrounding watershed, especially the adjacent riparian zone (Duff 1980, Merrit and Lawson 1978). The quality of the aquatic system is a result of the interaction between riparian vegetation, the stream/river channel, the water column, and the streambank (Platts 1982). By influencing water temperature, rate of flow and fluctuation in discharge, and available cover these determine the productivity of the fishery. Adverse alterations in riparian vegetation will affect the quality and quantity of fish habitat and may cause a decline in production.

The functions of riparian vegetation as they relate to the aquatic ecosystem are presented in Figure 1. Riparian vegetation reduces erosion and thus bedload sediment by controlling surface runoff and stabilizing streambanks. An increase in bedload sediment would interfere with intergravel waterflows and decrease oxygen available to incubating fish eggs and alevins. Stream bank erosion is a normal occurance but must be maintained in equilibrium with the buildup of new banks. Problems begin when this balance is upset. Vegetation slows overland water flow and traps sediment, building new stream banks and minimizing damage to the river channel and bank during periods of high flows. Burger et al. (1982) found that areas along the Kenai River, Alaska, with bank irregularities and overhanging vegetation resulted in higher catch rates of juvenile chinook salmon (*Oncorhynchus tshawytscha*). Greater numbers and higher frequencies of juvenile Coho Salmon (*O. kisutch*) were captured in the Susitna River in areas with emergent or aquatic vegetation and/or overhanging or deadfall cover (ADF&G 1983). Overhanging banks and vegetation provide fish with protective cover as do some submerged snags and boulders. Platts (1982) cites several studies that document the importance of cover to fish. Salmonid abundance declines as stream cover is reduced; as cover is added it increases. The removal of vegetation causes a reduction in bank irregularities and a tendency toward a smooth straight channel. Along with this goes an increase in water velocity and a reduction in cover and thus a loss of habitat.

By providing shade, vegetation maintains suitable water temperatures for fish, incubating eggs, aquatic plants, and invertebrates (Duff 1980). Hynes (1970) states that water temperature is one of the four most important abiotic factors in fish production. Temperature changes can affect the metabolic rate of fish, change the dissolved oxygen content in the water, and influence hatching success. Shaded streamside areas are a preferred habitat of juvenile salmonids (Platts 1982).

Riparian vegetation contributes to primary stream productivity by supplying the aquatic system with plant and animal detritus and nutrients that provide the basic components of the food chain (Meehan et al. 1977). Evidence suggests that organic detrital input into forested streams may support over 99 percent of the annual energy requirements for primary consumer organisms



RIPARIAN VEGETATION

SITE	COMPONENT	FUNCTION
above ground above channel	canopy & stems	1. Shade–controls temperature & in stream primary production 2. Source of large & fine plant detritus 3. Source of terrestrial insects
in channel	large debris drived from riparian veg.	1. Control routing of water and sediment 2. Shape habitat–pools, riffles and cover 3. Substrate for biological activity
streambanks	roots	1. Increase bank stability 2. Create overhanging banks–cover
floodplain	stems & low lying canopy	1. Retard movement of sediment water and floated organic debris in flood flows

Figure 1. Functions of riparian vegetation as they relate to the aquatic ecosystem. Adapted from Meehan et al. (1977).

(Fischer and Likens 1973). Organic debris supplies a food source to many aquatic invertebrates important in the diet of many fish. Riparian vegetation is also a supplier of terrestrial insects to the aquatic ecosystem. Vegetation along the Kenai River appears to supply food items to juvenile chinook salmon (Burger et al. 1982). Kennedy (1977) reports that 54 percent of the organic matter eaten by fish from the Missouri River is of terrestrial origin.

By its ability to absorb runoff, the riparian community can provide groundwater recharge to the aquatic system during periods of low flow, increasing available habitat to rearing fish. Absorbing surface runoff also mitigates high flows, reducing erosive forces.

Moose Habitat

Quality, quantity, and accessibility of riparian vegetation is absolutely essential for maintaining stable moose (Alces alces) populations. Good moose range consists of a complex of river bottomlands and adjoining lowlands and sub-alpine foothills (Alaska Department of Fish and Game 1973). For moose populations, riparian lands play a critical role in overwinter survival. During winter months, especially years of deep snow, subpopulations of moose travel distances up to 25 miles (40 km) from extensive areas to riparian communities along the Susitna River (Modafferi 1982). Here snow is less deep and food more accessible. During harsh winters river bottoms become yarding areas for high densities of moose. The areal extent and condition of riparian vegetation ultimately determine at what level moose populations will persist in a given area (LeResche et al., no date).

Numerous drainages in the Matanuska-Susitna-Beluga study area provide important winter habitat for moose (Table 1). On November 16, 1982, Bill Taylor (Alaska Department of Fish and Game, pers. comm.) counted 101 moose in riparian vegetation along Alexander Creek between the confluence of the Susitna River and Lower Sucker Creek. Aerial surveys flown between Mt. Susitna and Mt. Beluga reveal large numbers of moose in riparian drainages. Between Upper Sucker Creek and Bear Creek during the same years, early winter counts varied from 134 to 146 moose. Few other areas have been surveyed extensively.

While the number of moose in riparian communities increases markedly during winter months, year-round use is still significant. Along the Susitna River below Talkeetna, some moose use riparian areas for the entire life-cycle. A large majority (up to 90 percent) of the lower Susitna River moose are found between Montana Creek and Cook Inlet. Above Talkeetna, females migrate to riparian areas for calving (Modafferi 1982).

Movements between seasonal ranges often follow traditional migration routes. There are east-west movements of moose into the river valleys as well as movements parallel to the river corridor. Disruption of migration routes may cause a significant increase in mortality.

The natural seasonal variation in water flow, the frequency and magnitude of flooding, and ice and wind action create a shifting pattern of plant communities in the floodplain. This is most important in the creation and maintenance of primary and early successional plant communities such as willow shrublands. These, along with the understory vegetation of some later seral stages, provide important browse species. Horsetail-willow and horsetail-balsam poplar (cottonwood) plant communities provide substantial forage for moose, as do mature and decadent balsam poplar and birch-spruce stands. The extensive areal cover of the latter two communities makes them a major food resource for moose living in the floodplain of the lower Susitna River (McKendrick et al. 1982).

TABLE 1. Drainages that Provide Important Moose Wintering Habitat in the Matanuska - Beluga - Susitna Study Area. Additional Drainages may Provide Important Winter Habitat but no Information is Available.

Susitna River
Little Susitna River
Alexander Creek and Sucker Creek
Talachulitna River
Yentna River
Skwenta River
Kahiltna River
Twenty-mile slough
Moose Creek, Deshka River, Kroto Creek, Twenty-Mile Creek
Lewis River
Theodore River
Beluga River
Tokositna River (between Home Lake and Bunco Lake)
Lake Creek
Talkeetna River
Oshetna River
Little Oshetna River
Little Nelchina River
Tyone River
Tyone Creek and tributaries
Mendeltna Creek
Watana Creek
Maclaren River
Nenana River
Coal Creek
Fog Creek
Sanona Creek
Brushkana Creek
Tsusena Creek
Goose Creek
Clear Water Creek
Jay Creek
Butte Creek
Deadman Creek
Kosina Creek

SOURCES: R. Modafferi, 1982, pers. comm.; J. Didrickson, 1982, pers. comm. D. Bader 1983, pers. comm. Adapted from ADF&G, Habitat Division, Comments on Proposed Cook Inlet Oil and Gas lease sale #40, 1982.

The major factors currently causing declines in study area moose populations are habitat-related; loss or alteration of riparian moose habitat will seriously exacerbate the situation.

Furbearers

Beavers (Castor canadensis), muskrats (Ondatra zibethica), mink (Mustela vison) and river otters (Lutra canadensis) occur throughout the Susitna River drainage along rivers, streams, and around lakes and ponds. All are dependent upon riparian ecosystems throughout their life-cycle. All being furbearers, they are sought by trappers for the value of their pelts.

Beavers. Beavers are restricted to freshwater aquatic habitat bordered by riparian vegetation. They are found throughout the Susitna drainage from sea-level to 3,100 feet (1,000 meters) (Terrestrial Environmental Specialists, Inc. no date). The extent of habitat use is a function of the rate of water flow, water depth, fluctuations in water depth, ice depth, ice scouring, and the characteristics of channel bottoms, streambanks, and riparian vegetation (Gipson 1983). Boyce (1974) found beavers in Alaska favoring lakes or slow-flowing streams bordered by sub-climax stages of shrubs and mixed coniferous and deciduous forests. Densities of lodges in Interior Alaska were positively correlated to habitats high in balsam poplar (Populus balsamifera) and willows (Salix spp.). Shifting river channels create an environment conducive to the natural regeneration and colonization of balsam poplar (Gill 1972) and willow. Beavers prefer a seasonally stable water level and abandon colonies when flows become too low (Collins 1976). Fancy (1982) considers the water depth under the ice to be the major limiting factor for beavers in the floodplain. Beavers are generalized herbivores (Jenkins 1975), but primary food is the bark of aspen (P. tremuloides), willow, cottonwood (P. trichocarpa), balsam poplar, birch (Betula spp.) and sometimes alder (Alnus spp.) (Konkel et. al. 1980). In Alaska, willow is the most stable food source, although not necessarily the preferred food (Murray 1961).

Boyce (1974) found beavers foraging up to 195 feet (60 meters) from the water's edge. Slough and Sadleir (1977) report beavers foraging up to 650 feet (200 meters) from water; 90% of all cuttings were done within 98 feet (30 meters) of the water's edge.

In modifying habitat through damming, beaver impoundments not only improve their own habitat but provide aquatic and riparian wildlife habitat for other species. Damming creates ponds that provide feeding, staging, and brood-rearing habitat for waterfowl (Hair et al. 1978, Yeager and Rutherford 1957), improves range for moose (Yeager and Rutherford 1957), and provides rearing habitat for juvenile salmonids. Hakala (1952) reports that extensive willow growth in the Susitna River moose range is the direct result of beaver activity. Beaver ponds also stabilize watersheds, reducing flooding and sedimentation.

Beavers are one of the major furbearers sought by trappers in the Susitna basin, including the Susitna River, its tributaries, and large lakes such as Stephan's Lake (Terrestrial Environmental Specialists, Inc. no date). Beavers are one of the few furbearers that readily provide for non-consumptive use such as viewing, photography, and nature study (Alaska Department of Fish and Game 1980).

The most significant factors affecting beaver populations are habitat destruction and overtrapping. Concentrated trapping efforts near settlements and along roads can result in depletions of local populations. In Southwest Alaska beavers are five times as abundant in remote areas compared to areas near villages (Alaska Department of Fish and Game 1980). From 1850-1900 beavers were almost eliminated from southeastern United States by the effects of overharvest and habitat loss due to clearing land for agriculture (Hair et al. 1978). Roads, railways, and land clearings invariably follow waterways and are a major limiting factor to beaver habitat suitability. Artificial water regulation with manmade dams can produce severe water fluctuations, decreasing the capability of many areas to support beavers (Slough and Sadleir 1977). Small streams are the most susceptible to change in flow rates, sedimentation, and alteration of riparian vegetation (Hair et al. 1978, Terrestrial Environmental Specialists, Inc. no date).

Mink. In the Susitna basin, mink occur along all major tributary creeks of the Susitna River below 4,000 feet (1,200 meters) (Gipson 1982). In Southcentral Alaska, mink are highly dependent on riparian plant communities and are most commonly found near streams, ponds, marshes, and fresh or saltwater beaches (Alaska Department of Fish and Game 1976). Movements are largely restricted to shoreline areas. Schladweiler and Storm (in Brinson et al. 1981) report the primary zone of activity is within 230 feet (70 meters) of a stream. Mink infrequently range out to 600 feet (180 meters) from a stream. Mink have large home ranges and may cover an area up to three square miles (7.7 km^2) (Banfield 1974, in Konkel et al. 1980).

There appears to be some correlation between the size of the mink population and the size of the salmon run for areas on the Kenai Peninsula (Alaska Department of Fish and Game 1976).

Mink do not construct their own dens but generally rely on vacated or appropriated dens of other furbearers, or they use naturally occurring cavities in channel banks, drift piles, or fallen trees (Konkel et al. 1980). Natal dens are generally located near water.

Human development along rivers may be detrimental to mink (Alaska Department of Fish and Game 1976). Disturbance by heavy machinery and recreational vehicles along streambanks causes damage to the denning habitat of mink (Burns 1964 in Konkel et al. 1980).

For more information on impacts to furbearers see Agricultural Impacts - stream channelization, page 12.

IMPACTS OF LAND USE ACTIVIES

Riparian zones occupy relatively small areas and are vulnerable to severe alteration. Past and continuing degradation of riparian ecosystems has resulted in conditions that are detrimental to fish and wildlife populations. Native fish and wildlife resources are dependent upon the maintenance of natural conditions. The removal of riparian vegetation, the debasement of both water quality and quantity, and the alteration of stream morphology will reduce fish productivity, resulting in economic losses to the commercial fishery, increase conflicts between sport fishermen and commercial fishermen, reduce sport fishing opportunities, cause a decline in wildlife populations, with a consequent loss of hunting opportunities, effect the loss of other water-associated recreational activities and of aesthetic and economic values. By 1983, approximately $275 billion will have been spent in an effort to clean up the nation's rivers (Warner 1982).

Because many of the state's fish and wildlife species are dependent on riparian areas or use them disproportionately more than other habitat types, and because riparian areas are a major recreational attraction, protection of these areas should be a high priority. "Habitat rehabilitation must never be viewed as a substitute for habitat protection" (Reeves and Roelofs 1982).

To effectively manage and protect riparian ecosystems, development-related impacts to these systems must be understood. The impacts of alternate land uses and related activities (agriculture, grazing, forestry, mining, settlement, oil and gas, roads) should be weighed against the existing values provided by riparian systems. By understanding the habitat needs of fish and wildlife and the impacts from development, management guidelines for a particular land use can be implemented that will allow development to occur in a location and manner having minimal effects on the existing natural resources. We must, however, be aware of the fact that an accumulation of relatively small impacts can severely weaken the ecological integrity of natural systems through interacting and cumulative effects (Karr and Dudley 1981).

The best management practice to protect riparian ecosystems is to leave a buffer strip of natural vegetation along or around a waterbody. This buffer strip should be retained in public ownership and be of sufficient width to protect water quality, and quantity, provide terrestrial habitat, including food and cover to a high diversity of wildlife species, and provide a variety of recreational and subsistence opportunities without causing conflicts among user groups.

Agriculture

The effects of agricultural development in Alaska are expected to be similar to those of other activities causing large-scale changes in vegetation and land use, e.g. timber harvest, residential development, mining, and oil and gas development. The same attributes, nutrients, soils, and water that make riparian lands productive for wildlife are also attractive to agriculture. As with many other developmental activities, the impacts of agriculture on riparian systems are often complex and subtle. The direct loss of wildlife habitat from large-scale land clearing is perhaps the most obvious impact. The impacts to the aquatic system, which are essentially secondary effects of land clearing, are at first much less apparent but have far-reaching consequences. The removal of riparian vegetation modifies stream flow rates, water temperature, water chemistry, and natural erosion rates. The closer to the stream channel the vegetation is removed, the more pronounced the effect from land clearing (Fig. 2).

Water quality. In the United States, cropland is the greatest single cause (contributor to) of excessive stream sediment (McCorkle and Halver 1982). Cropland yields four times more sediment to public water than any other erosion source (Clark 1977). Aldrich and Johnson (1979) report that in Interior Alaska, removal of ground cover increased erosion 18 times above that on forested lands. Wolf (in Cordone and Kelley 1961) considers siltation created by agricultural practices to be the real cause for the extinction of stocks of Atlantic salmon. The detrimental effects of increased sedimentation to populations of salmonids and the aquatic life of streams has been reviewed by Cordonne and Kelley (1961) and Hall and McKay (1983).

Sediment deposited in stream gravels may be detrimental to the survival of eggs, alevin, and fry. Sediment deposited in the streambed may decrease the permeability of spawning gravels and block the interchange of subsurface and surface waters. Egg, embryo, and fry survival may decrease because of oxygen depletion, fungal infection, and delayed and impaired emergence. Sedimentation may inhibit production of aquatic plants and invertebrate fauna. Eliminating habitat for aquatic insects reduces available food sources to rearing and resident fish.

Water pollution from agriculture is often diffuse (nonpoint) in nature and therefore difficult to identify and control (Clark 1977). Sixty-eight percent of the basins in the United States report water pollution caused by agricultural activities (McCorkle and Halver 1982). The use of fertilizers, insecticides, pesticides, and fungicides adds nutrients and toxic chemicals to the aquatic system. Carcinogens found in the drinking water of New Orleans, which draws its water from the Mississippi River, originated with industrial and agricultural pesticides (Tripp 1979). Feedlots, often located along rivers and streams, have for many years introduced untreated animal wastes directly into surface waters (Clark 1977). Rummel (1982) lists the potential effects of agricultural development on primary water quality in Alaska. These include

- changes in temperature;
- increased suspended load;
- increased sedimentation;
- decreased light transmission;
- changes in pH;
- decreased concentration of dissolved oxygen;
- increased concentration of specific compounds containing nitrogen and phosphorus (plant nutrients including nitrates);

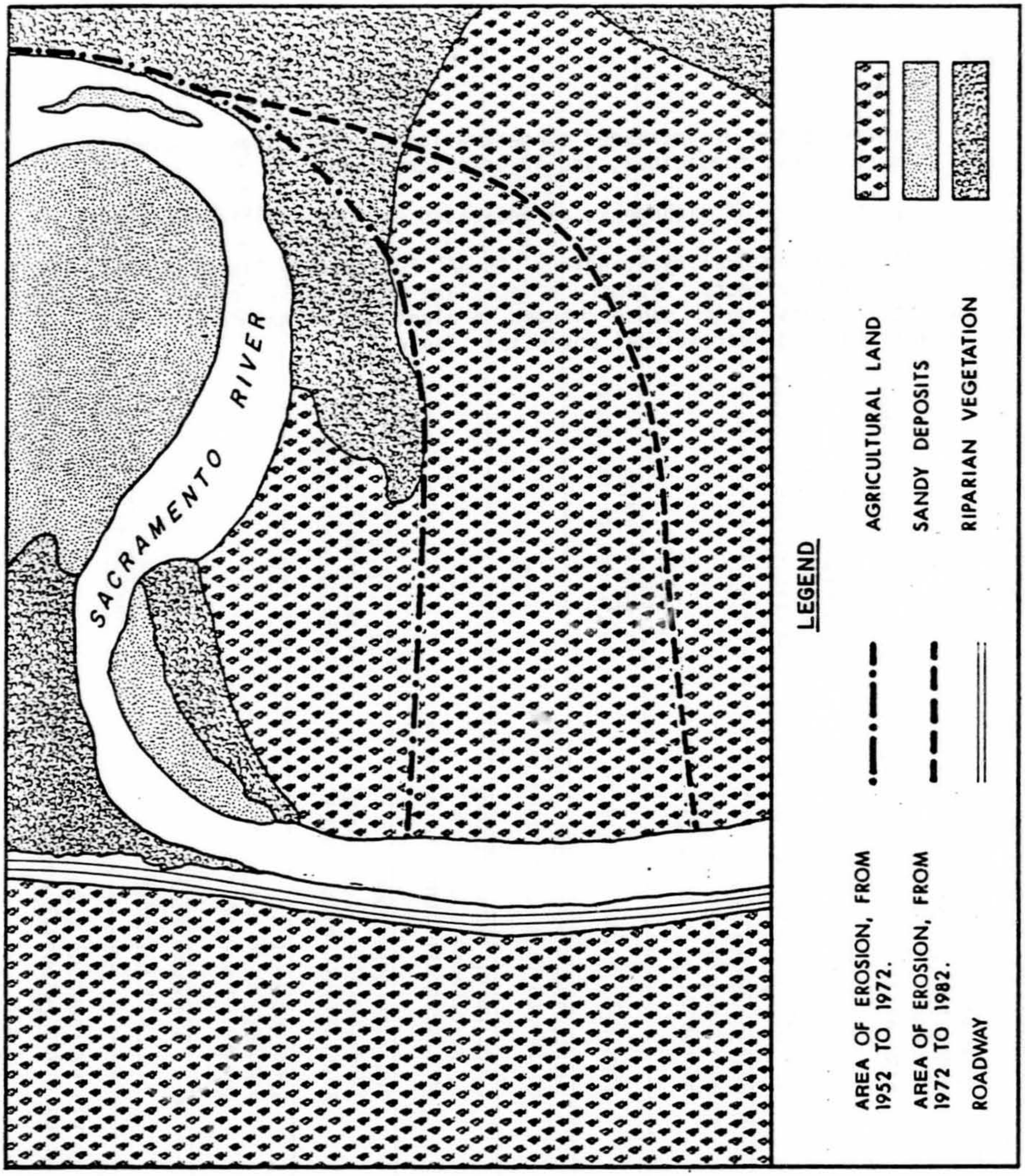


Figure 2. Extent of soil erosion from conversion of riparian forests to agriculture along the Sacramento River, California from 1952 to 1982. From McGill, 1975 and McGill (pers comm) 1983.

- introduction or increased concentration of pesticides, including herbicides, fungicides, and insecticides; and

- propagation of pathogens, as indicated by fecal coliform bacteria.

The Alaska Water Quality Standards (18 AAC 70) specify limits for primary water quality effects. Primary effects are responsible for secondary water quality effects, which cause changes in plant and animal communities, potability, and recreational potential (Table 2).

TABLE 2. Potential Primary and Secondary Water Quality Effects Resulting from Agricultural Practices in Alaska (adapted from Rummel 1982)

Primary Effects	Secondary Effects		
	Plant & Animal Communities	Drinking Water Supply	Recreational Potential
CHANGES IN TEMPERATURE	increased biological production to a limit; then decrease	--	warmer surface waters in summer
INCREASED SUSPENDED LOAD	interference with benthic invertebrates (fish food) and fish development	interference with water supply requiring filtration	--
INCREASED SEDIMENTATION	decreased reproductive success of anadromous fish from clogging of spawning beds	--	--
DECREASED LIGHT TRANSMISSION	decreased primary production; interference with food finding	--	muddy appearance of surface waters
CHANGES IN pH	some physiological effects	may require treatment of supply water	--
DECREASED DISSOLVED OXYGEN	decreased fish production; decreased growth in fish developmental stages	--	--
INCREASED NITROGEN AND PHOSPHORUS	increased growth of nuisance plants	contamination of water supplies from nitrates and nitrites	--
INCREASED CONCENTRATIONS OF PESTICIDES	wide variety of effects; from changes in behavior of aquatic organisms to developmental defects to death	contamination of water supplies	--
PATHOGENS	propagation of disease	propagation of disease	propagation of disease

Water quantity. Converting riparian forests to cropland or pasturelands leaves comparatively little vegetation or ground cover to intercept rainfall or retard surface runoff. Consequently, after rain or during snowmelt, floods will be more frequent and larger. As surface runoff increases, the relative amount of water that reaches underground reservoirs decreases. During low flows, streams are largely supplied with water from these subsurface resources. In addition, ground water modifies water temperature extremes, reducing ice thickness in winter and maintaining cooler temperatures in summer. Gosselink et al. (in McCorkle and Halver 1982) estimate that riparian forests of the Mississippi River alluvial floodplain historically had the capacity to store a volume of water equivalent to 60 days of river discharge. With land clearing, river channeling, and construction of levees this capacity has been reduced to 12 days. River stages are now higher for a given discharge during floods and lower during low water periods. Larger channels created during periods of high flow have an insufficient volume of water to fill the channel during low flows.

Agriculture is the largest single user of water in the United States. In the 17 western states, irrigation accounts for about 90% of freshwater use (McCorkle and Halver 1982). Withdrawals of water, whether directly from lakes and streams or indirectly from groundwater sources, will compound the problems previously discussed. Impacts will be greatest on small streams and lakes. Pumping ground water for crop irrigation has resulted in some streams losing their value for trout fishing (White, Hunter, in McCorkle and Halver 1982). The largest cause of losses of anadromous and resident fish in western streams is from lowered stream flows due to diversion of water for irrigation (National Wetland Newsletter 1982).

Stream channelization, impoundments, and dikes often accompany agricultural development. Following flood protection, farmers often remove riparian vegetation to plant more crops. Construction of flood control works and dams along California's Sacramento River System in the past 50 years has contributed significantly to the loss of riparian forests, and the number of king salmon spawning in the upper river has decreased by 50% (Burns 1978). The major consequences to aquatic systems from channelization include loss of spawning substrate, removal of instream cover, loss of instream vegetation, loss of streamside vegetation, loss of run-riffle-pool sequences, loss of overall stream length, increased gradient and velocity, draining of adjacent lands, physical and chemical changes in the stream, and decreased detrital input (Simpson et. al. 1982).

Stream channelization and its secondary effects decrease wildlife productivity and reduce populations appreciably. Alteration of streambanks is probably the most significant change affecting furbearers (Table 3). Gray and Arner (in Simpson et. al. 1982) found mink, beaver, and muskrat were all far more abundant along unchannelized stream segments than in channelized areas. After the Kissimmee River in Florida was channelized, the average duck harvest per day decreased from 374 to 50 (Montalbano, in Simpson et. al. 1982). Conversion of riparian vegetation to croplands will eliminate food and cover for moose in important wintering grounds, increase their susceptibility to predators, and eliminate travel lanes. Depredation by moose on agricultural crops may occur. Many of the major negative impacts to wildlife from agriculture, including loss of food and cover, wildlife depredation on crops or livestock, effects of agricultural chemicals on wildlife, and transmission of disease between domestic animals and livestock (Preston 1982), can be expected to be more pronounced in riparian areas because of the higher abundance and diversity of wildlife populations.

TABLE 3. Impacts on Furbearers Resulting from Stream Channelization Projects (from Singleton et al. 1982)

Effect of Channelization	Impact on Furbearers
Loss of woody vegetation (reduced diversity)	- Loss of bank cover - Reduction of roots and "nooks and crannies" for foraging - Decreases furbearer abundance
Bank composition and configuration	- Reduces available bank for foraging - Slope or sand and gravel deposition reduces den sites
Low water levels	- Underwater dens excluded
Reduction of channel snags and debris	- Reduces foraging areas
Reduction or loss of aquatic organisms	- Reduction or loss of food items

To reduce impacts from agricultural activities, setbacks or buffer zones should be required along all water courses to separate tilled land from waterbodies by a vegetated buffer area of specified width. A basic management goal should be that the higher the degree of development, the greater the vegetated buffer provided along water courses (Clark 1977). Depending on the amount of development within a watershed, additional buffer widths must be provided to offset the progressive effects of surface runoff associated with increasing development. Buffer widths required to remove contaminants and sediments from overland flows vary with soil characteristics, slope, climate, time of harvest, amount of cultivated area, type of farm operation, and type of vegetation in the buffer zone. Standard buffer strips for Maine's coastal zone vary between 50 and 110 feet, depending on slope (Table 4).

TABLE 4. Suggested Buffer Strip Widths to Control Sedimentation from Agricultural Practices for the Coastline of Maine (from Clark 1977)

Average Slope of Land Between Tilled Land & Normal High Water Mark (%)	Width of Strip Between Tilled Land & Normal High Water Mark [ft (m) along surface of ground]
0 - 4	50 (15)
5 - 9	70 (21)
10 - 14	90 (27)
15 and over	110 (34)

These are designed solely for purposes of sediment control. Guidelines for buffer zones developed for the United States Agricultural Research Service (Table 5) are also primarily for sediment control.

TABLE 5. Minimum Filter Strips for Cropland Water Quality Restoration Recommended to the U.S. Agricultural Research Service (from Clark 1977)

Slope (%)	Slight Erosion [ft (m)]	Moderate Erosion [ft (m)]	Severe Erosion [ft (m)]
0	30 (9)	35 (11)	45 (12)
10	55 (17)	65 (20)	80 (24)
20	80 (24)	95 (29)	115 (35)
30	105 (32)	125 (38)	150 (46)

Additional widths are required to provide for removal of nitrate and other agricultural chemicals. The minimum effective stream setback for nitrate removal covering most soil, slope, and vegetative conditions is 300 feet (91 meters) (Clark 1977).

Thompson et al. (1979) found that in a 118-foot (36 meters) buffer zone, nearly all of the manure-contributed nutrients present in runoff at the source were removed before reaching the stream. However, the quality and quantity of runoff is dependent upon the season of application, weather conditions, soil, and the amount of manure applied. Manure application in melting snow or just prior to rainfall represents the worst possible case for nutrient outflow.

Buffer strips are not a panacea for sediment control; persistent sediment sources will quickly overwhelm the absorptive capacity of the forest floor when surface pores are clogged by fine sediments (Chamberlin 1982). Buffer strips must also be designed for wind firmness and for providing wildlife habitat, including migration corridors. Therefore, widths recommend for sediment control represent a bare minimum and should be increased substantially to protect both aquatic habitat and terrestrial habitat.

Grazing

Since livestock are attracted to streamsides, overuse of the riparian zone by domestic livestock has often resulted in widespread stream degradation. In the western United States, livestock grazing is the single most important factor limiting wildlife and fisheries production (Platts 1979). Grazing has severely reduced riparian vegetation and altered stream geomorphology, adversely affecting fish and wildlife population. Behnke and Zarn (1976) identify livestock grazing as one of the principle factors contributing to the decline of native trout in the west. There are presently no range management techniques or guidelines short of fencing that can protect riparian vegetation from overgrazing by domestic livestock (Behnke and Raleigh 1978, Meehan and Platts 1978, Moore et al. 1979).

The consequences to fish habitat of changes, reductions, or elimination of riparian vegetation include the reduction of shade and cover, with subsequent increases in stream temperature, changes in stream morphology, and the addition of sediments through bank and off-site soil erosion. Stream-channel sedimentation caused by soil erosion on rangelands has long been recognized as a major problem.

Disturbance of ground cover and soil by livestock trampling has long been recognized as an important factor contributing to accelerated erosion and storm runoff in western forests and rangelands (Moore et al. 1979).

The sloughing and collapse of streambanks caused by improper livestock grazing is probably the greatest impact livestock has on fish populations (Platts 1981). This results in changes in stream morphology, including wider and shallower stream channels and the loss of undercut banks.

Other effects resulting from improper livestock grazing in riparian zones include decreased terrestrial food inputs because of loss of riparian vegetation, lowering of the water table, lack of regeneration of native trees and shrubs, loss of instream cover, and a reduction in fish populations (Behnke and Raleigh 1978, Platts 1981, Haugen and Duff 1982).

Interactions between wildlife and livestock, which may occur regardless of habitat, can be expected to have more pronounced effects in riparian lands because of the attraction of greater numbers of both wildlife and livestock. As determined from a literature review of over 1,200 references and conversations with biologists, Preston (1982) found loss of habitat, elimination of predators by livestock owners, disease transmission from domestic animals to wildlife, and competition for forage to be among the major impacts of grazing. Moose winter range could be severely affected by livestock grazing. In northeast Colorado, Crouch (1982) found significantly greater numbers of all game species in ungrazed bottomlands versus grazed bottomlands.

Settlement

Rivers, streams, and lakes are highly favorable areas for human settlement and frequently provide focal points for community aesthetics, recreation, commerce, and amenities. Nearly all phases of development in riparian areas, including residential developments, roads, airports, and commercial buildings, will affect river, stream, and lake habitat. The presence of native vegetation and the flow of water from the land are the primary factors controlling the condition of riparian ecosystems. Activities that degrade or remove vegetation also degrade the aquatic environment. Ultimately, not only does the local community environment suffer, but so does the environmental quality of downstream communities.

Poorly planned development will result in stream sedimentation. Erosion and run off from parking lots, housing developments, roads, and construction sites, and the use of natural drainages for storm sewers, dumping areas, and gravel extraction often produce high sediment loads. This degrades the capacity of freshwater habitats to support aquatic life. An appropriate level of soil erosion should, in most cases, be in the range of 0-3 tons/acre/year. Housing projects and other developments can produce up to 1,000 tons/acre/year (Johnson 1979).

Excessive nutrient input resulting from domestic sewage and soil erosion may produce large amounts of algae or bacteria in lake and streams. As algae decomposes, it decreases dissolved oxygen levels, promotes growth of bacteria, makes the waterbody less aesthetic, and reduces water quality.

Nutrient input is especially critical in floodplains, where wastes percolate rapidly into stream and groundwater. Public sewer systems often eliminate waste discharge; these are very expensive, however, and often increase the market value of land, offering strong economic incentives for land owners to sell. This often results in more development, thus increasing environmental problems in the long run (Palmer 1981).

Appropriations of water for domestic or industrial use often lower the capacity of freshwater bodies to support fish and wildlife populations. In addition, domestic water sources can become degraded when surface water stagnates and groundwater aquifers are depleted as a result of water withdrawals.

Increased settlement and development along floodplains brings increasing demands for flood control. As natural land surfaces are paved and developed, flood peaks increase and often arrive sooner after storm onset than under pre-developmental conditions (Anderson, in Platt and McMullen 1979). Impoundments, diversion structures, or stream channelization are often the solution. However, these reduce the productivity of both the terrestrial and aquatic system by eliminating habitat, and they encourage further settlement in the floodplain, destroying more wildlife habitat, blocking wildlife migration routes, and creating visual and noise disturbances to wildlife.

Encroachment upon floodplains in the belief they are "protected" sets the stage for heavy losses when floods exceeding the design capacity of flood control structures occur. Additionally, increased development in the floodplain diminishes its value as a natural water storage area, further increasing the magnitude of flood peaks and reducing baseflow water levels in rivers and streams.

The fragmentation of authority in floodplains when land is transferred to multiple owners makes integrated management difficult. Conflicts arise between public users and private landowners and between upstream development and downstream development. Fragmentation of landownership patterns along a river poses some of the most perplexing and least studied issues in floodplain management (Platt and McMullen 1979). Rapid conversion of rural lands to subdivisions has created problems for local governments that have only limited experience with large developments (Palmer 1981). The piecemeal evolution of year-round housing is hard to predict. Through a slow process of single lot development, the amount of building and settlement can become substantial, with impacts on water quality or wildlife habitat that were never expected initially.

Municipalities along the St. Croix River of Wisconsin and Minnesota require all new structures be set-back 200 feet from the normal high water mark. Additionally, no construction of buildings or alterations on slopes greater than 13% is allowed; no buildings are allowed in the 100-year floodplain, and buildings must be set-back 100 feet from bluff lines at the top of steep hills.

Because studies have shown unacceptable amounts of nitrate at distances of 150 feet from septic tank systems (Ketelle, Minear, and Patterson, in Clark 1977), a setback of at least 150 feet from the annual high water mark is required to minimize nitrate pollution. A setback of 300 feet should be required whenever possible because local soil and groundwater conditions may be unsuitable for nitrate removal (Clark 1977). Maine and Wisconsin require the absorption fields of septic tanks to be setback a minimum of 100 feet from surface waters. This allows for the removal of coliform bacteria and other waterborne pathogenic organisms from wastewater. Adequate soil purification removes organisms before they can reach and contaminate adjacent waterbodies.

Forestry

Timber harvest operations cause changes in water and land system processes, which in turn lead to changes in anadromous fish habitat (Chamberlin 1982) and terrestrial wildlife habitat (Tubbs 1980). The closer logging is to the riparian zone, the more severe the erosional impacts and the greater the danger of reducing water quality in the adjacent aquatic zones (Thomas et al. 1979).

Chamberlin's (1982) detailed review of how timber harvesting affects the aquatic habitat was used as a source document for much of this discussion. Gibbons and Salo (1973) have prepared an annotated bibliography with 278 references on the effects of logging on fish of the western United States and Canada.

Loss of vegetation and alterations in terrestrial habitat are a direct result of logging. The magnitude of these habitat changes to terrestrial wildlife depends on the extent and techniques of the logging operation. Habitat alterations can effect changes in bird populations in riparian communities (Stauffer and Best 1980, Tubbs 1980). Cavity-nesters and raptors are especially vulnerable to mature tree or snag removal. Beidelman (in Tubbs 1980) reported a four-fold decrease in spring species and a three-fold decrease in wintering birds in a highly productive eastern Colorado cottonwood-willow riparian community that was logged. Losses of thermal cover, hiding cover, and access to forage areas used by a variety of birds and mammals can result from logging practices (Thomas et al. 1979).

Alteration of vegetation in turn leads to changes in the aquatic system. Forestry, like other land-clearing processes, may substantially change

1) the distribution of water and snow on the ground; 2) the amount of water intercepted, transpired, or evaporated by foliage; 3) the rate of snowmelt; 4) the amount of water that can be stored in the soil or transpired from the soil by vegetation; and 5) the physical structure of the soil, which governs the rate and pathways of water movement to stream channels. Clearcutting can cause storm flow discharges of nine times those of undisturbed watersheds (Fig. 3) (Clark 1977). Impacts to the aquatic system include 1) introduction of surplus organic debris into streams; 2) acceleration of erosion and stream sedimentation; and 3) stream channel modifications.

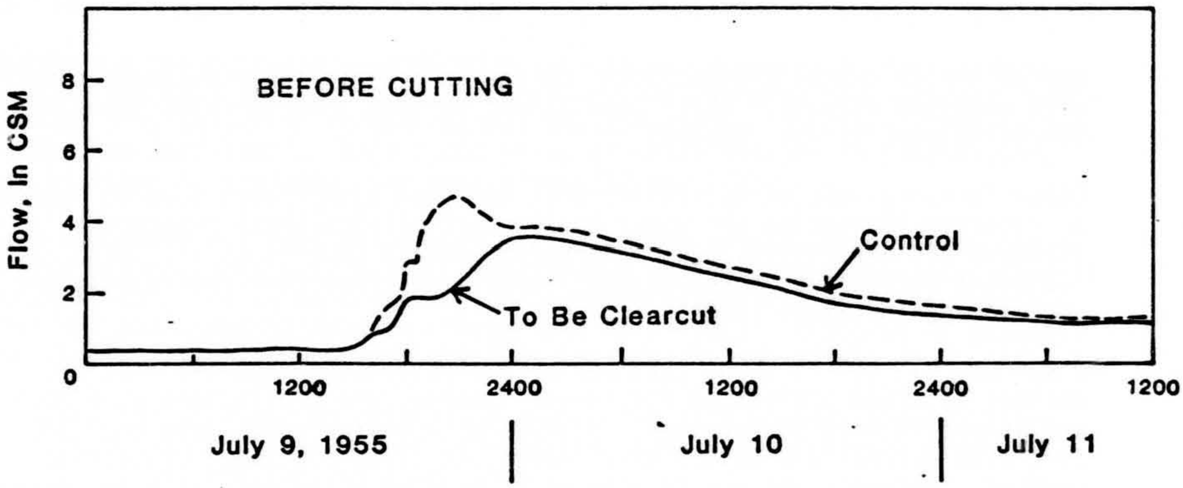
Increased erosion and sedimentation in streams often results from timber harvests (Swanson and Dyrness 1975). The majority of severe sediment problems are related to road systems, especially where roads cross stream channels (Yee and Roelofs 1980). However, removing tree cover on steep slopes reduces slope stability and may accelerate the movement of soil and excess sediment to the stream.

Tree cutting adjacent to streams has the potential for introducing large amounts of debris. On steep slopes, residual debris can still be transported to main channels years later. Although stable debris contributes to channel stability and habitat variability for both fish and wildlife, excessive amounts impede fish and wildlife movements and in streams may reduce dissolved oxygen levels if fine organic particles accumulate in stream bottoms (Hall and Lantz 1969). Logging and skidding near or across small streams covered by snow or ice are particularly likely to result in fine debris accumulation because operators may be unaware of the stream's location. Debris accumulation also impedes fishing access and generally reduces recreational opportunities in a river. Buffers of vegetation between skid trails and streambanks are necessary to minimize sediment and organic debris accumulation in stream channels (Chamberlin 1982).

Of all riparian ecosystem components, streambanks and stream margins are the most susceptible to direct influences from logging activities. The breakdown and destruction of streambanks by felling and yarding are among the most persistent of direct harvesting impacts, and they are the most difficult to avoid when streamside felling or skidding and cross-stream logging occur (Chamberlin 1982). Tree falling and yarding along streambanks may reduce bank stability, eliminate streamside cover, cause streambank erosion, increase sedimentation, and widen channels. Avoiding logging activities in streamside areas is frequently the only alternative to bank destruction (Chamberlin 1982).

The principal water quality parameters influenced by forest harvesting are temperature, suspended sediment, dissolved oxygen, and nutrients. Removal of streamside vegetation usually increases summer water temperatures and decreases winter temperatures. The effects of temperature change are discussed on page 3.

Erman et al. (1977) reported that the changes to aquatic invertebrate populations in logged streams are similar to changes found in streams affected by sewage effluents, thermal discharge, and run-off from agricultural activities. Logging along streams without leaving vegetated



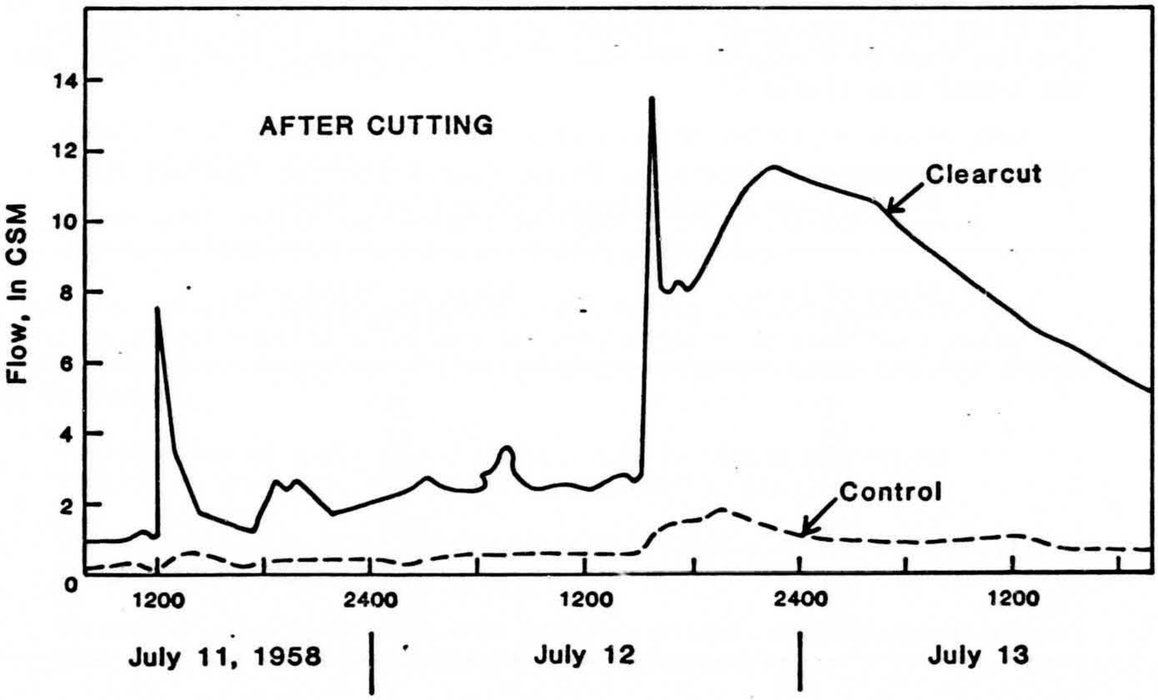


Figure 3. Sample storm hydrographs of clearcut and control watersheds before and after treatment. (Reinhart, Escher and Trimble 1963, in Clark 1977)

CSM = Cubic foot per second per square mile

buffer strips caused a significant change in benthic invertebrates, compared with unlogged streams. While populations of some invertebrates increased, overall diversity was reduced.

Other forestry-related activities that can have significant adverse impacts on riparian vegetation and water quality are silvicultural treatments (Everest and Harr 1982); use of forest chemicals (Norris et al. 1983), including herbicides, insecticides, fertilizers, and fire retardants; and log storage (Schmiege 1980).

Erman et. al. (1977) found that buffer strips greater than 100 feet (30 meters) afforded protection for stream invertebrate populations at a level equivalent to unlogged streams. Streams with buffer zones less than 100 feet wide generally show the same impacts as streams without protective buffers, including changes in population abundance and reduction in species diversity.

The dimensions of a buffer strip depend on slope, wind exposure, rainfall, type of vegetation, location, and type of timber harvest. Trimble and Sartz (in Clark 1977) recommend a minimum buffer strip of 25 feet (7.6 meters) plus two feet (0.6 meters) for each 1% of slope between surface water and the logged area (Table 6).

TABLE 6. Recommended Widths for Filter (Buffer) Strips (Derived for Higher-slope Harvest Areas) (from Clark 1977).

Slope of Land (%)	Width of Filtration Strip (ft)
0	25
10	45
20	65
30	85
40	105
50	125
60	145
70	165

The United States Forest Service suggests the following formula for determining ideal buffer width: width = 4 feet (1.2 meters) X (percent slope) + 50 feet (15.2 meters) (United States Environmental Protection Agency in Clark 1977). Generally, if the terrain is steep, the potential for erosion moderate to severe, and large-scale clear cutting is to be used, the buffer strip must be substantially wider than the recommended minimum (Clark 1977). On the Delaware River, no logging is allowed within 100 feet without a permit (Palmer 1981).

Mining

Mining can cause severe pollution of aquatic environments by increasing bedload sediment and turbidity, changing pH, discharging heavy metals, and causing alterations in stream channel and streamflow (Martin and Platts 1981 Haugen and Duff 1982). Over 2,000 miles of major streams in Pennsylvania are polluted by drainage from coal mines (Palmer 1981).

Although there are many methods of mining (strip mining, open pit mining, dredge mining, hydraulic mining, underground mining), mining-related impacts in riparian wildlife habitats and the aquatic system can be divided into physical and chemical impacts (Haugen and Duff 1982). Examples of physical impacts resulting from mine operations include the following:

- Removal of riparian vegetation associated with stream channelization, road construction, culvert and bridge installation, direct mining activity, and tailing deposition.
- Increased rates of stream sedimentation resulting from vegetation removal, road and mine construction, tailing deposition, stream channelization and dredging, and erosion of overburden.
- Flooding of riparian areas for the construction of tailing pond or water storage reservoirs.
- Reduction of stream flows associated with decreases in ground water level or water diversions.
- Entrainment and/or impingement of aquatic organisms due to water diversion facilities and dredge mining activities.

Chemically related impacts associated with mining and related activities generally affect aquatic organisms directly without necessarily harming physical habitat. Examples of chemical degradation of water quality include the following:

- Introduction of toxic materials utilized in mining operations (petroleum products, flocculants, dispersants, etc.).
- Thermal shocks to aquatic organisms associated with the release of processing water.
- Release of acid mine waste into aquatic systems, thereby resulting in precipitation of ferric hydroxide and heavy metals.
- Reduction in dissolved oxygen from organic enrichment and increases in water temperature.
- Increased turbidity and suspended solids due to removal of ground cover.

To date, most of the mining impacts in Alaska have been from placer mining or gravel removal from floodplains. Habitat alterations include removal of riparian vegetation, processing of stream gravels, channelization, channel diversion, road construction in streams, high turbidity and sedimentation, litter, and barriers to fish movement. Placer mining adversely altered large areas of riparian vegetation and aquatic habitat in the Kantishna Hills area (Meyer and Kavanagh 1983). Singleton et al. (1978) cite low soil moisture-holding capacity, due to loss of soil fines during mining, and unfavorable post-mining topography as being responsible for slow revegetation following mining. Zemansky et al. (1976) provide numerous references indicating that increased total settleable solids and turbidity resulting from mining operations cause direct adverse effects on fish, including effects on fish reproduction and food supplies, and a reduction in fish populations. Heavy metals that are damaging to fish, including cadmium, chromium, arsenic, and selenium and sulfates are released into the aquatic system by placer mining (Metsker 1982).

The Alaska Department of Fish and Game (1982b) found that an increase in placer mining activity resulted in a reduction of recreational fishing.

Habitat alterations from gravel mining operations in flood plains are well documented, including resultant impacts to river hydrology, the aquatic biota, terrestrial biota, and water quality (Woodward - Clyde Consultants 1980).

Oil and Gas

Starr et al. (1981) review the impacts on fish and wildlife habitats from all phases of oil and gas development activities.

Impacts to wildlife habitat are associated with 1) any activity that removes, scars, or covers the surface vegetation and which, in turn, leads to increased erosion, permafrost degradation, or drainage changes; 2) oil well blowouts, spills, leakage, or release of other toxic materials capable of killing or damaging vegetation; 3) any activity that will increase the frequency or intensity of fires, such as a burning oil or gas well blowout; 4) degradation of the quality of land surface or water bodies by the disposal of solid or liquid wastes; 5) the creation of physical barriers, such as roads, pipelines, or other facilities, that separate large tracts of previously continuous wildlife habitat and that may lead to differential use of habitats by wildlife; and 6) any activity, such as gravel or sand borrowing or water withdrawal, that will result in the lowering of habitat quality for aquatic invertebrates, fish, waterfowl, and non-game birds and mammals. While many of these activities are not confined to riparian ecosystems, their occurrence in such areas will cause impacts of equal or greater intensity than in other habitats because of the high biological diversity and sensitivity of riparian zones.

Principal impacts to aquatic populations may occur from 1) blockages of fish passage (including those caused by pipeline or road crossings of waterways or accumulation of debris); 2) fish entrapment in borrow pits or reservoirs connected to waterways only during periods of high water; 3) channel, bottom, or current changes; 4) any activity that lowers the physical, chemical, or biological quality and, hence, the carrying capacity of the aquatic habitat (for example, oil spills, waste disposal, excessive winter water withdrawals, or siltation); 5) seismic operations through ice or adjacent to water bodies; and 6) increased harvest of fish and game due to increased access through new roads and airfields, higher incomes, and increased human presence.

In Texas alone, 23,000 cases of ground and surface water contamination caused by petroleum activity have been reported (Council on Environmental Quality 1980).

The effects on riparian fish and wildlife habitat from oil and gas operations and secondary developments (e.g., alterations to water quantity, water quality, and vegetation) are generally similar to other development-related activities discussed in this paper.

Road Construction

Road construction in riparian zones will reduce habitat suitability for many species, and probably has more critical and long-lasting impacts on riparian zones than any other activity (Thomas et al. 1981). Roads and their construction cause major increases in sedimentation to streams, remove riparian vegetation, alter stream channels (Haugen and Duff 1982), act as physical barriers to the movement of juvenile and adult fish, and increase human access to previously remote and isolated areas (Yee and Roelofs 1980). Burns (1972) observed a water temperature increase of 20°F (9°c) following riparian canopy removal during road construction. Gibbons and Salo (1973) concluded that during timber harvesting, forest roads are the primary initiator of erosion caused by human activities. Yee and Roelofs (1980) state that "poor culvert design and location can still be ranked among the most devastating problems for fish habitat in western forests." Road culverts can be barriers to migration, usually because of outfall barriers, excessive water velocity in the culvert, insufficient water in the culvert, lack of resting pools below culverts, or a combination of these conditions (Elliot 1982, Yee and Roelofs 1980).

Roads result in a direct loss of habitat and increased disturbance to wildlife from traffic (Thomas et al. 1981). Roads placed through major moose migration routes or wintering areas will result in wildlife fatalities from automobile collisions. Habitat use by deer and elk is adversely influenced by the presence of roads open to vehicular traffic. Effects are markedly influenced by type of road, location, and amount of use. Researchers have reported decreased use of areas adjacent to roads for distances ranging from .25 to .50 miles (.4 to .8 km) (Perry and Overly; Ward, in Thomas et al. 1979).

Little research has been done on the possible toxic effects of surface and subsurface runoff from oiled and chemically treated roadways. The potential exists for development of localized water quality problems that could affect fish and aquatic habitats.

Natural Hazards

Flooding. Flooding is a natural phenomenon occurring along rivers and streams. It is an important component in determining the nature of the riparian vegetation and other biological aspects of the stream and its floodplain. Land use management programs need to acknowledge the benefits and values of undisturbed floodplains, recognize the hazards of locating developments in floodplains, and realize that encroachments, obstructions, or alterations of floodways can reduce their floodwater carrying capacity, resulting in increased flood heights, velocities, and frequencies (French and Burby 1980). Building on floodplains increases flood damage for both private property owners and the taxpayers who pay for disaster assistance, flood control projects, and subsidized flood insurance.

Flooding of urbanized areas is currently the most widespread natural hazard in the United States. Flooding causes public and private property damage of $1.5 to $2 billion annually (French and Burby 1980). Federal and non-federal expenditures to reduce urban flood damage during fiscal year 1974 were $954.7 million (Goddard 1979).

In contrast to the major floods of the 1930's, an increasing proportion of flood losses today are caused by flash flooding along seemingly insignificant streams and creeks (Platt and McMullen 1979). Changes in flood patterns can be attributed to changing land use practice.

In Alaska, flood losses to public and private property will increase unless steps are taken to minimize development in floodplains. Miller (1982) reports on flood damage in Alaska. Throughout the summer of 1971, flooding in the Matanuska-Susitna Valley caused almost $6 million in physical damage. Damages to private homes and personal property were approximately $1.4 million. The breakout of Lake George in the Knik River drainage was a near-annual event until 1966. Since then, the Knik Glacier has not advanced to dam the lake, and development has occurred in the floodplain. In 1969 a lake dammed by the Skilak glacier released, causing the Kenai River to rise and fracture river ice. Ice blocked the river channel at Soldotna, causing backwater flooding of roads, homes, and businesses. Again in 1974 and 1977, glacial lake dumping caused flooding along the Kenai River.

In Fairbanks, the 1967 Chena River Flood took six lives and caused damage in excess of $85 million. To mitigate flood hazards, $243 million was spent in federal and state funds to build the Chena River Dam and floodway. Operation and maintenance costs are estimated at $763,000 annually.

By establishing greenbelts (buffer zones) along creeks, Anchorage has increased residential property values while combining protection from flooding with increases in recreational opportunities (Miller 1982).

PUBLIC ATTITUDES AND CONFLICTS

Public Attitudes

The public's view of riparian ecosystem management varies greatly with personal values, perceptions, and according to whether one is a landowner, a resource manager, or a public user. A few studies have attempted to quantify these attitudes in order to improve management of riparian resources and minimize conflicts among landowners and recreationists. Minimizing conflicts has become increasingly important as recreational use of rivers and lakes, especially those near population centers and those with access, has been rapidly increasing. This trend is expected to continue. At the same time, competition for land and water for developmental purposes will increase. Deciding the most appropriate allocations among many special interests will continue to be a topic of heated debate. Any land allocation system must recognize the attitudes and needs of the participants (landowners and public users) and promote cooperation while protecting public resources. Thus, understanding problems and attitudes among user groups and correlating these with ecological values, economics, and the legal system is essential for ensuring good management in the future.

A recent public opinion survey conducted in Alaska by the Dittman Research Corporation (1982) found that 70% of the public respondents strongly or moderately supported the "establishment of recreational waterway and trail corridors to provide hunting, fishing and other recreational opportunities through private land near the urban centers." These same people expressed willingness to "create a fund to purchase access corridors." Sixty-nine percent of the public strongly or moderately supported spending state money to buy private land necessary to establish a recreational waterway or trail corridor system.

In most states, landownership patterns are opposite those in Alaska, with most land in private ownership. Recognizing the need for access, the values of riparian land, and the prohibitive cost of acquisition, the public in these states has favored other alternatives for acquiring riparian lands. In Oklahoma, a public opinion survey on "public attitudes toward stream and streamside (riparian) fish and wildlife habitats" showed that "...large majorities favored enactment of state statutes which would allow protection of minimum stream flows and provide tax incentives to landowners who would agree to manage riparian habitat on their private land" (The Wildlife Society 1982).

In Wisconsin, Roggenbuck and Kushman (1980) found little understanding and support for the protection of riparian ecosystems among riparian landowners. While landowners supported adopting policies to protect the stream channel, they were in disagreement on how or if to protect the river corridor. Landowners with misconceptions outnumbered those who were well informed on policy towards use, development, or other activities on riparian lands adjacent to the river. Problems with recreationists, litter, vandalism, trespass, pollution, and inadequate law enforcement were much greater concerns to property owners than maintaining ecological values, including a decrease in wildlife. Seventeen eastern states identified trespass as the most serious landowner-user conflict along rivers and streams (Countess et. al. 1977). Lack of access results in overuse of a few sites, increasing trespass and litter, and leads to a degradation of the habitat. As a whole, riparian landowners opposed restrictions on development and land use practices (Roggenbuck and Kushman 1980). Only 33% of the private riparian landowners favored easements for regulating riparian use and development, and only 35% favored the state's purchasing land from willing sellers (Table 7). Most property owners identify easements as an unwarranted and unjustified encumbrance on their land (Countess et. al. 1977). Landowners oppose the state purchasing private riparian lands for three main reasons: 1) a fear of an influx of recreationists to the area; 2) a belief that condemnation would result on other lands once the government achieved partial ownership; and 3) a belief that property taxes would increase on remaining private lands (Roggenbuck and Kushman 1980). According to

TABLE 7. Riparian Landowners' Agreement With Alternative Techniques of Wild River Policy Implementation. Adopted from Roggenbuck and Kushman (1980).

Alternative	Agree	Neutral	Disagree
		Percent	
Revised or new laws to lessen present restriction on use and development	40	20	40
Increased participation by local residents in DNR decisions	76	8	16
Written agreements between the DNR and landowners to guide use and development	62	11	27
Tax incentives to encourage landowners to maintain their property in a natural condition	69	12	19
Zoning to guide use and provide protection to river	54	12	34
Easements to guide use and development	33	16	51
State acquisition of land from willing sellers	35	8	57
Condemnation of properties within the 400-foot zone along the rivers	14	5	81

Coughlin and Plaut (1978), however, if public access is required, in addition to achieving conservation objectives, public ownership is necessary as easements will not be sufficient. Not only are the terms of easements very difficult to enforce, but the administrative costs of enforcement over many years may far outweigh the initial cost difference between easement and fee-title purchase (Priesnitz and Harrison 1977). When landowners are willing to sell land for conservation purposes, they appear to prefer selling to private conservation organizations rather than to public agencies (Burns 1978). Landowners fear that public ownership will increase access and recreation, along with trespassing, littering, and vandalism, on nearby private lands.

Curtiss (1977) describes the problems, confusion, and conflicts that arise between and among landowners and public users when river corridors come under multiple ownership. Regulations become complex and often contradictory. The maze of federal, state, and local laws and private property rights leads to overlapping controls, confusion, and conflicts. These widen the dichotomy between user and landowner, and both sides, as well as the resource, bear the consequence. When this occurs, issues arise that must be resolved politically. The concerns of a local constituency and their political support may outweigh the benefits to the public-at-large. In California, a major obstacle to riparian land protection is the riparian landowner (Burns 1978). Protecting agricultural lands from flooding and erosion and protecting private property rights elicits a quick response from elected officials. Flood control projects are implemented that give little consideration to impacts on fish and wildlife populations.

Access Problems in the Matanuska-Susitna Borough

In the Matanuska-Susitna Borough, trespass and congestion around lakes and along streams has become a prevalent problem that continues to worsen. Conflicts arise both between public users (primarily sport fishermen) and private landowners and among public users. The problem is most severe where salmon streams cross the Parks Highway between Willow and Talkeetna and around lakes in the Matanuska Valley. Eastside Susitna River tributaries that cross the Parks Highway support excellent salmon runs and attract large numbers of anglers mostly from Anchorage and the Matanuska Valley. Along Willow Creek, Little Willow Creek, Sheep Creek, Kashwitna River, Goose Creek, Sunshine Creek, and Birch Creek, the only public access is by a state reserved 100-300 foot-wide highway right-of-way or by launching a boat from the highway. All other access is across private lands.

Conflicts result from a combination of increasing human population, changing land ownership patterns, poorly surveyed or marked access, limited or no access to some sites, and absence of clear definitions of the rights and limitations of landowners and the public within access easements. Wherever private property supports good fishing or recreation in the absence of nearby public lands and access, trespass becomes a problem.

When such situations arise, the public loses opportunities to utilize public resources, and enjoyment of recreational activities is greatly reduced. Meanwhile property owners feel their rights have been violated. Many landowners regret having granted easements because of the increases in public use and continued lack of management. Disrespect for both public and private property and lack of environmental awareness on the part of certain recreationists has often created or worsened existing problems.

Lack of public recreational areas near population centers leads to overcrowding at existing sites. Overuse at recreational sites and boat launch areas has resulted in environmental degradation and pollution, sanitation problems, public safety problems, and excessive noise and litter. Continued overuse of sites can result in loss of vegetation and lead to accelerated erosion, habitat degradation, or disruption of fish and wildlife populations.

Past land disposals have not adequately retained public lands that support productive fish and wildlife populations or provide ample access to these resources. In addition, in recreational areas sufficient public lands are needed for recreationists to disperse. The population of Anchorage is currently increasing at a rate of 2,000 residents per month. The state's population is projected to increase by approximately 17 percent in the next 10 years. An increased population with more leisure time will demand more access to and along public and navigable waters. Without proper planning, existing conflicts can only be expected to worsen.

Many examples of these problems can be found in the Matanuska-Susitna Borough. In addition, it often costs the state millions of dollars to rectify problems that were created by poor planning.

At Birch Creek (reached from the Talkeetna Spur road), access to an excellent salmon fishery has been blocked by a landowner who has erected a cyclone fence across the creek and shoreline at the outlet of Fish Lake. The fence blocks access to upstream areas. Conflicts have led to incidences such as smashed car windows. All access to Goose Creek has been denied to the public by a few private landowners. A public resource has become part of a private hunting and fishing club.

Recently, in an attempt to alleviate access problems and overcrowding, the state purchased land on both sides of Montana Creek between the Parks Highway and the Susitna River. The cost was $1.2 million. More purchases are still necessary to ease conflicts on upriver portions, where any public use involves trespass. One landowner attempted to physically block access across neighboring private lands that permitted public access. The landowner attempted to charge people $10.00 per day to park their cars on his land.

The state recently purchased five acres for $25,000 for access to Sheep Creek. While this may help alleviate the problem of reaching the creek, it does not relieve overcrowded conditions at the creek nor permit movement up and down the creek corridor. Both Caswell and Sunshine creeks have trespass and litter problems.

Since 1980, 11 AAC 53.330. has authorized the director of the Department of Natural Resources to reserve a minimum 50-foot easement to provide for public access along inland navigable or public water. "The director shall (also) reserve an easement or right-of-way to provide access to coastal or inland navigable public water in the conveyance of land adjacent to or containing that water... (of) at least 50 feet wide." Without a current status plat it is difficult at best for the public to know when land was disposed of and whether an easement pertains to specific parcels or to all the land in an area. Under 11 AAC 53.350, "the director may require as a condition of any sale, lease, grant or other disposal of State land that the purchaser, lessee or grantee survey, mark or survey and mark public easements..." In addition, 11 AAC 53.340. allows the director to publish a directory of navigable and public waters and of the easements that provide access to and along them.

To further complicate matters, conditions affecting easements on Native lands come under the Alaska Native Claims Settlement Act (ANCSA) and have different stipulations.

The Department of Fish and Game stocks 25 lakes in the Matanuska Valley. All have easements or rights-of-way for access to the lake, but access around the lake and activities allowed in this access zone are open to interpretation.

Both Rocky Lake and Finger Lake are stocked with fish at public expense. Both have public campgrounds. However, anglers without a boat are restricted to the campground area. Better fishing sites around the lake are privately owned. Florence Lake, east of Willow, has a section line easement from the road to the lake. Within this easement, a landowner added a porch onto his house. He then posted no trespassing signs in an attempt to block public access. Prater Lake and Memory Lake in the Matanuska Valley are other examples of lakes where access easements have created landowner conflicts with fishermen.

Because of limited and marginal access at Seymour Lake (Big Meadow Lake), the public is utilizing more than just the right-of-way and is disturbing adjacent landowners. Limited and poorly defined public use areas and lack of management have resulted in litter, noise, unattended fires, and tree-cutting on public and private lands.

The seven lakes in the Keppler-Bradley Lake complex near Palmer are all stocked. Because of public demand for recreational sites, the state spent $3 million to purchase land once held in the public domain. The main entrance to the area is still controlled by a private landowner who has entered into an agreement with the state to allow access.

As a result of various federal and state land disposal programs over the years, much of the land along the Parks Highway and in the Matanuska Valley was transferred to private interests, particularly through homesteading programs. After gaining title to the land, many landowners moved elsewhere or sold their land, often having it subdivided. In the past, with fewer fishermen and either absentee or consenting landowners, access to lakes and streams was not as significant a problem as it is today. Over the years, the population has increased, people have acquired more leisure time, and landownership patterns have changed. Gaining access and avoiding conflicts while traversing several parcels of private land becomes more difficult than crossing only one parcel. Many landowners are reluctant to grant access when it involves many individuals rather than a few, especially now that more of the land is developed for private housing. However, because historically access was available many recreationists continue to use land unaware or in spite of trespass violations.

LOSS OF RIPARIAN ECOSYSTEMS

The conversion of floodplain forests to alternate land uses has been responsible for making riparian ecosystems among the most severely altered land forms in the nation. In the contiguous 48 states, over 70% of the estimated original coverage of riparian ecosystems has been altered or eliminated. As of 1981, riparian communities comprised less than 2% of the total land area in the 48 states (Brinson et al. 1981).

The alteration and destruction of riparian ecosystems on a national level has been gradual but steady. Historically, elimination of riparian lands has essentially followed a consistent pattern, and the extent of riparian vegetation has been reduced by a substantial amount in every region of the country. The same qualities that are attractive and productive for vegetation and wildlife also attract human development. Impacts from water development, agriculture, grazing, settlement, and forestry have been the primary forces responsible both directly and indirectly for the loss of this valuable habitat. With this loss goes a decrease in fish and wildlife populations and a loss of recreational opportunities.

Riverine bottomlands were frequently the first areas homesteaded by newly arrived settlers. Rivers and their fertile valleys provided abundant fish, game, furs, and other easily harvested natural resources needed by early inhabitants. Rivers also served as transportation corridors, and water power was easily converted to an energy source. The same fertile soils and abundant water that supported diverse vegetation and wildlife also proved to support rich agricultural development. As development continued, more land was cleared, and greater demands were made on riparian resources. Growing human populations increased demands for transportation, economic development, homesites, water supplies for domestic, industrial, and agricultural development, as well as flood protection for homes and crops. While vegetation and wildlife are adaptable and resilient to many of the unpredictable forces of nature, human developments generally are not. Various combinations of dams, dikes, levees, drainage ditches, water diversions, alterations, and stream channeling were used to accomplish protective goals. These alterations lead to secondary losses of habitat. With improved protection from the natural forces of the river, human populations increased and placed more demands upon the riparian land. More land was cleared of native vegetation and converted to alternate uses. The cumulative impacts of increasing populations, continuous development, land use changes, and the resulting loss of vegetation and modification of hydrologic regimes have numerous adverse effects on fish and wildlife. Where modification of habitat has been most severe, certain species have become scarce. Of the 276 species of plants and animals listed as threatened or endangered by the U.S. Fish and Wildlife Service, 80 are directly or indirectly dependent on riparian ecosystems (Brinson et al. 1981).

Although the amount of riparian vegetation present before the arrival of Europeans to North America and the amount remaining today are often difficult to assess, there are many examples to indicate the startling loss that has taken place in many parts of the country.

In the 1850's along the floodplain of the Sacramento River, California's largest river, there existed an estimated 775,000 acres of riparian forests. By 1952, 27,000 acres remained, and by 1972 there were less than 18,000 acres of riparian forests along the river (Sands 1978). Of the state's remaining riparian lands, between 60 and 90% is privately owned (Warner

1982). As urban development and streambank erosion claim prime agricultural land, (Figure 2) additional riparian forests must be cleared for conversion to agricultural production.

Riparian vegetation along the Colorado River has been cleared at a rate of about 3,000 acres per year. Additionally, water management practices and overgrazing have encouraged the replacement of native plant species by introduced exotic species that provide poorer wildlife habitat (Anderson et al. 1978).

According to David E. Morine, Director of Land Aquisition for the Nature Conservancy:

> When originally acquired, the Louisiana territory contained over 50 million acres of bottomland (riparian) hardwoods. Currently there are less than 3.5 million acres left in America (48 contiguous states) and these are being destroyed at a rate of 300,000 acres per year. Seven out of every eight acres of bottomland forest has been drained and cleared.

For the Mississippi River floodplain, the rate of clearing has averaged about 2% per year over the past 20 years (Brinson et al. 1981). A study published by the U.S. Fish and Wildlife Service estimates that since 1937 over 6.6 million acres of bottomland hardwood in the Mississippi River delta have been cleared and converted to soybean production. The report estimates that by 1985, 86% of the original bottomland forests will be destroyed. Of the remaining bottomland forests in this region, only 700,000 acres are in public ownership (National Wetland Newsletter 1982). As with Alaska's riparian lands, those in the southeast United States support an abundance of fish and wildlife and provide excellent hunting, fishing, and recreational opportunities. This tremendous loss of habitat has occurred in a region where a larger proportion of the people hunt and fish than any other portion of the country and the commercial and sport fishing enterprise constitute a multi-billion dollar industry (National Wetland Newsletter 1982).

As previously mentioned, several factors have combined to severely alter or eliminate riparian forests in the lower 48 states. Most of these habitat losses have come at considerable expense to the taxpayer. Most are the result of secondary habitat losses, after initial settlement is established. The effects of local or regional projects, however, often extend far beyond the intended target area. Among these are federal and state spending for water resource developments such as flood control and drainage projects, stream channelization for agricultural soil conservation programs, government subsidies and price supports for crops, and preferential tax policies.

CURRENT PROGRAMS FOR PROTECTING RIPARIAN ECOSYSTEMS

Increased recognition of the important public benefits and functions of riparian ecosystems and the extent to which they have been altered has resulted in efforts by the federal government and some states to exercise some control over development in riparian corridors and acquire riparian lands for public use.

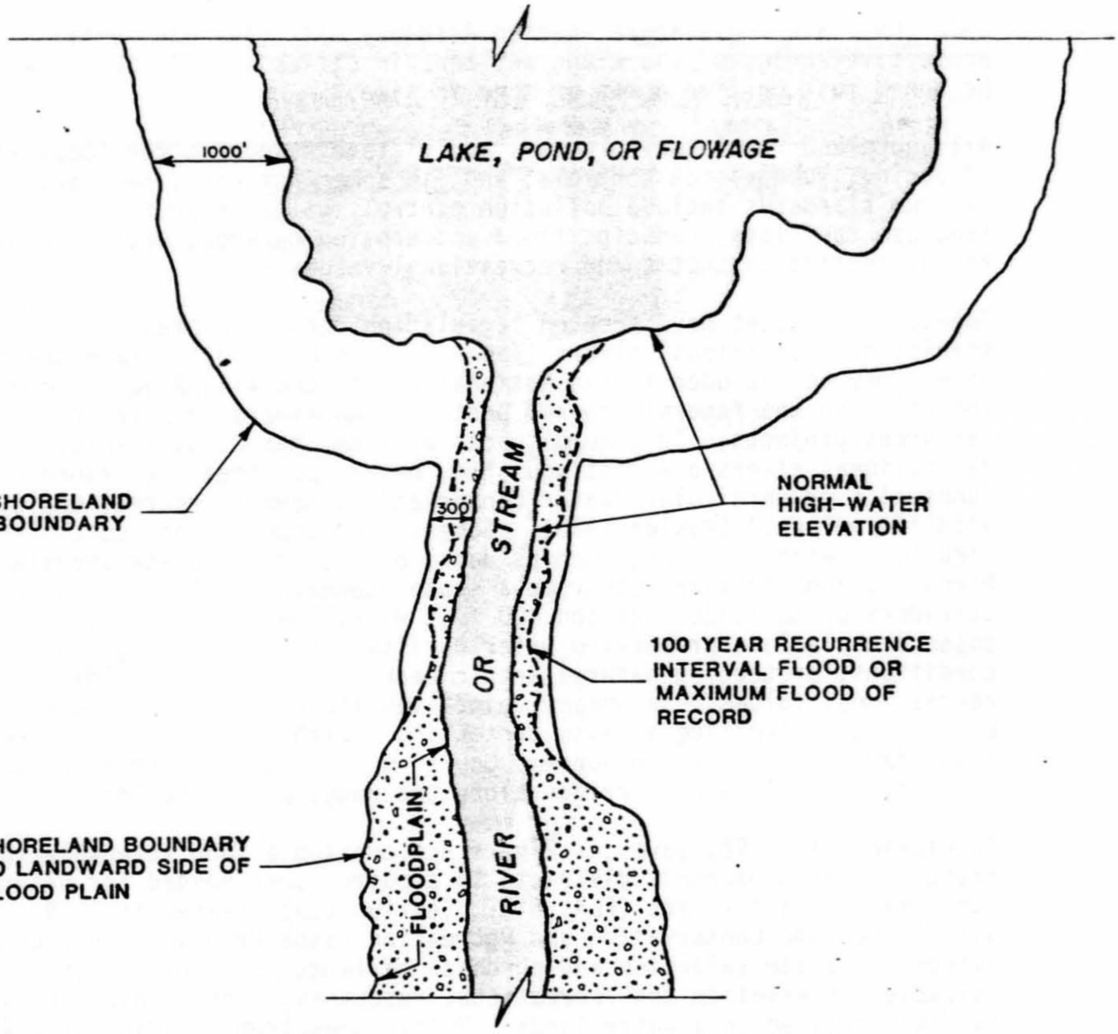
State Programs

Numerous alternatives for protecting riparian lands from future alteration or destruction are being utilized in various parts of the country. These include acquisition by fee simple and less-than-fee simple interest, acquisition of easements, leasing, direct government regulation, economic incentives, and management through compatible use. The Alaska Department of Fish and Game endorses a policy of maintaining riparian ecosystems in public ownership, especially when these lands are already held by the state. Examples from other states that have recognized the need for riparian land protection illustrate the high cost to the taxpayer of reacquiring these lands for public use. As a result, most programs are a case of too little, too late, or a second-best alternative. Acquisition of only a portion of the floodplain or stream segment does not assure adequate protection because disturbances in upstream areas or adjacent habitats can have downstream impacts extending far beyond the immediate area. However, many states are attempting to rectify past policies in land management, and the following discussion will present some examples of on-going programs.

Six states have adopted special legislation for the protection of inland shoreland areas: Maine, Vermont, Washington, Wisconsin, Minnesota, and Michigan (Kusler 1980). All six states define shoreland in relation to the high water mark of rivers and lakes. Depending on the state, distance from the high water mark to the shoreland boundary varies from 200 feet in Washington to 1000 feet in Michigan and Vermont. In addition, some of these states regulate river shorelands up to 300 feet from the high water mark or to the landward side of the 100-year floodplain. This minimum distance varies from 200 feet in Washington to up to 300 feet in Wisconsin and Minnesota. In general, one of two main approaches has been used to classify shoreland areas. The first method classifies specific riparian lands individually, such as particular wetlands around individual lakes. The second approach classifies lakes and streams in their entirety as "natural environment" or "recreational development" or "general development." These classifications then determine minimal standards.[1]

Wisconsin's shoreland zoning act (WIS. STAT. ANN. 144.26,59.971) has been in effect since 1965. It requires all counties to adopt zoning regulations for the protection of shoreland corridors in unincorporated areas. Shorelands are defined as lying within 1,000 feet of the highwater mark of a lake, pond, or flowage, or within 300 feet of a river or stream or to the landward side of a floodplain (Figure 4). The Wisconsin Department of Natural Resources is responsible for establishing a comprehensive plan for navigable waters and their shorelands. Different-use districts are designated. Enforcement of the zoning ordinances has been difficult (National Wetland Newsletter, 1980). No development is permitted in the shoreland-wetland zone except for minor structures associated with hunting, fishing, hiking, wild crop harvesting, and sustained yield forestry. In

[1] A more detailed description of state shoreland programs can be found in B. Berger, J. Kusler, and S. Klinginer, Lake-Shoreland Management Programs: Selected Papers, Univ. of Mass. Water Resources Research Center, Publ. No. 69, Technical Report, Amherst, Mass. (1976).



Figre 4. Wisconsin,s shoreline delineation.
(From Kusler, J., 1980)

1982 the state legislature enacted Assembly Bill (AB) 839, which requires protective zoning of shoreland wetlands in cities and villages. Wetlands to be zoned must be five acres or more in size.[2]

All shoreland regulatory programs apply state standards for local adoption of zoning, subdivision controls, and, in some instances, sanitary codes. Minimum standards include pollution control, wildlife protection, preventing land use conflicts, reducing flood and erosion hazards, wetland protection, and protecting aesthetic and recreational values.

Twenty-four states have adopted legislation for the protection of wild, scenic, or recreational rivers (Table 8) (Kusler 1980). State-designated rivers may be included in the National Scenic and Wild River Program. Inclusion in the federal program protects the rivers from federal water resources projects. In general, acts provide that wild, scenic, or recreational rivers are distinguished, based upon their "extraordinary" "unusual," or particular "water conservation, scenic, recreational, or wildlife values." (Kusler 1980). Some states impose tight controls on structures within rivers, such as dams, but do not regulate shoreland areas. Minnesota and Michigan authorize a state standard for local regulation in corridors up to 1,320 feet and 400 feet wide, respectively. Regulatory objectives include preserving water quality and free-flowing river conditions, protecting natural scenic beauty, vegetation, wildlife, and recreational values. Secondary objectives include minimizing alternate user conflicts, controlling access, protecting health and safety, and reducing flood damage. The Oregon Supreme Court sustained shoreland regulations for a one-fourth mile wide corridor along the Rogue River (Kusler 1980).

In Florida, the 1981 Save our Rivers Act created a fund to enable the state's water management districts to acquire lands needed for water management. Another act (FLA. STAT. Section 259) created in 1979 established the Conservation and Recreation Lands Program. This program authorizes state selection and purchase of lands containing Florida's most valuable conservation and recreational resources. Under this act, a trust fund was created to acquire lands. Money comes from severance taxes on the mining of minerals and oil and gas.

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[2] For further information on this legislation, contact Wisconsin Wetlands Association, 2 South Fairchild Street, Madison, Wisconsin 53703; (608) 256-0565, or Editor, Environmental Law Institute, Suite 600, 1346 Connecticut Ave., N.W. Washington, D.C. 20036.

TABLE 8. Summary of State Wild and Scenic Rivers Programs.

State	System or Program	How Established (date) Legislative	Admin.	Number of Rivers
Alabama	System		1969	1
Alaska	None			
Arizona	None			
Arkansas	None			
California	System	1972		9
Colorado	None			
Connecticut	None			
District of Columbia	None			
Florida	Program		1972	0
Georgia	System	1969		0
Hawaii	None			
Idaho	None			
Illinois	None			
Indiana	System	1972		2
Iowa	System	1970		1
Kansas	None			
Kentucky	System	1972		8
Louisiana	System	1970		43
Maine	System	1966		1
Maryland	System	1971		9
Massachusetts	Program	1971		0
Michigan	System	1970		6
Minnesota	System	1973		4
Mississippi	None			
Missouri	None			
Montana	None			
Nebraska	None			
Nevada	None			
New Hampshire	None			
New Jersey	None			
New Mexico	None			
New York	System	1973		61
North Carolina	System	1971		2
North Dakota	System	1975		1
Ohio	System	1968		8
Oklahoma	System	1970		5
Oregon	System	1971		8
Pennsylvania	Program	1972		0
Puerto Rico	None			
Rhode Island	None			
South Carolina	System	1974		0
South Dakota	Program	1972		0
Tennessee	System	1968		11
Texas	None			
Utah	None			
Vermont	None			

TABLE 8. (Continued)

Virginia	System	1970		2
Washington	None			
West Virginia	System	1969		5
Wisconsin	System	1965		3
Wyoming	None			
Total		24	2	190

Source: Bureau of Outdoor Recreation, Wild and Scenic Rivers, Outdoor Recreation Action, No. 43, U.S. Department of Interior, Bureau of Outdoor Recreation, Washington, D.C., Spring 1977.) Adapted from Kusler (1980).

Due to the shortage of public funds and the high cost of land acquisition an alternative method of riparian land protection has been established in Oregon. The Oregon state legislature passed a bill (S.B. 397) that grants property tax exemptions and income tax credits to private landowners who voluntarily dedicate their riparian lands to wildlife uses. The bill states that "the legislative assembly declares that it is in the best interest of the state to maintain, preserve, conserve and rehabilitate riparian lands to assure the protection of the soil, water, fish and wildlife resource of the state for the economic and social well-being of the state and its citizens."

In Oregon's approach to riparian land protection the emphasis is placed on local administration and self-management by landowners. The program was attractive to landowners interested in more monetary incentives and less regulation. It is too early to evaluate the effectiveness of this legislation in achieving goals, such as increased salmon production, stream bank stabilization, and increased late-season streamflows.[3]

This type of program does not necessarily allow access; landowners are not committed to the program over a long time frame, and agreements must be renegotiated with a change of ownership. Further, a program of this type is no guarantee for protection of large continuous tracts of land necessary to support populations of highly mobile species such as moose. Such a program does not provide incentive to protect critical habitats such as moose wintering grounds, and it has not been in existence long enough to have been tested for effective enforcement. It must also be determined what acceptable level of economic gain is necessary to encourage a landowner to participate in such a program. Clearly, such a program remedies only some of the symptoms created by past practices and does not solve the underlying cause of the problem.

The Oregon State Department of Fish and Wildlife has spent an average of over $500,000 per year for the last 15 to 20 years for the purchase of private land for public access, recreation, and habitat protection (Dick

[3] For futher information on this legislation, contact Water Resources Analyst, Metro Office, Oregon Wilderness Coalition, 2637 S.W. Water St., Portland, Oregon 97201.

Scherzinger, pers. comm.). Some of these costs include money for development and maintenance. In one of its larger projects, the state recently purchased 17 miles of river frontage along the Deschutte River. Money came from the Department of Fish and Wildlife, State Parks, and public contributions. Total cost equalled $1.6 million. Another major state purchase of riparian lands involved buying 11 miles of river frontage along the Middle Fork of the Malheur River. Purchased in the late 1970's, this cost $750,000 (Dick Scherzinger, pers. comm.).

In 1947, the California legislature passed the Wildlife Conservation Act (chapter 1325, statutes 1947). Section 1 of the act states:

> It is hereby declared that the preservation, protection and restoration of wildlife within the State of California is an inseparable part of providing adequate recreation for our people in the interest of public welfare; and it is further declared to be the policy of the state to acquire and restore to the highest possible level, and maintain in a state of high productivity those areas that can be most successfully used to sustain wildlife and which will provide adequate and suitable recreation. To carry out the aforesaid purposes, a single and coordinated program for the acquisition of lands and facilities suitable for recreational purposes and adaptable for conservation, propagation and utilization of the fish and game resources of the state is hereby established.

This act established the Wildlife Conservation Board (WCB). The purpose of the WCB is to acquire and develop lands and waters for wildlife conservation and related recreational purposes for the State Department of Fish and Game (DOF&G).

In 1951, the WCB began land acquisitions. Prior to 1951 all lands were acquired directly by the DOF&G. Information prior to 1951 is not available.

Between 1951 and December 31, 1982, the WCB has spent approximately $22.3 million[4] acquiring land in riparian habitats (pers. comm., John Wentzel, WCB). This includes purchases and easements for the purpose of access to freshwater fishing sites, fish habitat protection, and protection of river and stream riparian wildlife habitat. In addition, land valued at $676,000.00 was donated to the state through the WCB. Donations are tax deductible.

The WCB has spent approximately $33.5 million in acquiring coastal fishing access, freshwater and coastal wetlands, hunting access, deer winter and summer range, bighorn sheep range, and lands acquired for the protection of threatened and endangered plants and animals. Some of this undoubtedly includes riparian lands but has not been included in the above dollar value for riparian acquisitions. A large percentage of this money goes to acquiring wetlands and state waterfowl management areas.

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[4] $7,354,000 included in the $22.3 million was acquired with State Water Project (California Aquaduct) funds for mitigation of damage to wildlife habitat during construction. I do not know how much of this cost was used for riparian land acquisition.

A breakdown by primary recreational use of each acquisition is difficult, as many of the areas provide several recreational opportunities and also protect valuable habitat.

Much of this land was purchased prior to the recent inflationary spiral, and present costs and future costs will be much higher.

Other municipal, county, state, and federal agencies are also responsible for acquring land for access, recreation, and habitat protection. The amount acquired and costs incurred by the WCB is probably a relatively small percentage of the total for riparian land acquisitions within the state.

The Riverine Corridor concept in California was first implemented on the American River. Sacramento County has purchased 4,100 acres along a 23 mile stretch of the American River at an average cost of approximately $4,000 per acre; this amounts to a total cost of roughly $16 million (Walt Veda, pers. comm.). The county still has plans to purchase another 800 acres but is hindered by rising costs and lack of funds. Additionally, the county has purchased small tracts of 0.5 to 4.5 acres along the Sacramento River for public access to fishing. There was a proposal (as of 1979) to establish a Sacramento River Parkway (corridor) with a length of over 300 miles and a width of 300 feet on each side of the river. Land acquisition costs were estimated at $165 million (Warner 1982). The high cost of acquisition made enancting this proposal an impossibility. Although funds are often available for acquisition, purchase of important riparian tracts is not assured. Both the Wildlife Conservation Board and the Department of Parks and Recreation have been unsuccessful in acquiring fee title or easements to important riparian lands (Burns 1978). Other counties have similar programs and are competing for federal and state money. Because of the high costs involved in purchasing land, emphasis is being placed on zoning to protect riparian ecosystems (Ross Henry, pers. comm.).

In California, legislation (AB 3147, 1978) provided funding for a two year Department of Fish and Game study to survey California's remaining riparian lands and make recommendations for action by the legislature. California Fish and Game established a riparian task force to develop programs and procedures for the maintenance, protection, and restoration of the state's riparian resources.

Idaho is similar to Alaska in that a high percentage of land within the state is owned by the federal government. Yet, despite the large amount of public land and the fact that the U.S. Forest Service and Bureau of Land Management have retained some riparian lands, there is still a big demand for public access to rivers and lakes (Gene deReus, pers. comm.). In addition, development of private lands has interfered with the migration routes of big game. As a result, the state has been spending public money to purchase private lands, acquire easements, and lease lands to provide public access to the state's waters.

Since 1965, the Idaho Department of Parks and Recreation has spent approximately $13.3 million (combined state and federal money) purchasing riparian land from private landowners (Dale Christiansen, pers. comm.). With $2.00 received from the sale of every hunting and fishing license the

Idaho Department of Fish and Game spends $450,000 per year for land acquisition, easements, and leases for the purpose of "sportsmen access" to rivers and lakes and for habitat protection (Gene deReus, pers. comm.).

In the State of Washington the Interagency Committee for Outdoor Recreation (ICOR) oversees land acquisitions for state resource agencies. Between 1965 and 1981 the ICOR has assisted the State Game Department in purchasing 273 parcels of land. Of these, 218 (80%) have included riparian fish and wildlife habitats. During this 16 year period, 37,385 acres of riparian lands were purchased for the Department of Game at a cost of nearly $6.2 million (Ronald Taylor, pers. comm.). According to Mr. Taylor, this is not the total sum but represents the majority of the riparian land acquisitions. Money comes from the Federal Land and Water Conservation Fund and the State Capital Budget. The Department of Game also acquires land with money made available through the Pittman-Robertson Act. Additionally, the ICOR has funded another 1,500 projects by state and local agenices for the purchase of recreational lands. Due to financial constraints, land acquisition projects have been reduced in the past few years, although demand for public recreational lands and access to them is still high.

Private Programs

Not all projects and programs for the protection of riparian lands are initiated by public agencies. The private sector as it begins to understand and recognize riparian values is also contributing time and money to protect riparian resources. Some of the best examples come from work done by the Nature Conservancy, a national conservation organization committed to preserving natural diversity.

The conservancy also enters into cooperative programs with state agencies. In 1974, the Mississippi Game and Fish Department, with the Assistance of the Nature Conservancy, drafted legislation to create the Mississippi Wildlife Heritage Committee. The goal of the committee is to create and implement a state-wide comprehensive natural resources program to guarantee the preservation of the state's most important wildlife habitats through acquisition or other means. Many of these habitats are in riparian ecosystems. In another effort in the Southeast, the Nature Conservancy, with a grant of $15 million and by raising matching funds, is attempting to purchase key tracts of land to protect six major river systems. The conservancy's goal is a total gain of 350,000 acres of river habitat. The purchase price of this land is over twice the original cost for the entire Lousisiana Territory, an area of over 525,911,680 acres.

Another strategy used by the Nature Conservancy for protecting habitats is acquisition of conservation easements. Along nine miles of the Brule River in northern Wisconsin, the conservancy has negotiated easements with private landowners for protecting the natural character of almonst 5,000 acres. The conservation easements are parcel specific but contain some common provisison. Mining, alteration of topography, alteration of water courses, filling or removal of gravel, sand, topsoil, rock, or other materials, and dumping trash, noncompostable garbage, or other offensive materials are prohibited. Also prohibited are commercial development, access to commercial development, billboards, mobile homes, off-road vehicles, grazing, shooting within one-quarter mile of raptor nests, application of herbicides and pesticides (except in home gardens), and introduction of non-native species. A conservation easement is a legally enforceable restriction that attaches to the land in perpetuity and is recorded at the register of deeds office. In addition, the landowner is entitled to a charitable contribution deduction on his federal income tax, equal to the amount of the reduction in the value of the property.

Federal Programs

The federal government has also recognized the values and special mangement needs of riparian ecosystems. The Environmental Protection Agency and the U.S. Forest Service (1978) published a cooperative report describing a survey of streamside management zone laws, ordinances, and regulations on state and private lands in all 50 states, some counties, and local jurisdictions. At least 209 laws are applicable to riparian areas (Duff 1980). Thirty-one percent of these laws have been enacted since 1980.

Executive Order 11988, May 24, 1977, Floodplain Management (42 FR 26951), requires that federal agencies all "take action to reduce the risk of flood loss, to minimize the impact of flood loss, to minimize the impacts of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains." This is an important act because many riparian areas have been adversely affected by federally funded projects for development of agricultural lands, flood control projects, water diversions, and road construction.

Executive Order 11990, May 24, 1977, Protection of Wetlands (42 FR 26961), may also be applicable, as riparian ecosystems are considered wetland ecosystems by many authors (Duff 1980, Brinson et al. 1981). This order calls for "action to minimize the destruction, loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands." It requires each federal agency to determine how its activities affect wetlands and to revise regulations to minimize adverse impacts on wetlands. As with EO 11988, this applies only to federal projects.

The National Wild and Scenic Rivers Act of 1968 (Public Law 90-542:82 Stat. 906, et sef.) can be applied to entire watersheds to ensure better management of water quality and land use. Of the seven national and wild scenic rivers in Alaska, not counting those in national parks or wildlife refuges, none are within the boundaries of the Matanuska-Susitna-Beluga Study Area.

The Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500, Sec. 208; Stat. 816 et sef.) are intended to "restore and maintain the sociological integrity of the nation's waters." Section 208 requires water pollution controls for both point and non-point sources, including soil erosion. This may be interpreted to have great significance for requiring better managerial practices to protect riparian vegetation. This legislation is being implemented through federal, state, and regional water quality plans.

The Federal Fish and Wildlife Coordination Act (16. USC 661 et sef.) requires federal agencies to give wildlife conservation equal consideration with other features of water resource develomental programs. This includes "aquatic and land vegetation upon which wildlife is dependent." While the act gives wildlife managers the opportunity to comment and make recommendations, the acceptance of these recommendations is not mandatory.

A possible federal alternative to Oregon Riparian Bill is the recently introduced Conservation Land Sale Tax Incentive Bill (HR 6465). Introduced into the U.S. House of Representatives by Rep. Robert Lagomarsino (R-CA) and 43 co-sponsors, the bill would give landowners a tax incentive for selling or exchanging real estate to "qualified organizations" for conservation purposes, instead of to developers. Qualified organizations include federal, state, and local agencies and private non-profit conservation organizations. The conservation purposes must be protected in perpetuity and may include 1) preservation for education or public recreation, including hunting and fishing; 2) protection of fish, wildlife, and plant habitat; and 3) land acquisition to carry out federal, state, or local conservation programs.

Current legislation can go only so far in mitigating damages to riparian systems. Another method commonly used, and among the most desirable methods for long-term protection, is through direct federal or state acquisition of riparian lands. Riparian lands have been purchased by agencies often with money made available by the Land and Water Conservation Fund Act (16 U.S.C. 4601-4 to 4602-11). This act established the Land and Water Conservation Fund. The fund provides money for purchase of fee and easement interests in lands designated for protection of fish and wildlife and other ecological values.

Alaska's Programs

The State of Alaska has few programs, laws, or policies that specifically recognize and protect the functions and values of riparian ecosystems. Those provisions most applicable to riparian ecosystems are contained in the Alaska Administrative Codes (ACC) and the Alaska Statutes (AS). The Standards for Resources and Habitats (6 ACC 80.130) defines rivers, streams, and lakes as habitat types in coastal areas subject to the Alaska Coastal Management Program (ACMP). Section 6 AAC 80.130 c (7) states that rivers, streams, and lakes will be managed to protect natural vegetation, water quality, important fish and wildlife habitat, and natural flow. In addition, Section 6 ACC.80.130 b (7) provides that rivers, streams, and lakes shall be managed so as to maintain or enhance the biolgical, physical, and chemical characteristics of the habitat that contribute to its capacity to support living resources.

The standards of the ACMP are implemented in three ways: 1) through local coastal management plans; 2) through the ACMP's "state consistency' provisions, which require state agencies to carry out both planning and regulatory actions that affect the use of coastal resources in a manner consistent with both the ACMP standards and any local coastal management programs; and 3) through the state's review of federal actions for consistency with the state program.

The only statewide authority applicable to riparian areas is AS 16.05.870. This authorizes the Alaska Department of Fish and Game to regulate activities proposed for streams supporting anadromous fish. The statute states that the approval of the commissioner of the Department of Fish and Game is needed to, use, divert, obstruct, pollute, or change the natural flow or bed of a river, lake, or stream, specified as important to the spawning or migration of anadromous fish. Alterations of riparian vegetation may change the natural flow of a river if these alterations are severe enough or encompass a large area.

Legislative designation of state game refuges, sanctuaries, and critical habitats can be used for the protection of riparian lands or riverine corridors. Under AS 16.20.220, the legislature can designate certain lands and waters as "Fish and Game Critical Habitat Areas" to protect and preserve habitats especially crucial to the perpetuation of fish and wildlife and to restrict all other uses not compatible with that primary purpose.

Curran and Dwight (1979) review existing state water use laws and their administration. For a review of wetlands management in Alaska and the legal authorities pertaining to it, see State of Alaska (1981).

Two recently introduced bills to the Alaska State Legislature also address the need for better management of the state's rivers and streams. Senate Bill No. 9, introduced in January 1983 by Vic Fishcher and Joe Josephson (later withdrawn), included provisions for establishing state historical, recreational, and wilderness waterways.

House Bill No. 278, introduced in March 1983, by Fritz, Malone, Szymanski, and Bussell recognizes that "Alaskan rivers are among the most important of the State's natural resources and that they must be protected and preserved for the maximum benefit of all Alaskans." To solve problems endangering fish and wildlife habitats, increasing erosion, causing overcrowded, unpleasant conditions, and causing a fragmentation of management jurisdiction, this act would establish an Alaska Rivers Commission.

Already in Alaska demand for acquiring recreational access and public recreational lands is much greater than the money available for purchase (Russ Redick, pers. comm.). Lakes, rivers, and streams are the lands most sought by recreationists. Due to the state's demographic patterns, demand for recreational access and conflicts over land use are increasing, especially on the Kenai Peninsula and in the Mat-Su Borough. In response to public demands, the State Division of Parks has spent over $2 million buying back private riparian lands once held in the public domain along rivers and creeks in the Kenai Peninsula. Land purchases were targeted for areas receiving heavy recreational use (Jack Wyles, pers. comm.). In 1982, the legislature appropriated $3 million to buy back lands for access in the Kepler-Bradley Lake System in the Mat-Su Borough. Land acquisition in the Nancy Lakes area has cost the state over $565,000. To provide access, the state recently spent $1.2 million to purchase land along Montana Creek and $25,000 to purchase land adjoining Sheep Creek (page 27). These costs have been incurred because past land disposal systems did not consider future population patterns and recreational needs, nor needs to protect natural resources.

Another example of the public's need for Alaska's riparian lands and the high cost to the taxpayer of "buying back" this land can be found in Anchorage. The municipality has been purchasing "greenbelt" tracts along Fish Creek, Chester Creek, Ship Creek, and Campbell Creek. The municipality is in the process of trying to acquire land along Little Campbell Creek and Rabbit Creek, but with the rapid growth in Anchorage over the past few years, demand for developable land has made land very expensive. Between 1976 and 1981, the municipality has spent $3.2 million to buy 60.4 acres along Campbell Creek (Diane Reusing, pers. comm.).

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APPENDIX D

THE USE OF MOOSE AND OTHER WILD RESOURCES IN THE TYONEK AND UPPER YENTNA AREAS
A BACKGROUND REPORT

by
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ABSTRACT

This report contains background information on the use of moose and other wild renewable resources by the residents of the village of Tyonek (population 239) and the Upper Yentna area (population 145), both of which lie in Game Management 16B. The data derive from two Division of Subsistence research projects which have been investigating resource uses in these areas in order to provide data for area and regional plans, and to the Board of Fisheries and Game for their review of proposals for regulatory change. Several proposals to reestablish a November moose hunting season in GMU 16B will be considered by the Board of Game during its Spring 1983 meeting. This report supplements an earlier Division paper on the use of moose by Tyonek residents (Foster 1982a).

Research methodologies have included interviewing, participant-observation, and mapping. Data were collected from 52 percent of the Tyonek households and 82 percent of the households in the Upper Yentna Area.

An annual round of resource harvests and a map of the geographic areas used for these harvests are provided for both areas. In addition, harvest quantities for 43 resources or groups of resources are reported for the Upper Yentna area. In both areas, residents harvest a wide range of resources. At Tyonek, the three year average subsistence catch of salmon has included 1,900 kings and 250 reds. Fifteen moose were taken by Tyonek hunters in September 1981. In 1982, Upper Yentna households harvested an estimated maximum of 1,630 salmon, 1,800 freshwater fish,

and 30 moose for local use. Travel to hunting and fishing areas in the Tyonek area is primarily by pickup truck along a network of roads built for timber harvesting, by boat along several rivers, and by ATV. In the roadless Upper Yentna area, travel is by boat, snowmachine, ATV, and dogsled along rivers and trails and is highly dependent on weather conditions.

The preservation of most meat and fish in both areas is accomplished by methods not requiring electricity, including smoking, canning, and freezing outdoors.

Over the past three years, an average of 59.6 percent of the households in the Upper Yenta area harvested at least one moose; most unsuccessful households received moose meat from other households. Harvest levels in Tyonek were monitored in 1981 only. While sharing was extensive, the total of fifteen moose harvested was said to be insufficient to meet village needs. Of the Tyonek households interviewed, 73 percent expressed a preference to reopen a November or December moose season.

Residents in both areas have few sources of wage employment and utilize a variety of sources of monetary income, most of which are seasonal, for the purchase of non-locally produced commodities. The use of local harvests of wild, renewable resources has historically played a major role in the economic and sociocultural systems of this region.

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PURPOSE

This report describes the uses of wild resources and socioeconomic characteristics of the residents of portions of Game Management Unit 16B. It provides a background for the Board of Game's consideration of several proposals for regulatory change which would open a November moose season in that GMU.

The data derive from two ongoing Division of Subsistence research projects. The first, the "Tyonek Comprehensive Resource Use Study," commenced in 1980 and will conclude in 1984. The second, the "Susitna Basin Resource Use Study," began in December 1982. One purpose of both of these projects is to gather data on the current patterns of resource uses by local residents of each area which may be incorporated into area and regional land use plans. These data may aid in our understanding of the potential effects of land disposals, timber sales, road construction, and the development of nonrenewable resources such as coal, oil, and gas. To date, the Division has been able to comment on several potential resource development projects (such as Oil and Gas Lease Sales 33 and 40; coal leases; geothermal leases) and, in addition, has provided data on land use patterns for the Department of Natural Resources' Susitna Area Plan.

A second major purpose of these projects is to provide information on local uses of fish and wildlife to advisory committees, regional councils, and the Boards of Fisheries and Game which may inform their consideration of fish and game regulations. Accordingly, as particular regulations have been subjected to review and modification, the Division has periodically prepared reports based on ongoing projects (Foster 1981; Stanek, Fall, and Foster 1982). The current paper is an example of such a report. While based in part on preliminary data describing only portions of the unit under consideration, the paper depicts the general patterns of resource use by residents of this area. This description can serve as a context for understanding the use of moose.

Additionally, the paper will also introduce the new Board of Game members to the Division's research program in the Cook Inlet area and, especially, outline the scope of our recently initiated work in the Susitna Basin.

METHODOLOGY

Tyonek Comprehensive Resource Use Study

Research methodologies for the "Tyonek Comprehensive Resource Use Study" have included formal interviewing with the aid of survey instruments (Foster 1982a: Appendix B; 1982b:60-61), informal discussions, mapping, and participant observation. Data specific to the use of moose by Tyonek's 239 residents were gathered in the fall of 1981. Of 48 identified moose hunters, 40 were interviewed. Hunting trips by several Tyonek residents were also observed. Using United States Geological Survey (USGS) 1:63,630 topographic maps, local residents indicated the areas that they had hunted in 1981. From these maps, the researchers prepared a composite map of the village moose hunting area. The complete results of the research on 1981 moose harvests in Tyonek are discussed in Foster 1982a.

During the spring and summer of 1982, data were collected on the current annual round of resource harvests in the Tyonek area. With the aid of several key respondents, the researcher chose of a sample of 39 households representing 52 percent of the village households for intensive interviewing. This sample included those households most active in resource harvesting. Respondents were asked to indicate the resources which they had regularly harvested within the last five years. The results of this research included an annual round of hunting and fishing activities, an estimate of the percentage of Tyonek households participating in harvest activities, and a series of maps of harvest areas (Foster 1982b). The major findings of this research are summarized below.

Susitna Basin Resource Use Study

Data on resource uses in the Upper Yentna study area (Figure 1) were primarily collected through household interviews with the aid of an interview guide (Appendix A) and in field notes. Prior to conducting household interviews, Division staff discussed the proposed research, including its purpose, objectives, and methods, with area residents at a public meeting in Skwentna.

In a population census survey conducted by Schulling (1982) in the same geographic area as this study, 145 full-time residents were identified. With the aid of local key informants, Division staff mapped the approximate locations of homes of Upper Yentna residents. During a five week period in December 1982 and January and February 1983, the Division researchers attempted to interview as many of the households as possible. At the end of the study period, 38 households, with a total population of 126, had been interviewed. This provided a sample of 87 percent of the census population.

Several factors influenced the choice of households to contact,

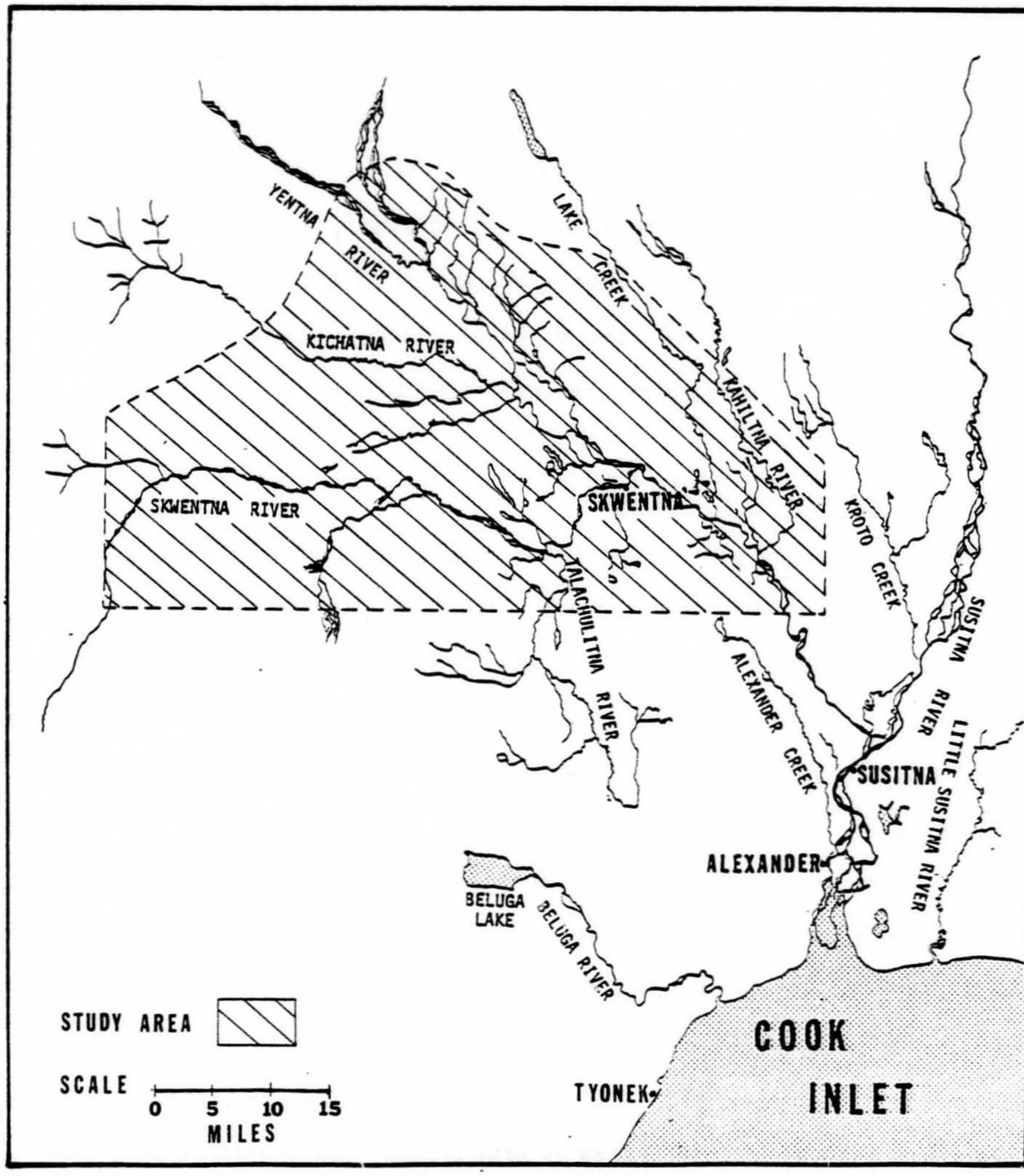


Figure 1. The Upper Yentna area in which households were interviewed.

including the availability of household members for interview, logistical constraints such as availability of transportation, prevailing weather conditions, and time limitations. There was a tendency to select those households which were the most active users of local resources, such as trappers, hunters and fishermen, and guides, although other residents who used resources to lesser degrees were not systematically excluded. An effort was made to include in the sample as many long-term residents as possible.

Questions on the interview guide asked for household information appropriate to 1982 use levels. When discussing harvest levels, many households were unable to recall exact harvest quantities for particular species. This was particularly true for fish. In such cases, a range was estimated. For big game and furbearers, respondents generally were able to recall exact harvest levels.

The researchers attempted to arrange interviews before visiting each home. This allowed residents to decide in advance whether they wanted to participate and to prepare for the discussion. Interviewees were given the option of not answering questions with which they felt uncomfortable. Two researchers were present for each interview. One researcher asked questions from the interview form and recorded data pertinent to each question, and the other researcher recorded additional information from ensuing discussions.

All household members were encouraged to participate in the interviews. Since most interviews were prearranged, the persons most knowledgeable about particular subjects were present to reply to specific questions. In addition, this approach proved beneficial in reaching a consensus on harvest quantities, seasons, or locations. In all interviews, open discussion of resource use activities was encouraged in order to elicit any qualifiers to specific interview responses.

Mapping of resource use areas followed each interview. The researchers used the list of resources generated earlier as a guide in mapping use areas, which was done on 1:63,630 USGS topographic maps. Because mapping of use areas for a single year might not realistically represent the area generally used, interviewees were asked to draw a line encompassing the area they currently use to harvest each resource or category of resources. Resource use areas were grouped into fishing, trapping, moose hunting, wood gathering, berry picking, small game hunting, and bear hunting areas.

RESULTS

Patterns of Wild Resource Use in Tyonek

The uses of wild resources by the residents of the village of Tyonek have been described in detail in several Division reports (Stickney 1980; Stanek and Foster 1980; Stanek, Fall, Foster 1982; Foster 1982a, 1982b). In this regard, the reader should refer to Foster (1982a), Foster (1982b: 32-54), and Fall (1982). This section briefly summarizes these earlier findings.

The geographic area utilized by Tyonek residents for the harvest of resources from 1978 to 1982 is depicted in Figure 2. The harvest and utilization of fish and game in the Tyonek area proceed according to an annual round of activities (Figure 3). A new round begins each April as groups of villagers travel south in dories to Redoubt Bay to harvest razor clams and three other species of shellfish. These trips are usually

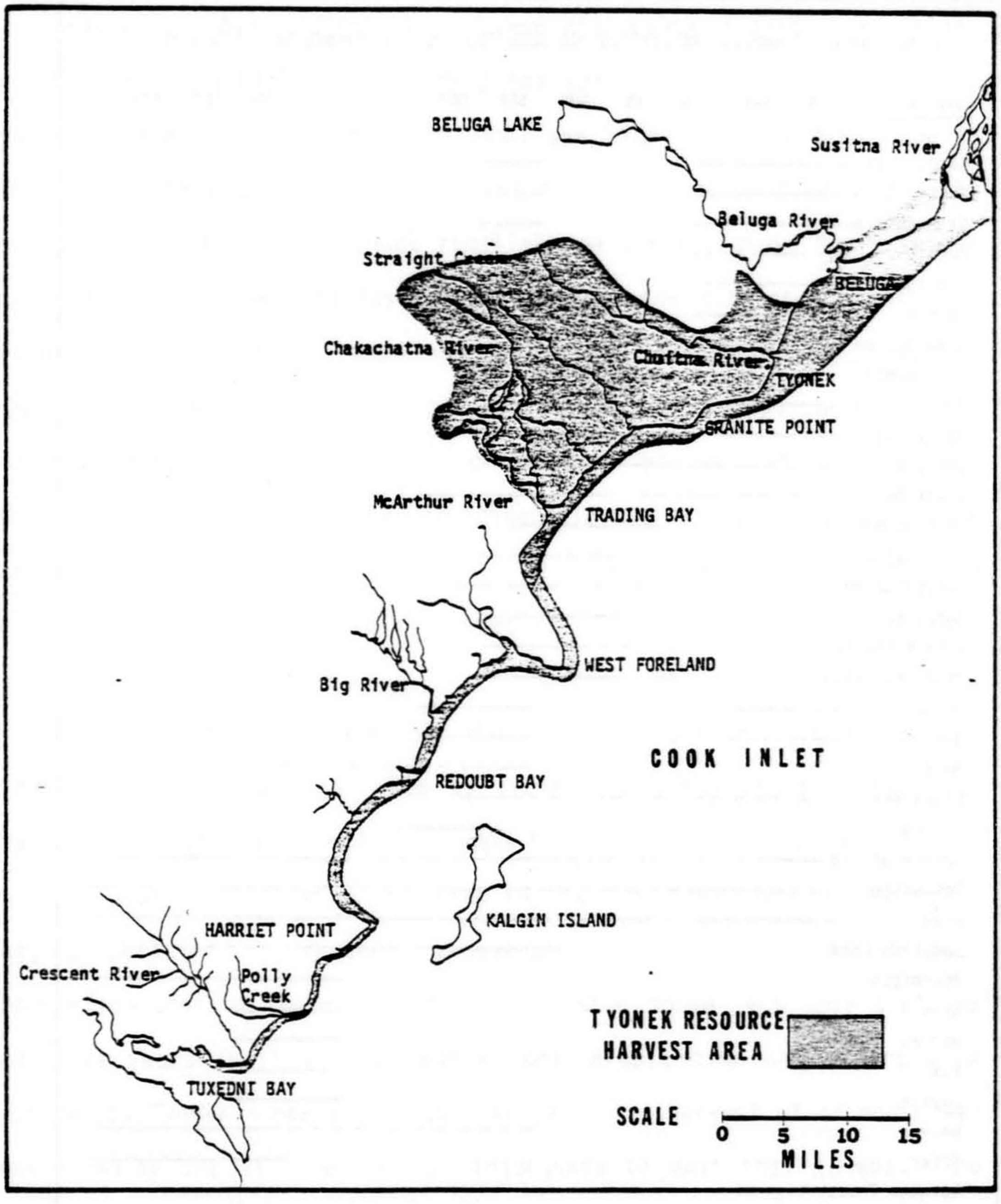
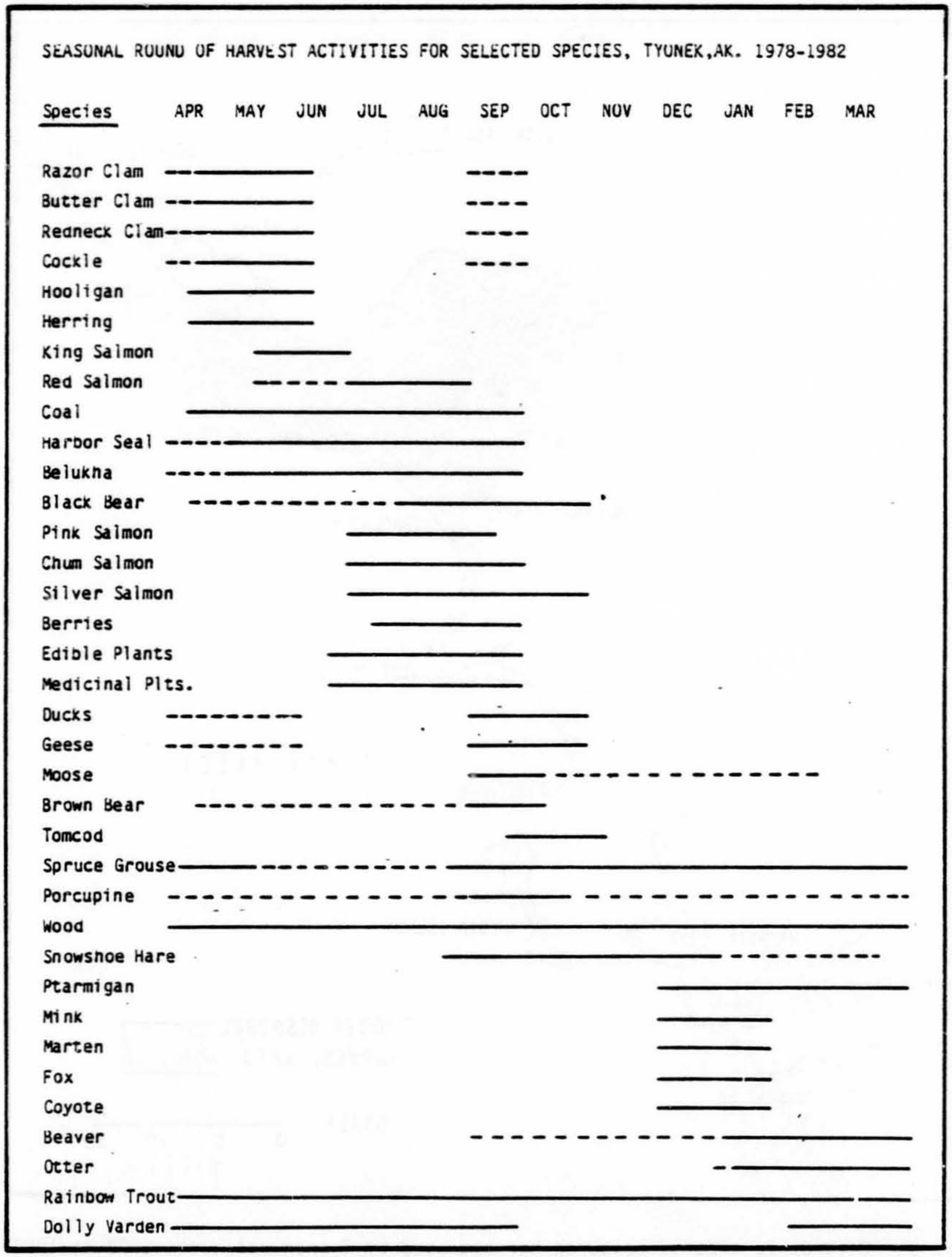


Figure 2? Geographic area of resource harvest used by Tyonek residents 1978 to 1982



Key:______ Usual period of harvest effort; ------ Occasional period of harvest effort.

Figure 3. Seasonal round of harvest activities by Tyonek residents (Foster 1982b:34)

organized by older, more experienced men with boats and motors. The village harvest of 2,000-3,500 clams is distributed throughout the community.

Preparation for subsistence and commercial salmon fishing takes place in late April and early May. During the summer months, the majority of Tyonek households take salmon for local use with set gill nets from 28 fish camps. Many camps also have smoke houses and other fish processing facilities, although most Tyonek families now cut and smoke their salmon in the village. Over the last three seasons, the subsistence catch at Tyonek has averaged about 1900 kings and 250 reds. Additionally, approximately 25 households fish commercially at the same camps. Harbor seals and belukha are also harvested during the summer months. About 37 percent of Tyonek households regularly participate in the harvest of these marine mammals. As with clams, the products of these hunts are widely distributed in the village. Salmon fishing, especially for silvers, continues into the fall.

Each September, approximately 50 Tyonek residents hunt moose. Figure 4 depicts the general area used by Tyonek moose hunters in 1981. The area hunted in 1982 was similar. Access to hunting areas is along the network of local roads first constructed in the early 1970s for a commercial logging operation, or by dory to several rivers south of the village. About 87 percent of Tyonek households harvested moose regularly over the past five years (Fall 1982). While considerable time and effort were expended by Tyonek hunters in September 1981, the harvest of 15 moose was considered by the villagers to be inadequate to meet their needs. The 1982 fall harvest was of a similar size. Traditionally, moose hunting in the Tyonek area, as well as the Susitna Basin, continued throughout the winter months (Fall 1981:146-49, 188, 197). Tyonek residents have

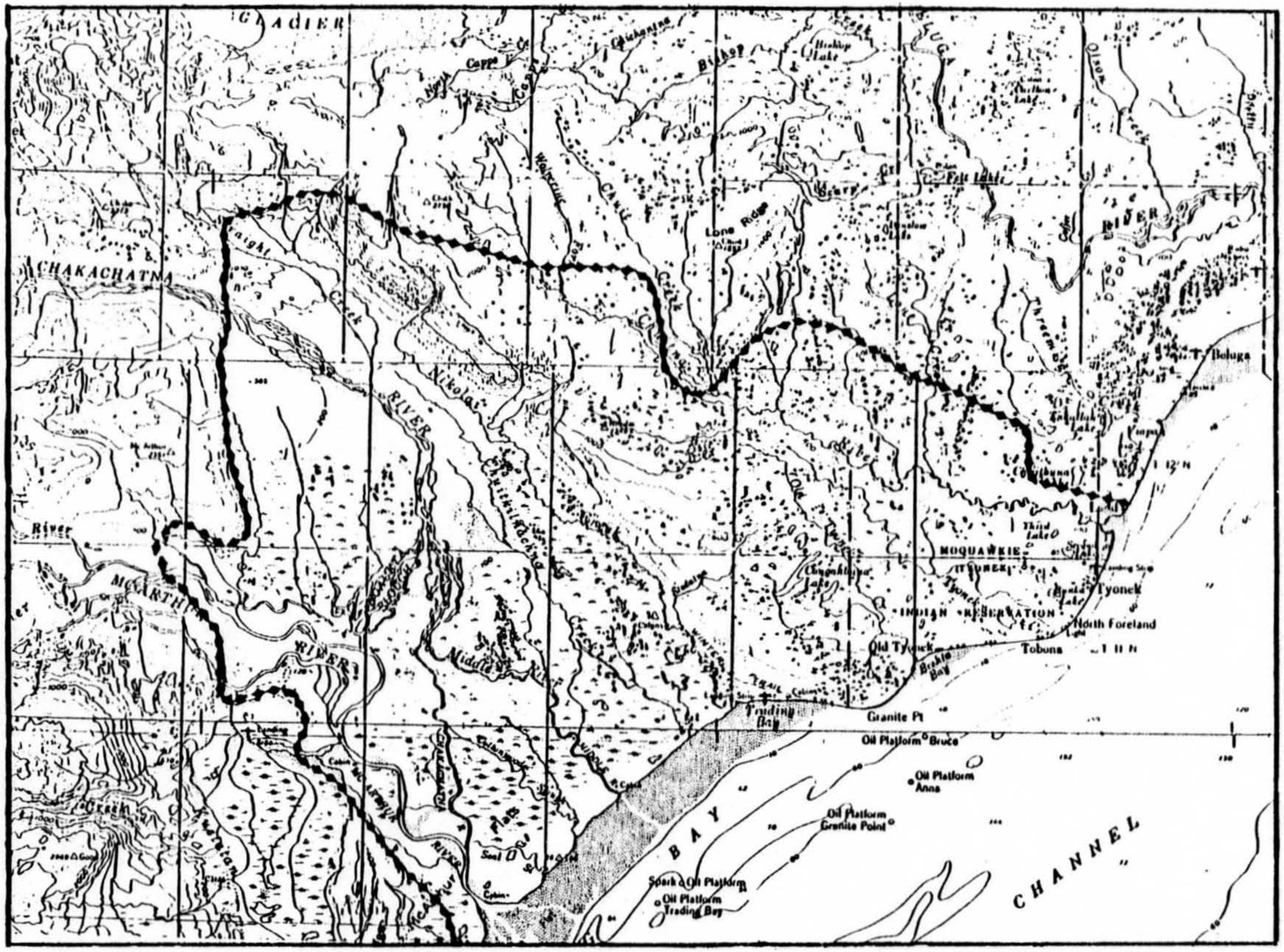


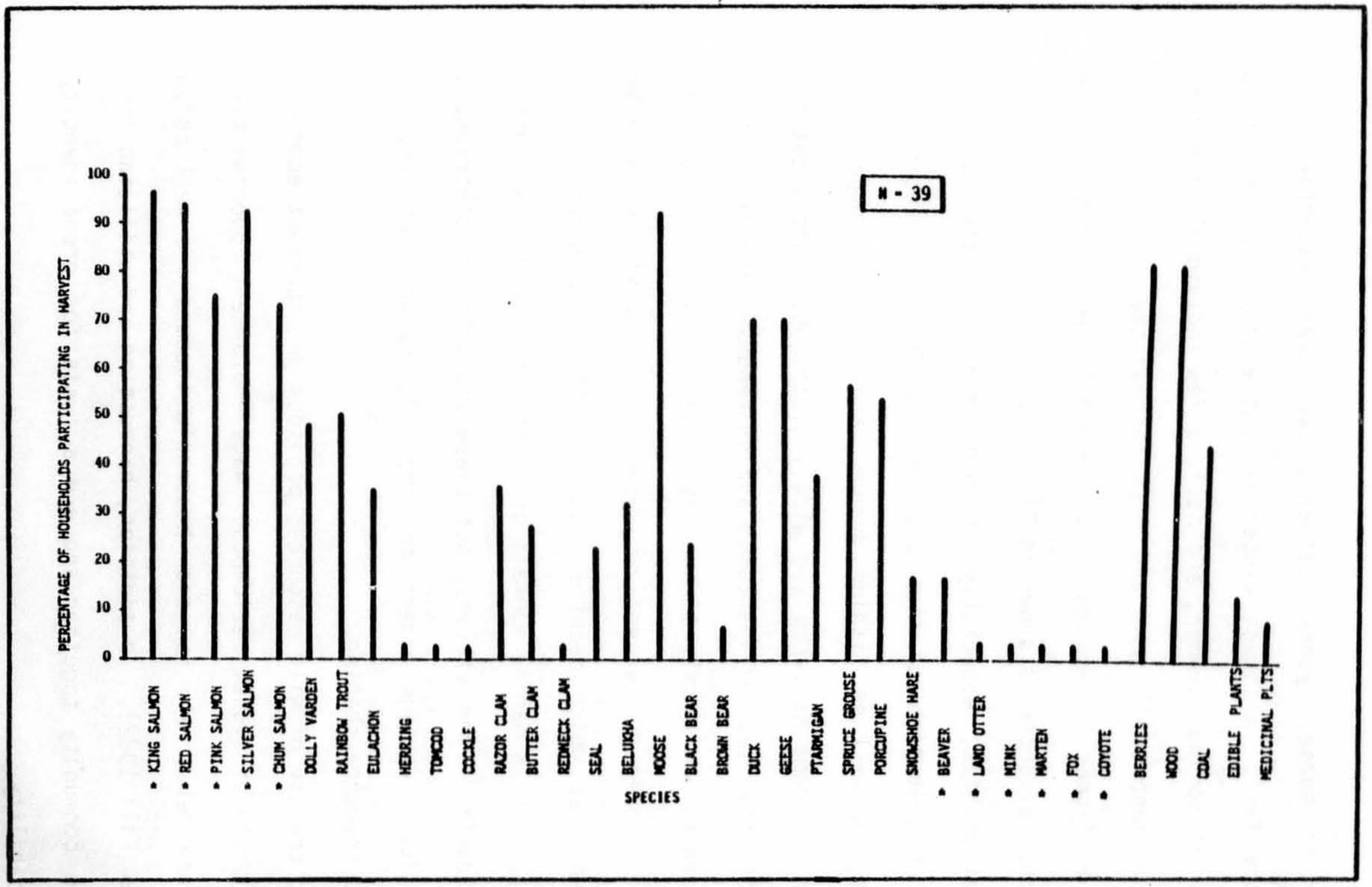
Figure 4. Areas used for moose hunting by Tyonek residents during 1981 moose season, representing a composite of individual hunting areas (N=40) (Foster 1982a:9)

indicated a desire to reopen a November or December season (Foster 1982a:25).

In addition to moose, Tyonek residents take bear, waterfowl, and small game in the fall. Although winter harvest activities are not as intense as those of spring, summer, and fall, a few individuals run trap lines, and others hunt small game and fish through the ice for trout. The percentage of Tyonek households which generally participate in the harvest of various resources is shown in Figure 5.

Social relationships, especially kinship, structure the harvest, processing, and distribution of fish and game in Tyonek. Hunting and clamming parties, as well as fishing groups, are normally composed of relatives. Fish and game harvests are widely distributed throughout the village, and facilities such as fishcamps and smokehouses are extensively shared. For example, while only 15 hunters successfully harvested moose in September 1981, over 90 percent of Tyonek's 75 households received moose meat. Resources which require special skills and equipment for their harvesting, such as marine mammals or clams, are taken by a limited number of individuals in the village, but these products are distributed almost village wide. Village elders and the ill, as well as kin, are included in this resource sharing.

In summary, the use of wild resources provides an important economic base for the majority of Tyonek residents. Wage employment opportunities in the village are relatively few and household incomes are well below Alaska's average (Fall 1982). In addition, harvesting and utilizing fish and game tie the community together and are a basis for group identity and community stability.



* Species harvested for household use and commercial sale.

Figure 5. The percentage of sampled Tyonek households which participated in resource harvest during the period 1978-1982 (Foster 1982b:33)

General Characteristics of the Upper Yentna Area

The Upper Yentna area is located in the Susitna basin along the upper reaches of the Yentna River. The focal point for the area's residents is Skwentna, which is located near the confluence of the Yentna and Skwentna Rivers approximately 55 air miles northwest of Anchorage.

Travel in the area is by boat or airplane during summer months and fall months, and by snowmachine, airplane, dogsled, and ATV during the winter months. Especially, travel in fall and spring is highly dependent upon the weather and the freezing and thawing rivers, lakes, airstrips, and trails.

Settlement Patterns

The aborginal inhabitants of the Yentna River drainage, the Upper Inlet Dena'ina, had greatly declined in population by the early twentieth century, most due to diseases. Subsequently, a few scattered households of trappers and prospectors comprised the permanent population until, within the past 30 years, human settlement again increased as a a result of State and Federal land disposal programs. Consequently, concentrations of households have appeared in areas along rivers or bordering lakes. This is the current pattern around the mouth of Lake Creek, at Skwentna, and in the Whiskey and Hewitt Lake areas.

The means by which local residents acquired their land included purchase from previous owner (36.8 percent), State open-to-entry programs (21.0 percent), State remote parcel programs (18.4 percent), and a variety of other State and Federal programs (Table 1).

Population Characteristics

A summary of interview findings regarding households member charac-

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TABLE 1.

UPPER YENTNA HOUSEHOLD LAND ACQUISITION

Purchased From Previous Owner	14
State Open-To-Entry (OTE) Program	8
State Remote Parcel Program	7
Federal Homestead	2
State Homesite Program	2
Borough Housing	1
Federal Cabin Site	1
Rental	1
Purchased from State	1
Other	1

TABLE 2.

CHARACTERISTICS OF UPPER YENTNA HOUSEHOLD MEMBERS

	Mean	Range
Number of Persons/Household	3.3	1-7
Age of Heads of Households	42.9	25-70
*Number of Years in Alaska	16.4	3-41
*Number of Years in Upper Yentna Area	7.9	1-33

*Indicates number of years for the longest residing household member.

teristics appears in Table 2. Household size varied from one to seven members and averaged 3.3 persons.

The results of interview questions asking about length of residency appear in Figures 6 and 7. The range of time that household members had been in Alaska was 3-41 years. The average length of time in Alaska was 16.4 years. Residency in the Yentna area ranged from .5 to 33 years, and averaged 7.9 years. Overall, most residents have resided in the area for less than 10 years.

The age/sex structure of the population, depicted in Figure 8, reflects this immigration of most families into the area. The few individuals over 50 years of age are mostly males. Middle aged couples (ages 31-50) and their children (ages 11-20) comprise most of the population. The age/sex profile also reveals that there are few children under ten years of age and few young women in prime child-bearing years (ages 21-30). This suggests that the population is not yet reproducing itself; individuals must still find mates from outside the area.

Wage Employment and Other Sources of Monetary Income

Full time wage employment opportunities in which the sample of 126 Upper Yentna residents were involved during 1982-83 included positions as school teacher (3), weather reporter (2), equipment operator (1), postmaster (1), and facilities engineer (1). The remaining sources of cash income were seasonal, part time, and/or temporary. Some people worked outside the area on a seasonal or part time basis. Examples of local seasonal jobs include guiding hunters and fishermen (8), trapping (18), freighting (2), consulting (2), assisting at lodges (7), operating

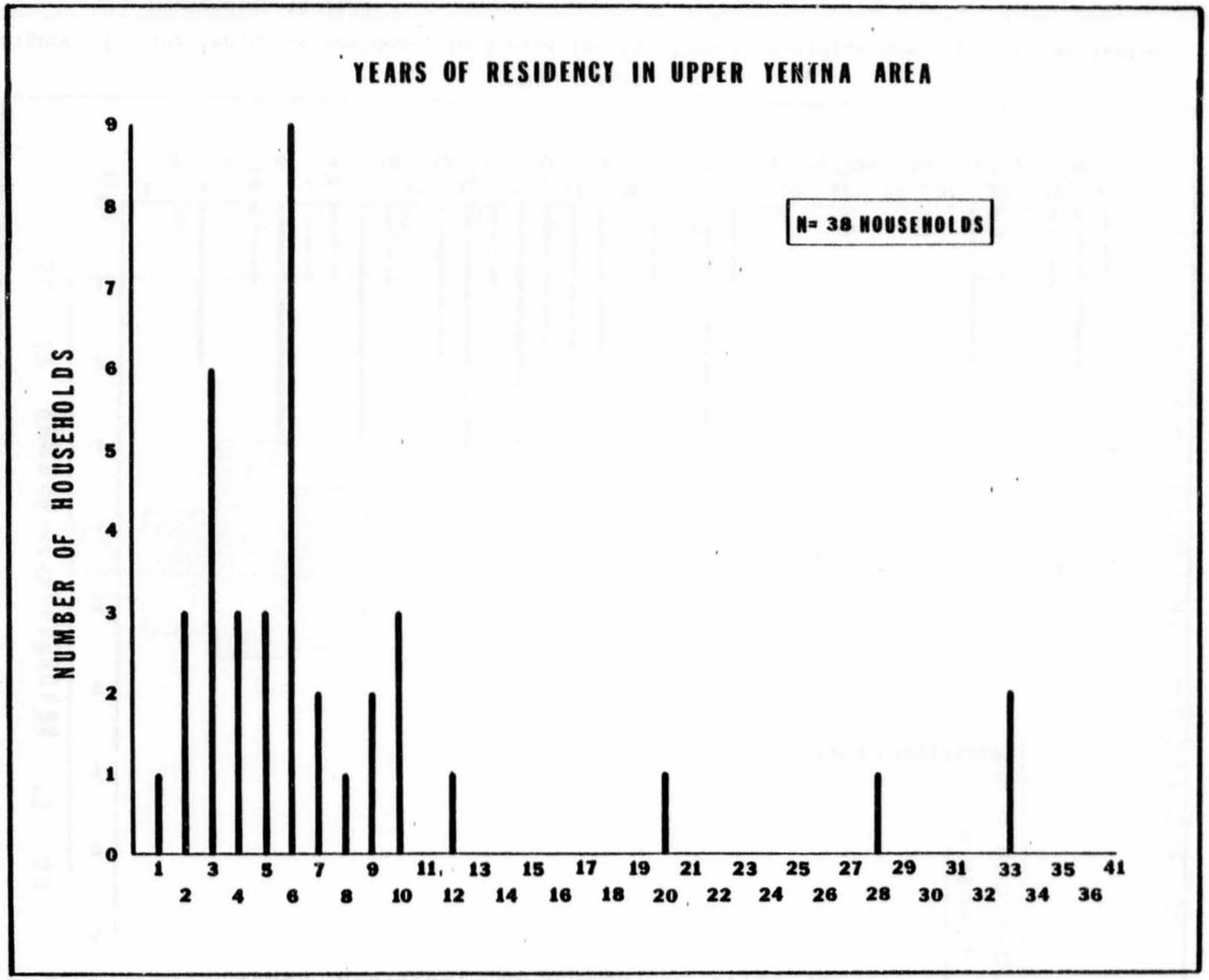


Figure 6. The length of residency in the Upper Yentna area for the longest residing member of each household in 1982

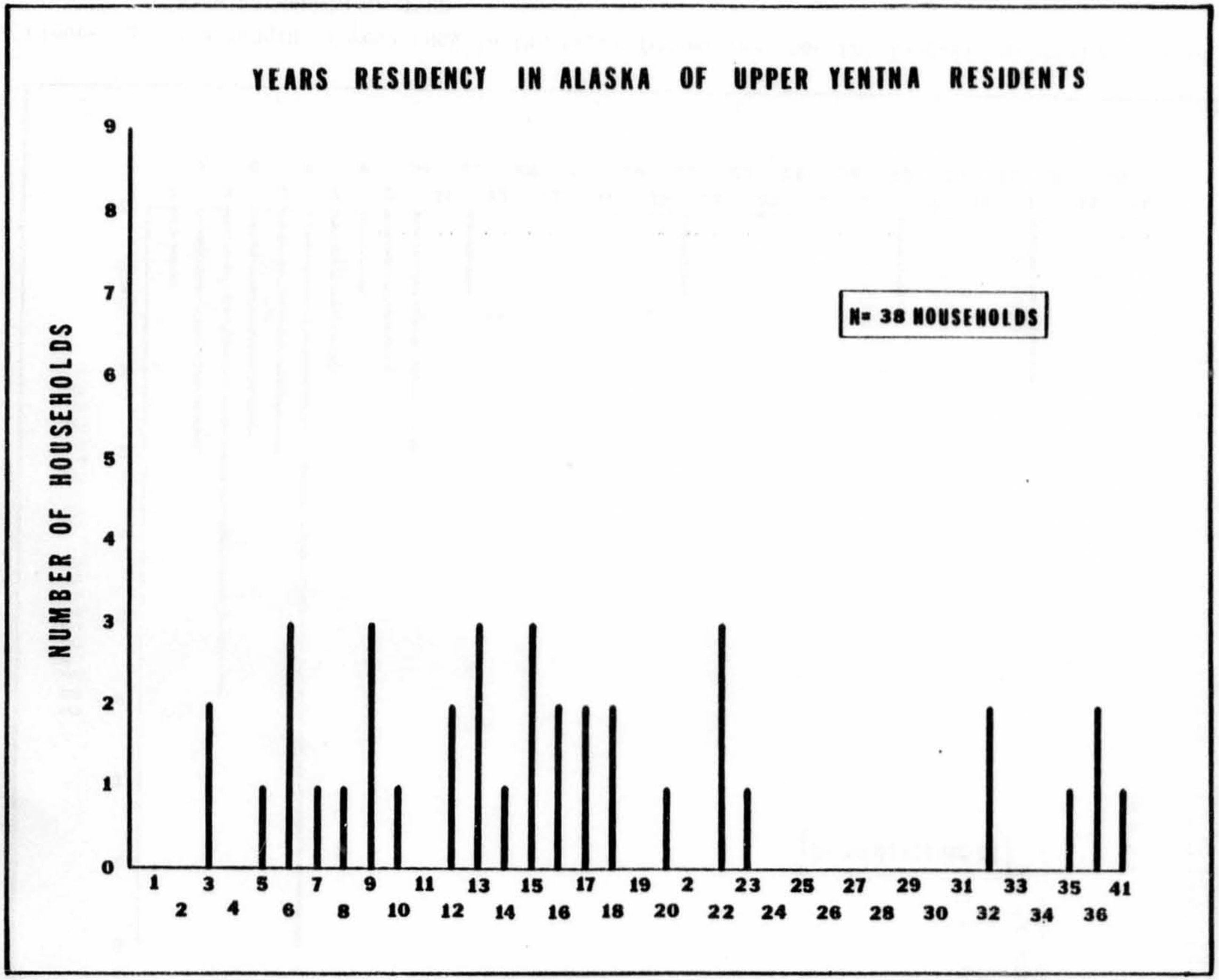


Figure 7. The length of residency in Alaska for the longest residing members in Upper Yentna households in 1982

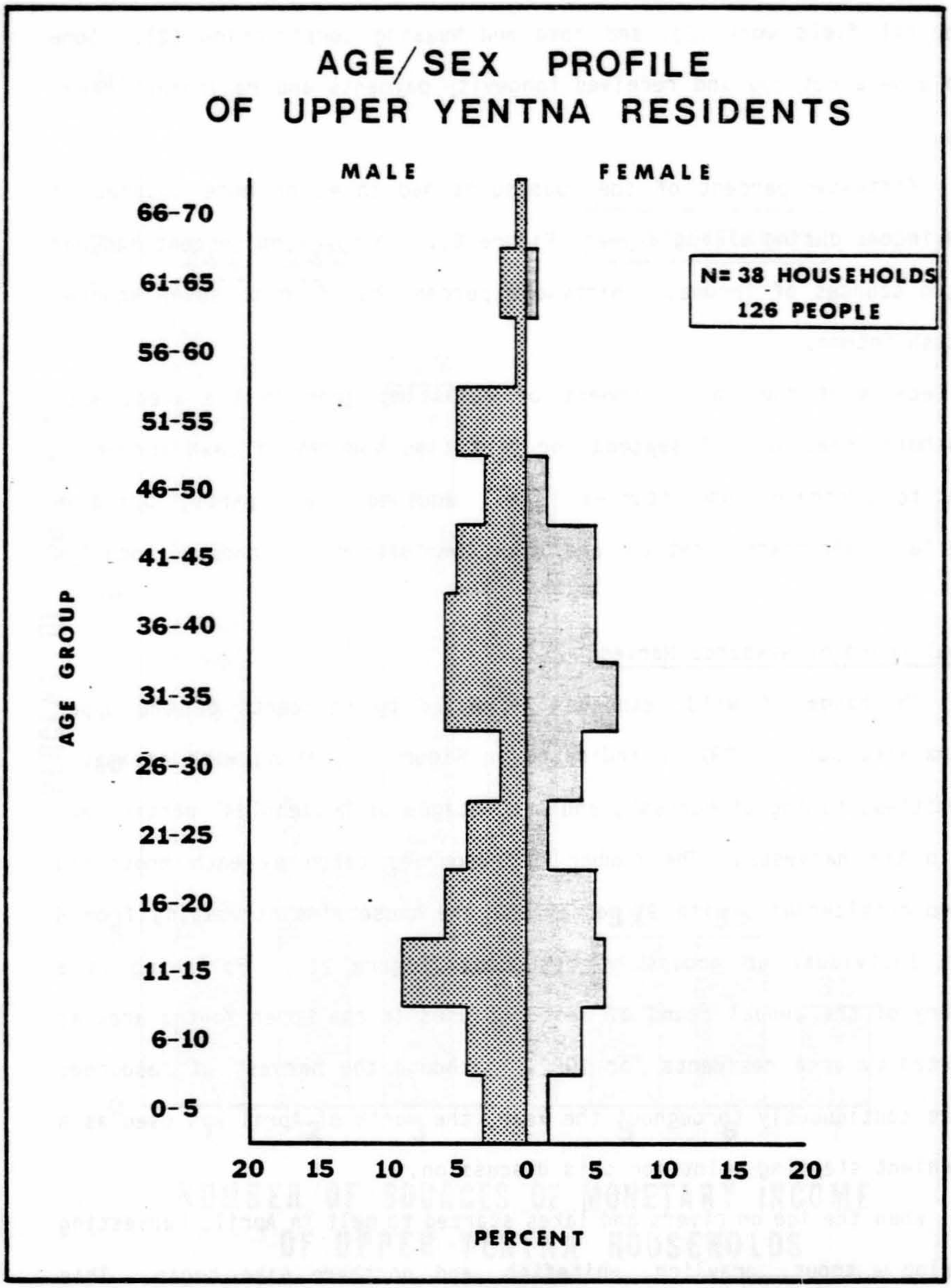


Figure 8. The age/sex structure of Upper Yentna households in 1982

the store (4), running river boats (3), and operating saw mills (2). Examples of nonlocal employment include commercial fishing (2), North Slope oil field work (2), and road and housing construction (2). Some people were retired and received longevity payments and retirement benefits.

Fifty-two percent of the households had three or more sources of cash income during a single year (Figure 9). Forty-eight percent had one to two sources of income. Thirty-one percent had four to seven sources of cash income.

Because of the small numbers of full-time jobs in the area, most households need several seasonal or part time sources of cash income in order to purchase food staples, fuel, equipment and parts, building materials, air transportation, and other commodities not produced locally.

Annual Round of Resource Harvest

The range of wild resources harvested by residents of the Upper Yentna area during 1982 is indicated in Figure 10, along with estimated quantities, timing of harvest, and percentages of households participating in the harvests. The number of resources taken by each household varied considerably, with 91 percent of the households harvesting from 6 to 25 individual or groups of resources (Figure 11). Following is a summary of the annual round of resource uses in the Upper Yentna area as reported by area residents for 1982. Although the harvest of resources occurs continuously throughout the year, the month of April was used as a convenient starting point for this discussion.

When the ice on rivers and lakes started to melt in April, harvesting of rainbow trout, grayling, whitefish, and northern pike began. This

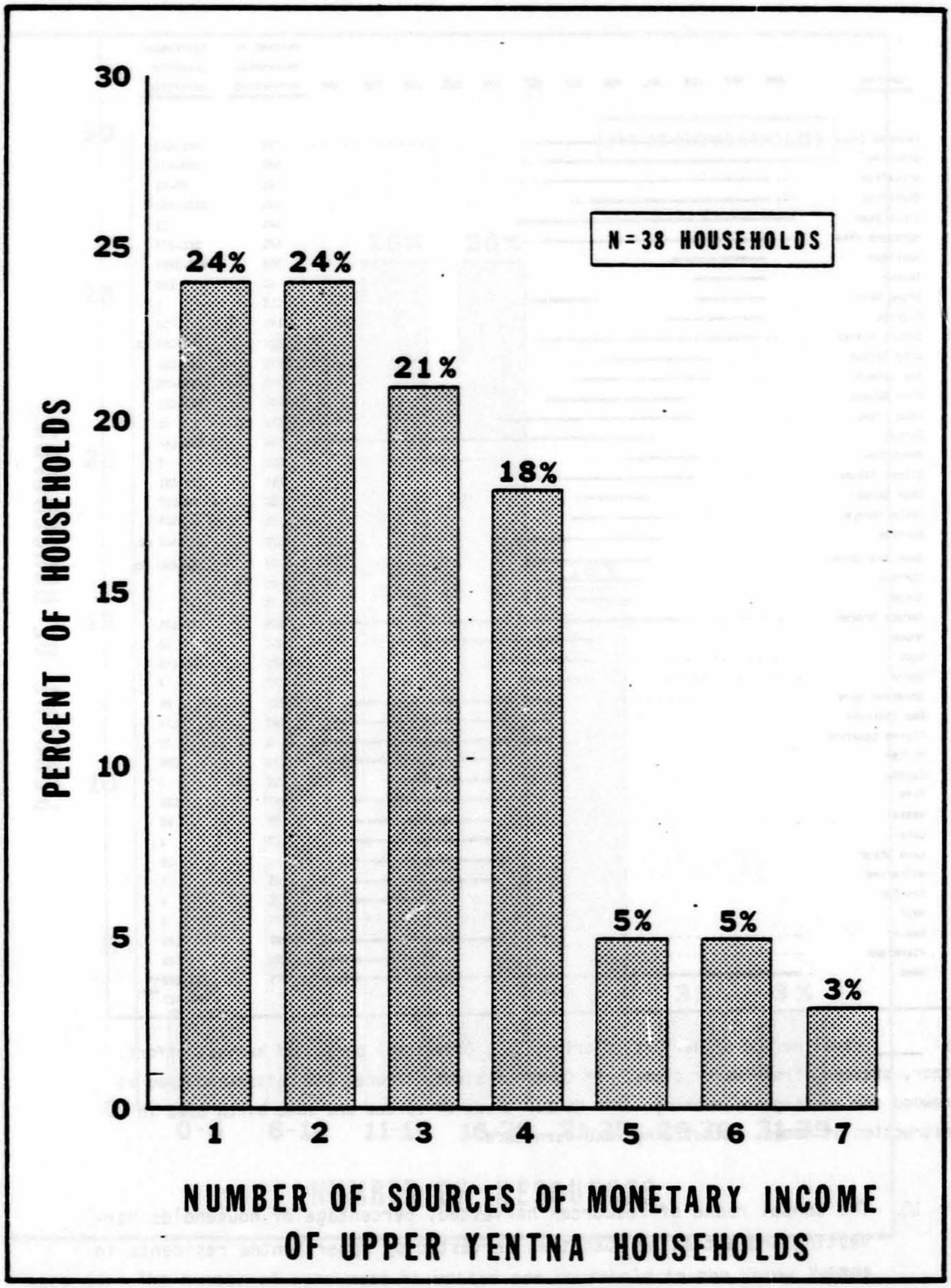
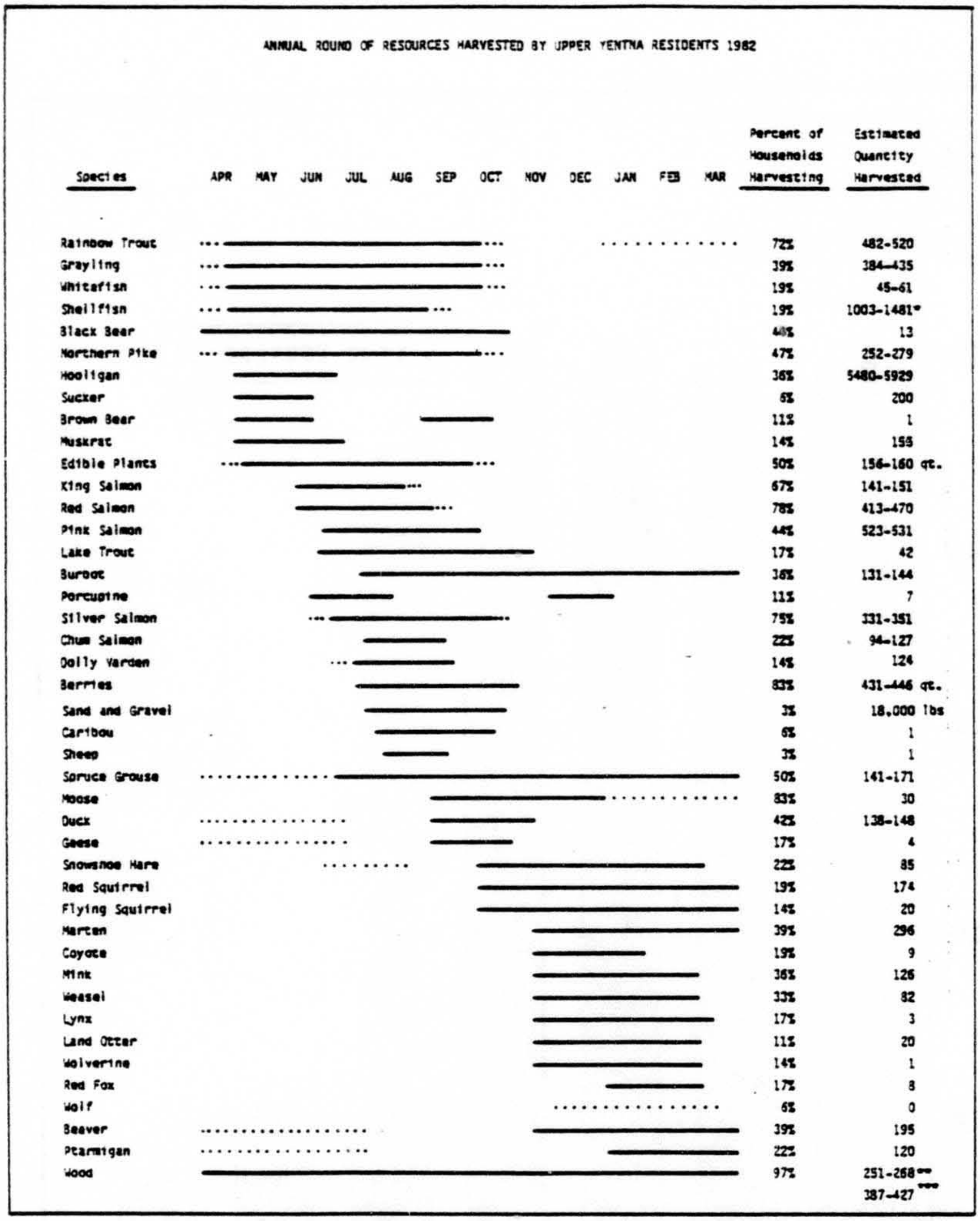


Figure 9. The number of sources of monetary income of Upper Yentna households in 1982



Key: _____ Usual period of harvest effort; ...... Occasional period of harvest effort. *Razor, steamer, fresh water clams. ** Cords of birch, spruce, and cottonwood used as firewood for heating and cooking. *** Number trees of spruce and some birch used in construction of homes, outbuildings and furniture.

Figure 10. The annual round of resources harvested, percentage of households harvesting and estimated quanities harvested by Upper Yentna residents in 1982

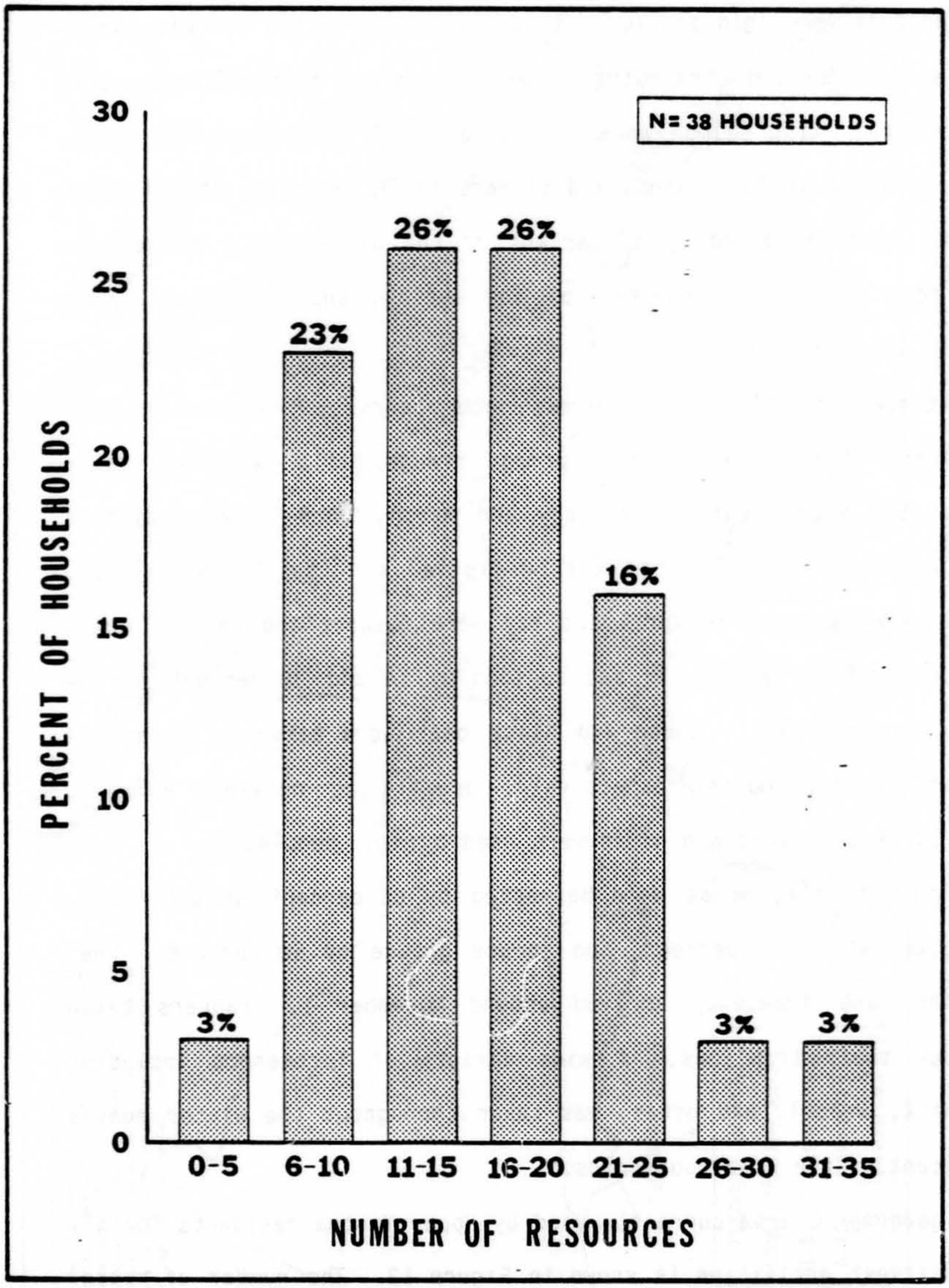


Figure 11 The number of resources harvested per household in the Upper Yentna area in 1982

continued through September. The percentage of households harvesting each species was as follows: rainbow trout--72 percent; northern pike--47 percent; grayling--39 percent; whitefish--19 percent. For a short period in May and June, hooligan and suckers were included in the harvest. Nearing the end of May and continuing through November, five salmon species were harvested: king salmon were harvested by 67 percent of the households, red salmon by 78 percent, and silvers by 75 percent. At this time lake trout were harvested by 17 percent of the households. Burbot was said to be a highly desired species for eating, and was taken by 36 percent of the households.

Plant species including edible mushrooms, berries, fireweed, and fiddlehead fern, were gathered from spring through fall. Wood was taken throughout the year. During February and March, when snow conditions were favorable for travel, wood was stockpiled for the following year. Among the mammals taken in April and May were muskrat and beaver, which were trapped primarily for fur and dogfood by 14 and 39 percent of the households respectively. Brown and black bear were taken by 11 and 44 percent of the households respectively, usually as nuisance animals, although black bear meat and hides were used by many people.

During the fall, moose were harvested by 83 percent of the households, waterfowl by 42 percent, and spruce grouse by 50 percent. When cold weather and freeze-up arrived around November 1, trappers began setting out their traplines. A wide variety of furbearers including marten, mink, weasel, and otter, was taken throughout the winter months by 40 percent of the area households.

The geographic area currently used by Upper Yentna residents for all resource harvest activities is shown in Figure 12. The number of households indicating use of a particular area varies depending upon the

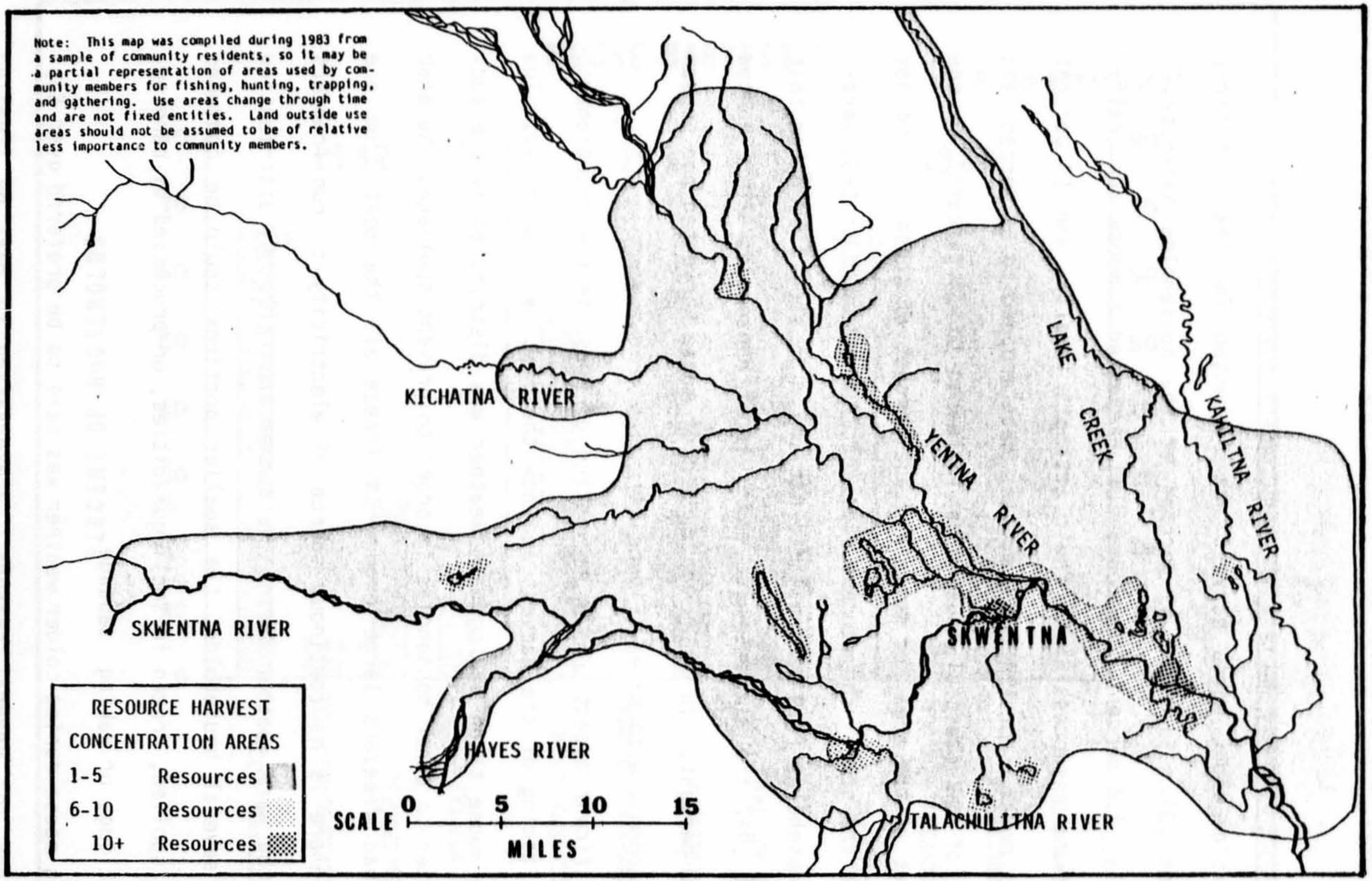


Figure 12. Geographic area currently used for resource harvest by Upper Yentna residents indicating levels of use (N=38)

proximity of the area to local residences, accessibility of the area by rivers, streams, and trails, and the variety of resources present.

Characteristics of Moose Harvest by Upper Yentna Residents

Information about moose harvest was requested for the past three years (Figure 13). In 1980, 63 percent of the households harvested a moose locally, 2.6 percent (one household) harvested a moose nonlocally, 21 percent were unsuccessful in their attempts locally, and 13 percent did not hunt moose. In 1981, the success rate dropped to 52 percent and the portion of unsuccessful households increased to 34 percent; no one travelled out of the area for moose and the percent of those who did not try remained the same. The success rate for 1982 returned to 1980 level, and fewer households (7.9 percent) did not try. It should be noted that in 1980 and 1982 the success rate among local households which hunted moose was 80 percent. In 1982, the number of moose harvested per household ranged from one to three (Figure 14).

A significant aspect of the harvesting of moose is the relationship between the timing of the harvest and how the meat is distributed. The meat of any moose taken during warm weather was distributed by the successful hunter to other households in order to prevent spoilage. No area households had freezers large enough to freeze all the meat from one moose, and there is no continous source of electricity to run freezers throughout the warm weather during the summer and fall. By distributing meat among several households, the smaller portions could be consumed before they spoiled, frozen in small quantities, or processed by canning, drying, pickling, or making sausage.

Hunting moose during colder weather was said to be preferrd over September seasons for several reasons. Preservation of meat by freezing

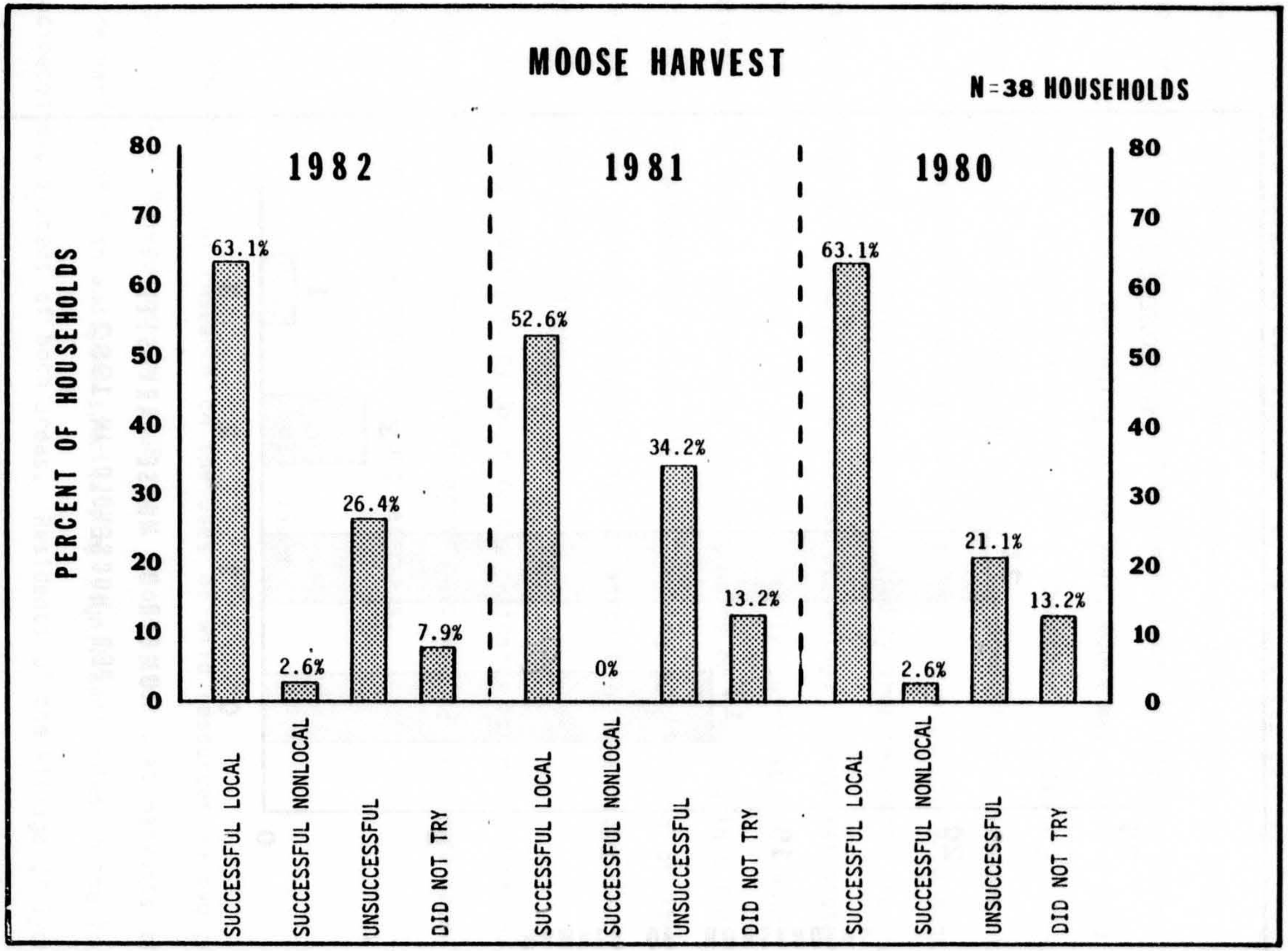


Figure 13. The three year moose harvest characteristics for Upper Yentna households, 1980-1982

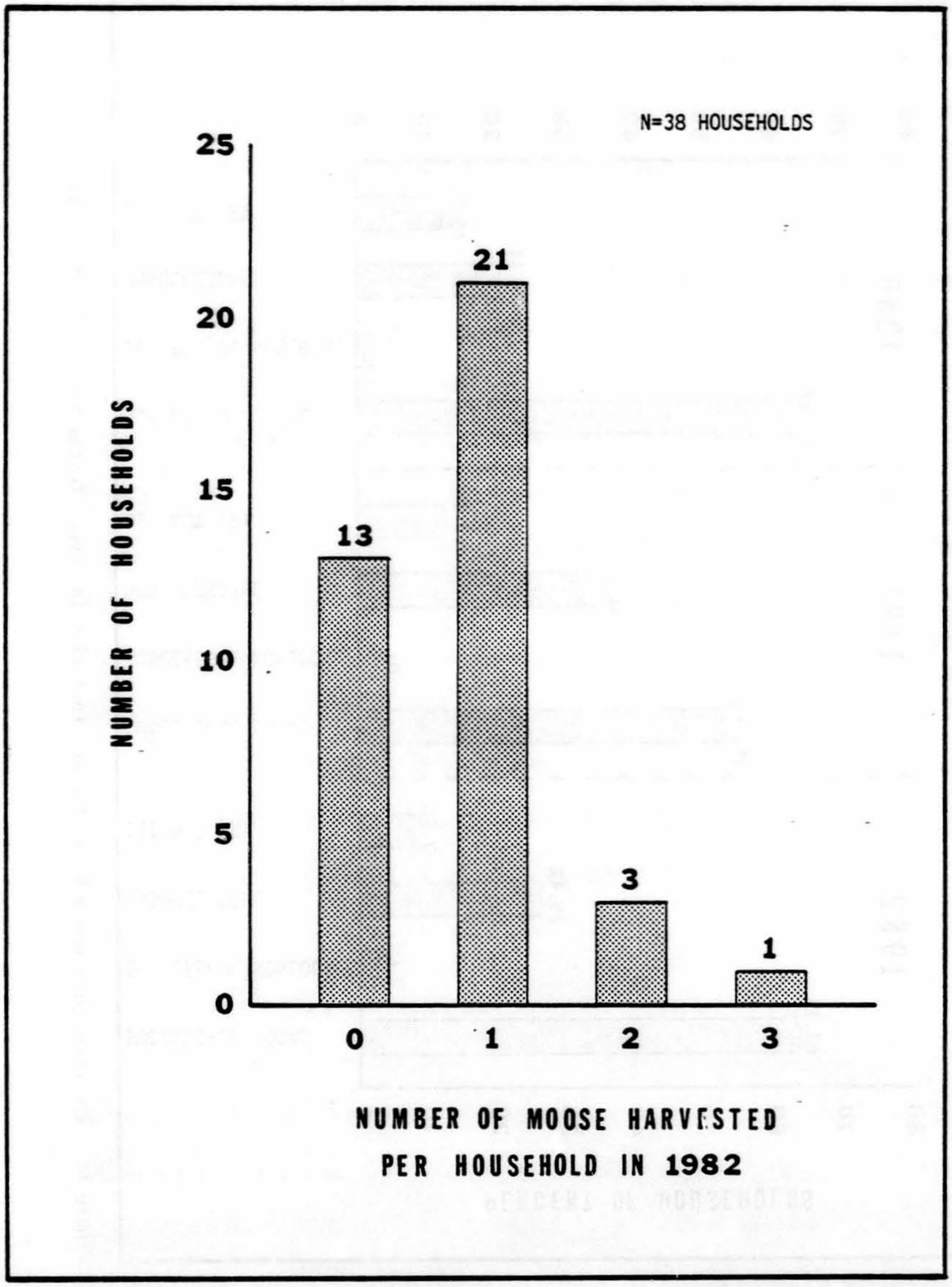


Figure 14. The household moose harvest for Upper Yentna households during 1982

outdoors is possible, and snow and/or ice conditions make hauling of the meat easier and, in most instances, possible. At this time, the lack of foliage makes selecting the desired size of moose easier. As previously mentioned, moose harvested before freeze-up usually are shared with other households and another animal would be needed later in the year to replenish the meat supply. Depending on the year, moose may not move into the local area from higher elevations until December or January. People cannot afford to fly to Anchorage to purchase domestic meat whenever they need it and keeping large quantities is impossible during warm months.

The methods of preserving moose meat used by area residents are indicated in Figures 15 and 16. The largest percentage of meat was preserved by freezing out-of-doors (48 percent). Nearly twice as much meat was preserved by this method than by either canning or freezing in a freezer. The greatest percentage of people used canning as a method of storage than any other method, although only 21 percent of the moose meat was actually preserved this way.

Geographic areas used by Upper Yentna residents for moose hunting are shown in Figure 17. Moose hunting areas most heavily used were those in the vicinity of residences and along waterways.

DISCUSSION

The results of research on the uses of wild resources in two portions of Game Management Unit 16B have demonstrated that harvests of a wide variety of fish and game species play significant roles in the local socioeconomic systems of both areas. Residents of the village of Tyonek and the Upper Yentna area harvest local wildlife resources in substantial

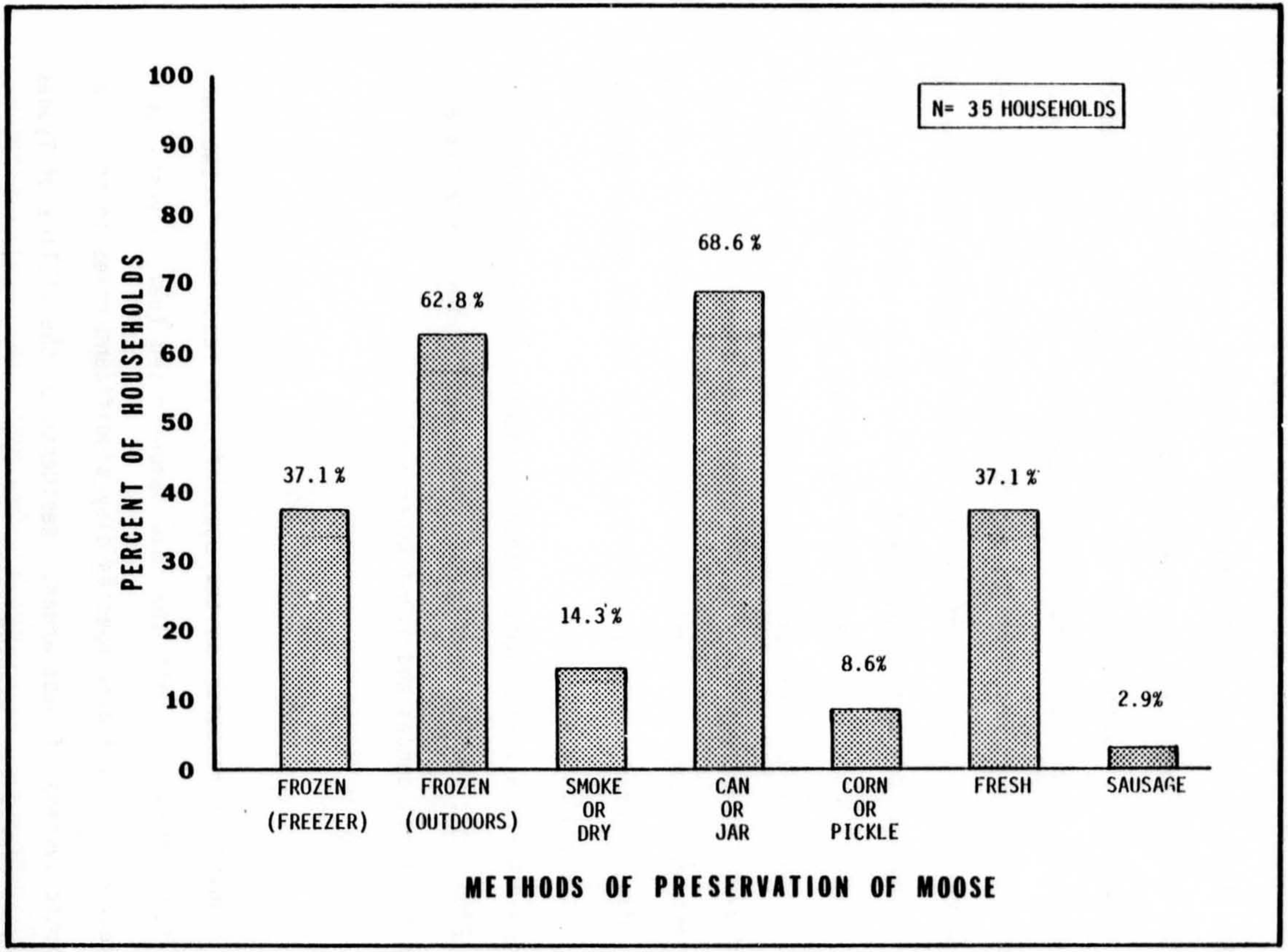


Figure 15. The methods of meat preservation used by Upper Yentna households during 1982

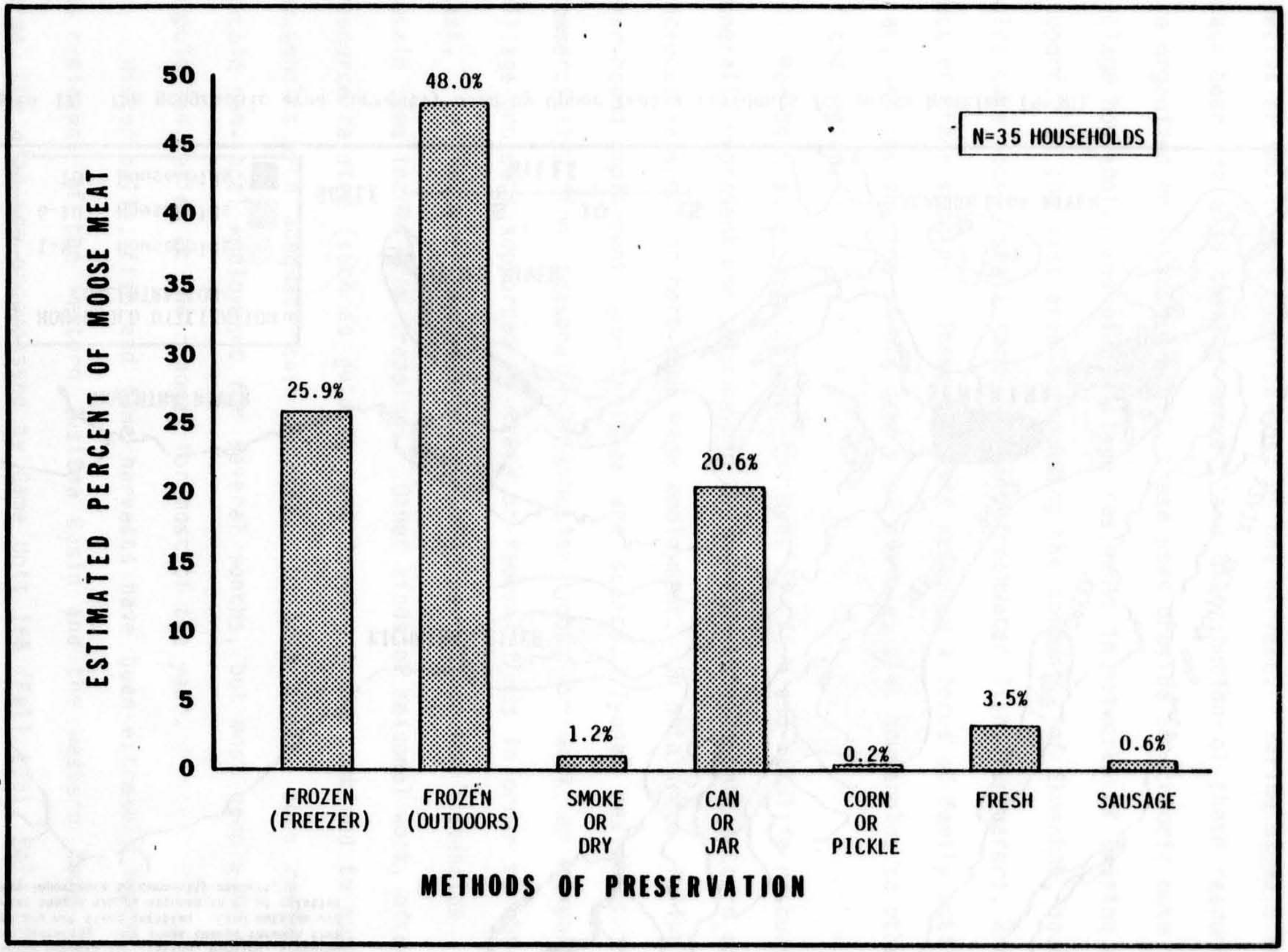


Figure 16. The amounts of moose meat preserved by various methods by Upper Yentna households in 1982

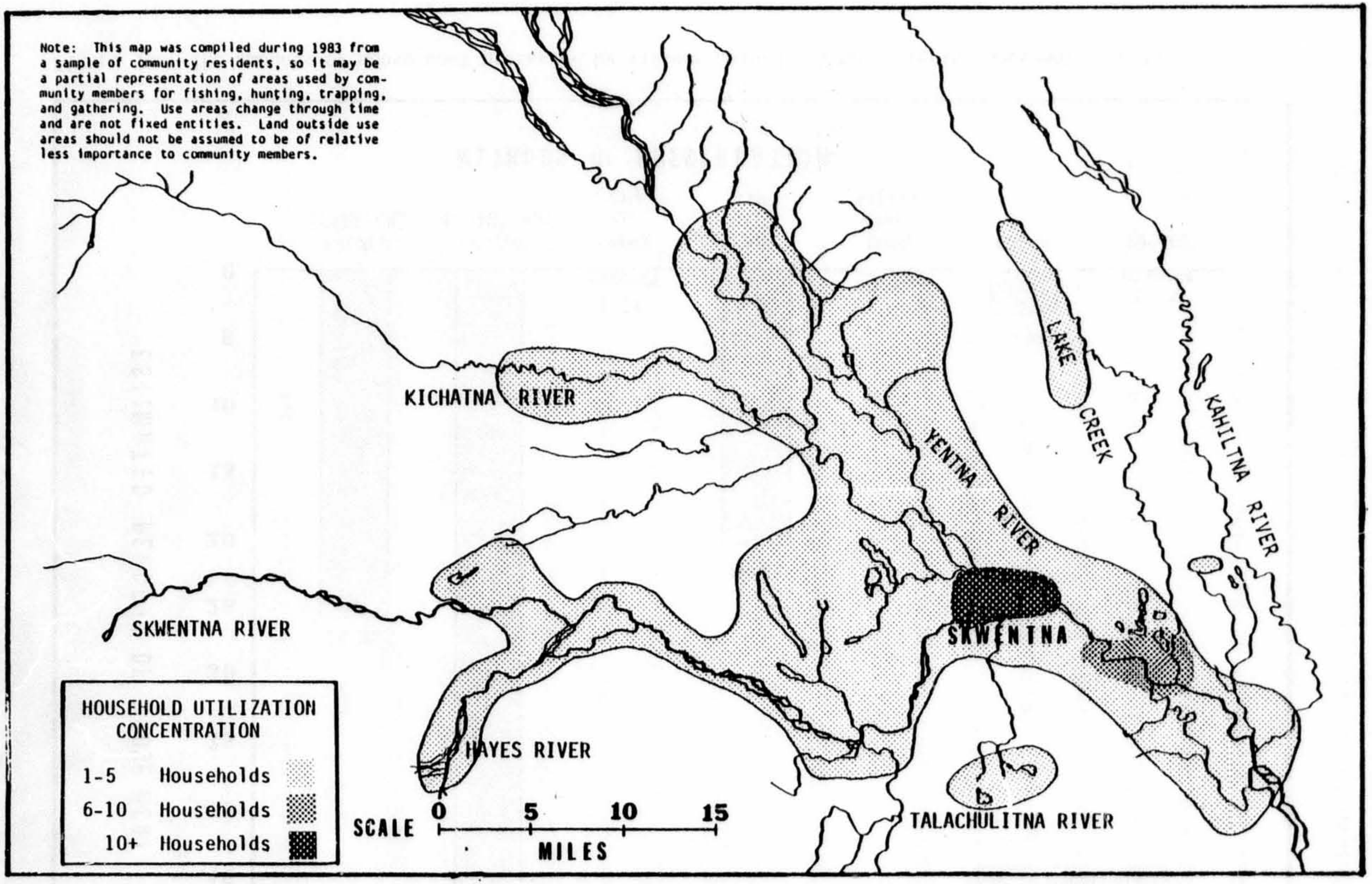


Figure 17. The geographic area currently used by Upper Yentna residents for moose hunting (N=38)

quantities according to an annual round of activities. In Tyonek, five species of salmon, clams, waterfowl, freshwater fish, moose, and several species of small game comprise most of the harvest. Marine mammals and black bear are also taken. Harvest and distribution of these resources are organized on a kinship basis; these uses provide an economic base for village households and bind village residents in networks of sharing and support. In the vast area surrounding the community of Skwentna, households take moose, small game, salmon, freshwater fish, furbearers, and a host of other species. These harvests serve as a focus of family activities, and the sharing of big game, for example, ties households to others of the region.

For both study populations, the uses of fish and wildlife resources generally represent one component of an overall socioeconomic pattern that includes seasonal or part-time wage employment. In both areas, full-time year-round employment opportunities are scarce. Tyonek residents fish commercially, find seasonal construction jobs, or work on temporary village projects supported by state or federal funds in order to obtain cash. In the Upper Yentna area, about 40 percent of the households obtain some income from trapping. Other kinds of seasonal work, often resource related (such as guiding, and logging,) are combined to supply households with adequate cash incomes. In both areas, some residents obtain non-local employment for several months, but most people in each population reside at their homes for most of the year.

Historically, fish and game harvests have been extremely important to residents of the western Susitna Basin and the western Cook Inlet area, the area now encompassed by Game Unit 16B (Fall 1981, Cole 1982). The aboriginal inhabitants of the area, the Upper Inlet Dena'ina, utilized all of this area for fish and game harvests until diseases reduced their numbers early in this century. While some Dena'ina continued to use portions of the Upper Yentna area seasonally into the 1940s, most former Native residents of the area and their descendents now reside in Tyonek. The area currently used by these and other Tyonek people has been harvested for fish and game by the Dena'ina since before recorded history. During the twentieth century, a small number of prospectors and trappers replaced the Dena'ina in the Upper Yentna area. In the 1900s and 1910s, many newcomers arrived or passed through the area to exploit the Cache Creek or Sunflower Basin mining districts. A few stayed on to hunt and trap. While there has been no subsequent industrial or other development in this region, in the last several decades state and federal land policies have resulted in the introduction of a small, permanent population in the area. As the findings of the first phase of the "Susitna Basin Resource Use Study" have demonstrated, these households have developed a pattern of hunting and fishing which in some ways resembles the historic resource use patterns of the area.

One component of the historic and contemporary resource patterns of the residents of Tyonek and in the Upper Yentna area is the use of moose. In the past, moose have been harvested throughout the fall and winter, generally as needed and as accessible, with a preference for hunting when temperatures permit preservation by freezing outdoors and when travel is convenient.

Findings of this report have demonstrated the widespread use of moose in both areas today. About 87 percent of Tyonek households have harvested moose over the last five years, although only 15 hunters were successful during the September 1981 season. In the Upper Yentna area, about 63 percent of the households reported a successful moose harvest in 1982. Residents cited the possibility of outdoor preservation, ease of travel, and accessibility as reasons for post-freeze up harvests. In both Tyonek and the Upper Yentna areas, the majority of hunters have expressed their desire to reopen a moose hunting season in November in the vicinity of their homes.

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APPENDIX A

I.D. NUMBER________ INTERVIEWER____________

DATE ____________ LOCATION ____________

1. Did you or any member of your household hunt, fish, trap, or gather wild resources in 1982? Yes______ No_______

2. Did your household use any wild resources harvested by other people in 1982? Yes______ No_______

3. I'd like to ask you some questions about your uses of wild resources in 1982. I'll review a list of resources. Please let me know if you harvested or used the resource in 1982. If 1982 was not a typical year, please tell me what is typical for your household. I'm also interested to know the methods you use to harvest resources, how much you harvest, and the time of year you harvest resources. I would also like to map your general harvest areas while we discuss these resources. As we conduct the interview one of us will go through the survey and record your responses to the questions. The other person will record any other information you wish to provide. We are interested in any observations and ideas which you may have about resources and their use in this area.

APPENDIX A CONT.

RESOURCE	KING SALMON	RED SALMON	SILVER SALMON	PINK SALMON	CHUM SALMON	RAINBOW TROUT	DOLLY VARDEN	GRAYLING	LAKE TROUT	BURBOT	NORTHERN PIKE	WHITEFISH	FLAT	BROAD	HOOLIGAN	LAMPREY (EEL)
DID YOU TRY TO HARVEST THIS IN 1982																
QUANTITY HARVESTED IN 1982?																
AMOUNT RECEIVED FROM OTHER HOUSEHOLDS																
METHOD OF HARVEST?																
METHOD OF TRANSPORTATION?																
RESOURCE USE? (TRADED, CONSUMED, SOLD, ETC.)																
QUANTITY CONSUMED?																
DISTANCE TRAVELED TO HARVEST RESOURCE?																
JANUARY																
FEBRUARY																
MARCH																
APRIL																
MAY																
JUNE																
JULY																
AUGUST																
SEPTEMBER																
OCTOBER																
NOVEMBER																
DECEMBER																

RESOURCE	FISH EGGS	SHELLFISH	OTHER	SEAL	MOOSE	CARIBOU	SHEEP	BLACK BEAR	BROWN BEAR	OTHER	SPRUCE GROUSE	RUFFED GROUSE	PTARMIGAN	WILLOW	ROCK	WHITE-TAIL
DID YOU TRY TO HARVEST THIS IN 1982																
QUANTITY HARVESTED IN 1982?																
AMOUNT RECEIVED FROM OTHER HOUSEHOLDS																
METHOD OF HARVEST?																
METHOD OF TRANSPORTATION?																
RESOURCE USE? (TRADED, CONSUMED, SOLD, ETC.)																
QUANTITY CONSUMED?																
DISTANCE TRAVELED TO HARVEST RESOURCE?																
JANUARY																
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JULY																
AUGUST																
SEPTEMBER																
OCTOBER																
NOVEMBER																
DECEMBER																

APPENDIX A CONT.

RESOURCE	DUCK	GEESE	CANADA	SNOW	SNOWSHOE HARE	PORCUPINE	RED SQUIRREL	GROUND SQUIRREL	FLYING SQUIRREL	MARMOT	MARTEN	RED FOX	COYOTE	WOLF	MINK	WEASEL
DID YOU TRY TO HARVEST THIS IN 1982																
QUANTITY HARVESTED IN 1982?																
AMOUNT RECEIVED FROM OTHER HOUSEHOLDS																
METHOD OF HARVEST?																
METHOD OF TRANSPORTATION?																
RESOURCE USE? (TRADED, CONSUMED, SOLD, ETC.)																
QUANTITY CONSUMED?																
DISTANCE TRAVELED TO HARVEST RESOURCE?																
JANUARY																
FEBRUARY																
MARCH																
APRIL																
MAY																
JUNE																
JULY																
AUGUST																
SEPTEMBER																
OCTOBER																
NOVEMBER																
DECEMBER																

I would now like you to think back a couple years about moose. Did you harvest a moose in 1982, 1981, 1980?

4. 1982	5. 1981	6. 1980
Yes, locally____	Yes, locally____	Yes, locally____
Yes, nonlocally____	Yes, nonlocally____	Yes, nonlocally____
No, but tried____	No, but tried____	No, but tried____
No, didn't try____	No, didn't try____	No, didn't try____
Not resident of area___	Not resident of area___	Not resident of area___

7. If the household did not harvest a moose in the last 3 years, when was the last time they harvested one locally?

Year ____________

Not a resident ____________

Never while a resident ____________

8. How do you preserve your moose meat? Estimate the percentage.

Frozen (freezer)________%

Frozen (outdoors)________%

Smoke/Dry________%

Can/Jar________%

Corn/Pickle________%

Salt________%

Fresh________%

Other________%

I would now like you to think back a couple years about moose. Did you harvest a moose in 1982, 1981, 1980?

4. 1982	5. 1981	6. 1980
Yes, locally____	Yes, locally____	Yes, locally____
Yes, nonlocally____	Yes, nonlocally____	Yes, nonlocally____
No, but tried____	No, but tried____	No, but tried____
No, didn't try____	No, didn't try____	No, didn't try____
Not resident of area____	Not resident of area____	Not resident of area____

7. If the household did not harvest a moose in the last 3 years, when was the last time they harvested one locally?

Year ____________

Not a resident ____________

Never while a resident ____________

8. How do you preserve your moose meat? Estimate the percentage.

Frozen (freezer)________%

Frozen (outdoors)________%

Smoke/Dry________%

Can/Jar________%

Corn/Pickle________%

Salt________%

Fresh________%

Other________%

9. In the past year, about how many households have given your household:

Game__________________

Fish__________________

Furs__________________

Berries_______________

Food Plants___________

10. In the past year, about how many households has your household given:

Game__________________

Fish__________________

Furs__________________

Berries_______________

Food Plants___________

11. Which of the following best describes how you get most of the resources you harvest?

	Individually	with relatives	with friends/partners
salmon fishing			
other fishing			
moose hunting			
sheep hunting			
trapping			
berry picking			

12. Please approximate what percent of your household meat, fish , and fowl in the past year has been from wild resources. ____________________%

13. Does your household raise a garden? yes_____ no______

14. (If yes) Please estimate the percentage of your produce which comes from your garden ________________% None bought in store? _______

15. Does anyone in your household engage in logging as a business in this area? yes_____ no_____

16. Does anyone in your household participate in mining? yes____ no_____

17. Do you own any of the following?

item	yes/no	approximate value
boat		
snowmachine		
airplane		
ATV		
dogteam		
automobile		
freezer		
smokehouse		
generator		
trapping cabin		

18. Which of the following are sources of household monetary income?

	location: town GMU
_____ guiding	____________
_____ trapping	____________
_____ commercial fishing	____________
_____ logging	____________
_____ mining	____________
_____ construction	____________
_____ other	____________
_____ other	____________
_____ other	

19. In terms of income, which of the above is most important? ________________

20. What kinds of resources/supplies must you get outside the area?

____

____

____

21. How many people live in this household?

	ages
males	____ ____ ____ ____ ____ ____ ____ ____ ____
females	____ ____ ____ ____ ____ ____ ____ ____ ____
total	____

22. Please indicate the longest time any household member has been in

Alaska______________

Skwentna area________

23. How many months did you stay in the Skwentna area in 1982? ________ months.

Explain prolonged absences.______________________________

____

____

24. How did you acquire your property/home (e.g. what program or through sales)

Homestead__________ Other________________

Subdivision________

Homesite__________

Purchased from previous owner__________

25. What are your ideas on a winter moose season in this Game Management Unit (16B)?

____

____

____

____

APPENDIX E

INSTREAM FLOW RECOMMENDATIONS
SUSITNA AREA PLAN

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1983

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INTRODUCTION

The 1980 Alaska State Legislature passed an amendment to the Water Use Act (AS 46.15.145) which allows reservation of water to protect fish and wildlife habitat, migration and propagation, for recreation and parks, for navigation and transportation, and for sanitary and water quality purposes. The Alaska Department of Fish and Game believes that the maintenance of fish and wildlife and their habitats are among the highest priority water uses in the Susitna basin.

The survival of anadromous and resident fish species within the Susitna basin depends not only upon identifying and protecting streams important for spawning and migration and managing fish populations wisely, but also upon insuring the availability of adequate seasonal water supplies within these streams. Seasonal water supplies, or instream flows, are a primary component of habitats used for spawning, incubation, rearing, overwintering, and passage of fish. The maintenance of instream flows assures that there will be enough water for fish to migrate to spawning areas, that eggs will not become desiccated and that rearing areas will remain wetted and accessible to juvenile fish seasonally. Winter water levels may be especially important to salmonid eggs and rearing fish. Seasonal flow regimes are also integral to determining the habitats of other aquatic and terrestrial biota.

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.

This discussion is primarily limited to lotic (flowing water) environments and their relationship to fish. However, all hydrologic systems, including groundwater and precipitation, are interrelated. Changes in any component of the hydrologic cycle may affect other components directly and in subtle and indirect ways.

INSTREAM FLOW EFFECTS

Historical records of stream flows in the Susitna basin are generally nonexistent or of insufficient duration to predict long-term flow patterns. In addition, data on instream flow requirements of specific stocks of Alaskan fishes are also incomplete. 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 in the Susitna basin are to be preserved, management decisions must consider seasonal fish and wildlife instream flow requirements, even if these requirements have not yet been specifically quantified.

Physical and biological parameters influenced by instream flows, and the consequences resulting from seasonal flow modifications are described below.

Effects of Instream Flows on Physical Parameters

Physical parameters which influence aquatic environments 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). Each of these factors is strongly controlled by the flow levels in a stream.

Because hydrologic systems maintain a state of dynamic equilibrium, change in any one of these factors will usually result in changes in the other parameters. For example, watershed alterations such as land clearing can increase erosion and consequently increase the amount of sediment entering a particular stream. If there is too much material entering the channel to remain suspended, sediments begin to deposit. Over time, this deposition results in changes to the channel slope and stream velocity. Eventually channel slope will decrease until the streamflow velocity is just high enough to transport the amount of material entering the stream, and an equilibrium will be reached.

Alterations in instream flows resulting from impoundments, diversions, channelizations or withdrawals also cause changes in stream equilibrium. There may be substantial changes in flow regime, channel shape, wetted area, substrate characteristics or water quality as the stream moves toward equilibrium. Moreover, these changes may affect areas far downstream from the original disturbance. Disturbances such as channelizations and impoundments may also cause stream readjustments upstream and downstream from the disturbance.

The complexity of the physical interactions is compounded by natural fluctuation in flows with season and climate. As a result, changes produced by alterations in lotic systems stem from both the amount of modification (e.g., volume of flow withdrawal or alteration) and from the timing of the modification in relation to normal seasonal flow fluctuations. For example, certain periodic high flows (e.g., bankfull discharge) are responsible for maintaining channel morphology by flushing sediments or transporting bed load. Reduction, elimination, or rescheduling of regular high flows (e.g., during flood control) can have serious consequences on channel characteristics. On the other hand, during some high flows it is possible to withdraw water for human consumption, storage or industrial use with only minor effects to the stream system. During low flows, withdrawals represent a larger proportion of available instream flow and are more difficult to manage without inducing adverse changes to the stream environment. The complexity of these possible interactions, and effects of modifying them, must be considered on both a seasonal and cumulative basis for specific waterways.

Effects of Instream Flows on Biological Parameters

Although this discussion emphasizes effects on fisheries, instream flows also affect other aquatic organisms and the riparian and terrestrial wildlife associated with the lotic environment. For example, flow regimes 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 and muskrat.

Modifications of instream flows, and the associated change to the physical environment, may have very significant effects to the fisheries resources. Specifically, streamflow modifications may cause changes to spawning, incubation, rearing, overwintering, and passage habitats. For example, decreased flows may prevent upstream or downstream passage of fish and may reduce the quantity or extent of spawning and rearing habitats. Reduced flows may also lead to silt deposition and reduced oxygen levels in spawning gravels, and therefore, cause suffocation of incubating eggs, pre-emergent fry and other aquatic organisms. Increased flows may wash away spawning gravel or destroy sheltering areas. Both decreases and increases in flows may alter stream productivity and thus modify food availability in rearing and overwintering habitats.

Alterations in flow regimes may also affect the seasonal behavior of fish species. Hynes[1] 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... 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.

---

1 Hynes H.B.N. 1970. The Ecology of Running Waters. University of Toronto Press. 555p.

The complex interrelationships between instream flows and seasonal fish behavior are compounded by the seasonal flow requirements of a particular species. For example, returning salmon 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[2]). The preservation of fisheries resources requires that certain volumes of instream flow be maintained and that specific flows be available at particular times of the year. Tennant[3] provides a valuable discussion of the "instantaneous flow" percentages of average annual streamflow required to maintain particular levels of aquatic resources. He suggests that stream degradation begins with the first reduction in flow, and not after an arbitrary minimum flow level has been reached. Orsborn and Estes[4] 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[5] provide a general literature review of methods to assess instream flows in Alaska.

INSTREAM FLOW RECOMMENDATIONS

Protection of fisheries resources and other aquatic resources in the Susitna basin requires that seasonal resource-maintenance flows be defined, established, and legally reserved.

The Alaska Department of Fish and Game recommends that decisions 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 hydrologist:

1. physical effects of seasonal flow alterations;

2. biological effects of seasonal flow alterations;

3. seasonal variation in physical and biological effects;

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

5. ability to mitigate effects of altered flow regimes.

---

[2] ibid

[3] Tennant, D.L.1975. Instream Flow Regimes for Fish, Wildlife, Recreation and Related Environmental Resources. U.S. Fish and Wildlife Service, Billings, Montana.

[4] Orsborn, J.F., C. Estes 1981. Alaska Department of Fish and Game. Unpublished Report.

[5] Ott, A.G., and K.E. Tarbox. 1977. "Instream Flow" Applicability of Existing Methodologies for Alaska Waters. Woodward-Clyde Consultants, Anchorage, Alaska, 70 pp.

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 assessments.

Specific instream flows will not be recommended at this time because flow data within the Susitna basin are minimal or non-existent on most of the streams identified. Alaska Department of Fish and Game proposes the postponement of any water withdrawals which will cause loss of fish or wildlife habitat until studies have been conducted to determine the extent of habitat loss and to propose acceptable mitigation measures. This condition should apply except where water is being appropriated for municipal or domestic use. Investigations are needed to determine flow regimes and the effects of reduced flows on fish and wildlife habitat.

Criteria for Stream Recommendations and Instream Flow Considerations

Specific waterbodies in the Susitna basin were identified as being important for reservations of water to maintain the instream flow and aquatic habitat values.

These areas were considered and selected based on the following criteria: fisheries and wildlife values, unique habitat characteristics and their potential for recreational use. Streams were defined as important for fisheries if escapements were greater than 1,000 for sockeye, coho, pink and chum salmon combined or greater than 500 for chinook salmon (Table 1). Each identified waterbody significantly contributes to the returning salmon population used for commercial harvest, recreation and continued propagation of salmon. Table 2 lists sport fishing effort days for select streams within the Susitna Area Plan. Harvest information was obtained from the Statewide Harvest Study for 1979 and 1980, and from a Sport Fishing Location, Access, and Effort Map, Alaska Department of Fish and Game, Sport Fish Division 1983.

Proposed Guidelines to Protect Instream Flows

Except for domestic use, the maintenance of fish stocks is the highest priority water use in the study area. It is the Alaska Department of Fish and Game's goal to:

1. maintain the historic levels of productivity of fish and wildlife populations and the carrying capacity of their natural habitats and

2. provide for optimum commercial, recreational, and subsistence use of fish and wildlife populations through conservation and management.

The following recommendations are based upon general habitat and land management practices. These issues need to be addressed if the productivity

TABLE 1(a). Salmon Escapement/Harvest Data for Susitna Area Plan Systems Upper Cook Inlet West Side Systems

Area	Year	Chinook	Sockeye	Coho	Chum	Pink	Reference
Beluga River	1980			520(E)		1,500(E)	CIAA
Bishop Creek	1977	468(E)					CIAA
Coal Creek	1972		1,250(E)				CIAA
	1978	1,551(E)	2,313(E)				CIAA
Coal Creek Lake	1972		1,700(E)				CIAA
	1981		1,100(E)				CIAA
Drill Creek	1980	1,000(E)				5,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Olson Creek	1977	1,229(E)					CIAA
Pretty Creek	1980					1,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Scarp Creek	*	1,000(E)					Per.Comm. 1983 Div. of SF/ADF&G
West Fork	*		1,000(E)				Per.Comm. 1983 Div. of SF/ADF&G
Chakachatna River	1982	1,300(E)	1,000(E)	1,000(E)	500(E)		Per.Comm. 1983 Div. of SF/ADF&G
Noaukta Slough	1981		5,000(E)				Per.Comm. 1983 Div. of SF/ADF&G
Straight Creek	1981		3,000(E)				WWC
	*					5,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Tributary to Straight Creek	1982	1,300(E)	3,000(E)			5,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Chuitna River	1976-79	1,130-1,984(E)					DE
	*			1,000(E)			Per.Comm. 1983 Div. of SF/ADF&G
BHW Creek	1982	285(E)		1,000(E)			Per.Comm. 1983 Div. of SF/ADF&G
Chuit Creek	1982	1,000(E)		1,000(E)			Per.Comm. 1983 Div. of SF/ADF&G
Lone Creek	*			5,000(E)			Per.Comm. 1983 Div. of SF/ADF&G
	1982	548(E)					
Middle Creek	1982	150(E)		1,500(E)			Per.Comm. 1983 Div. of SF/ADF&G
Wolverine Fork	1982			1,000(E)			Per.Comm. 1983 Div. of SF/ADF&G
Lewis River	1978, 1979, 1981	546-560(E)					CIAA
	*			1,000(E)		5,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Nikolai Creek	*			500(E)		10,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
	1982	500(E)					Per.Comm. 1983 Div. of SF/ADF&G
Theodore River	1976-79, 1981	512-2,263(E)					CIAA
	*			1,000(E)		5,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Threemile Creek	*		1,000(E)	1,000(E)		5,000(E)	Per.Comm. 1983 Div. of SF/ADF&G

Legend A DOWL Engineers (DE)
Cook Inlet Aquaculture Association (CIAA)
Woodward-Clyde (WWC)
Personal Communication, Division of Sport Fish, Alaska Department of Fish and Game
Escapement data (E)
Harvest data (H)
NOTE: Escapement and harvest data do not necessarily estimate the total stream escapement.
*Escapement estimates from several years of observation

TABLE 1(b). Salmon Escapement/Harvest Data for Yentna River Drainage

Area	Year	Chinook	Sockeye	Coho	Chum	Pink	References
Bear Creek	*	100(E)				5,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Cache Creek	1983	500(E)					Per.Comm. 1983 Div. of SF/ADF&G
Clearwater Creek	*	100(E)				5,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Contact Creek	*	100(E)				1,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Canyon Creek	1983	575(E)					Per.Comm. 1983 Div. of SF/ADF&G
Donkey Creek	*	100(E)	1,000(E)			5,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Eightmile Creek	1982			1,000(E)			Per.Comm. 1983 Div. of SF/ADF&G
	1983	250(E)					Per.Comm. 1983 Div. of SF/ADF&G
Fish Creek	1982			1,000(E)			Per.Comm. 1983 Div. of SF/ADF&G
Happy River	1983	500(E)					Per.Comm. 1983 Div. of SF/ADF&G
Puntella Lake	1977		2,100(E)				Stream Survey Data ADF&G
	1978		1,105(E)				Stream Survey Data ADF&G
Hewitt Lake	1976, 1978, 1980		1,200-2,017(E)				Stream Survey Data ADF&G
Hewitt & Whiskey Lake	1981		9,850(E)				Stream Survey Data ADF&G
Huckleberry Creek	1980	1,750(E)					Stream Survey Data ADF&G
Hungryman Creek	*	100(E)	5,000(E)				Per.Comm. 1983 Div. of SF/ADF&G
Kichatna	*	1,000(E)	10,000(E)			10,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Nakochna River	*					1,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Lake Creek	1976-79	3,735-8,931(E)					Stream Survey Data ADF&G
		6,000(E)	5,000(E)	2,500(E)	15,000(E)	500,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Camp Creek	1983	1,000(E)					Per.Comm. 1983 Div. of SF/ADF&G
Chelatna Lake	1980		4,120(E)				Stream Survey Data ADF&G
	1981		14,900(E)				Stream Survey Data ADF&G
Home Creek	1982	500(E)					Per.Comm. 1983 Div. of SF/ADF&G
Sunflower	1983	1,000(E)					Per.Comm. 1983 Div. of SF/ADF&G
unnamed tributary	1980					500(E)	Per.Comm. 1983 Div. of SF/ADF&G
(T.25N., R.10W., SM)	1983	250(E)		250(E)			Per.Comm. 1983 Div. of SF/ADF&G
Yenlo Creek	1977	1,061(E)					Stream Survey Data ADF&G
	1982			500(E)		2.500(E)	Per.Comm. 1983 Div. of SF/ADF&G
Peters Creek	1976	1,489(E)					Stream Survey Data ADF&G
	*	4,000(E)		1,000(E)		10,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
	1982			500(E)		500(E)	Per.Comm. 1983 Div. of SF/ADF&G
Black Creek	1983	100(E)					Per.Comm. 1983 Div. of SF/ADF&G
	1982			500(E)		500(E)	Per.Comm. 1983 Div. of SF/ADF&G
Kenny Creek	1983	100(E)					Per.Comm. 1983 Div. of SF/ADF&G
Martin Creek	1976	791(E)					Stream Survey Data ADF&G
	1977	1,061(E)					Stream Survey Data ADF&G
Pickle Creek	*					5,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Portage Creek	1980					1,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Quartz Creek	1981		1,210(E)				Stream Survey Data ADF&G
Quiggs Creek	1982			500(E)			Per.Comm. 1983 Div. of SF/ADF&G
	1983	250(E)	1,000(E)				Per.Comm. 1983 Div. of SF/ADF&G

TABLE 1(b). Salmon Escapement/Harvest Data for Yentna River Drainage

Area	Year	Chinook	Sockeye	Coho	Chum	Pink	References
Bear Creek	*	100(E)				5,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Cache Creek	1983	500(E)					Per.Comm. 1983 Div. of SF/ADF&G
Clearwater Creek	*	100(E)				5,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Contact Creek	*	100(E)				1,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Canyon Creek	1983	575(E)					Per.Comm. 1983 Div. of SF/ADF&G
Donkey Creek	*	100(E)	1,000(E)			5,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Eightmile Creek	1982			1,000(E)			Per.Comm. 1983 Div. of SF/ADF&G
	1983	250(E)					Per.Comm. 1983 Div. of SF/ADF&G
Fish Creek	1982			1,000(E)			Per.Comm. 1983 Div. of SF/ADF&G
Happy River	1983	500(E)					Per.Comm. 1983 Div. of SF/ADF&G
Puntella Lake	1977		2,100(E)				Stream Survey Data ADF&G
	1978		1,105(E)				Stream Survey Data ADF&G
Hewitt Lake	1976, 1978, 1980		1,200-2,017(E)				Stream Survey Data ADF&G
Hewitt & Whiskey Lake	1981		9,850(E)				Stream Survey Data ADF&G
Huckleberry Creek	1980	1,750(E)					Stream Survey Data ADF&G
Hungryman Creek	*	100(E)	5,000(E)				Per.Comm. 1983 Div. of SF/ADF&G
Kichatna	*	1,000(E)	10,000(E)			10,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Nakochna River	*					1,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Lake Creek	1976-79	3,735-8,931(E)					Stream Survey Data ADF&G
		6,000(E)	5,000(E)	2,500(E)	15,000(E)	500,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Camp Creek	1983	1,000(E)					Per.Comm. 1983 Div. of SF/ADF&G
Chelatna Lake	1980		4,120(E)				Stream Survey Data ADF&G
	1981		14,900(E)				Stream Survey Data ADF&G
Home Creek	1982	500(E)					Per.Comm. 1983 Div. of SF/ADF&G
Sunflower	1983	1,000(E)					Per.Comm. 1983 Div. of SF/ADF&G
unnamed tributary	1980					500(E)	Per.Comm. 1983 Div. of SF/ADF&G
(T.25N., R.10W., SM)	1983	250(E)		250(E)			Per.Comm. 1983 Div. of SF/ADF&G
Yenlo Creek	1977	1,061(E)					Stream Survey Data ADF&G
	1982			500(E)		2,500(E)	Per.Comm. 1983 Div. of SF/ADF&G
Peters Creek	1976	1,489(E)					Stream Survey Data ADF&G
	*	4,000(E)		1,000(E)		10,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
	1982			500(E)		500(E)	Per.Comm. 1983 Div. of SF/ADF&G
Black Creek	1983	100(E)					Per.Comm. 1983 Div. of SF/ADF&G
	1982			500(E)		500(E)	Per.Comm. 1983 Div. of SF/ADF&G
Kenny Creek	1983	100(E)					Per.Comm. 1983 Div. of SF/ADF&G
Martin Creek	1976	791(E)					Stream Survey Data ADF&G
	1977	1,061(E)					Stream Survey Data ADF&G
Pickle Creek	*					5,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Portage Creek	1980					1,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Quartz Creek	1981		1,210(E)				Stream Survey Data ADF&G
Quiggs Creek	1982			500(E)			Per.Comm. 1983 Div. of SF/ADF&G
	1983	250(E)	1,000(E)				Per.Comm. 1983 Div. of SF/ADF&G

TABLE 1(b). [continued] Salmon Escapement/Harvest Data for Yentna River Drainage

Area	Year	Chinook	Sockeye	Coho	Chum	Pink	References
Red Creek	1977	1,511(E)					Stream Survey Data ADF&G
	1981	749(E)					Stream Survey Data ADF&G
	*					5,100(E)	Per.Comm. 1983 Div. of SF/ADF&G
Johnson Creek	*					5,100(E)	Per.Comm. 1983 Div. of SF/ADF&G
Red Salmon Lake	1980		1,100(E)				Stream Survey Data ADF&G
Shell Creek	1979		1,000(E)				Stream Survey Data ADF&G
	1981		5,100(E)				Stream Survey Data ADF&G
Shell Lake	1980		5,500(H)				Sport Fish Harvest ADF&G
	1981		6,050(H)				Sport Fish Harvest ADF&G
Talachulitna R. System	1976-81	1,319-2,025(E)	9,295-25,935(E)			30,000-500,000(E)	Stream Survey Data ADF&G
	*			2,000(E)	10,000(E)	500,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Friday Creek	1983	950(E)					Per.Comm. 1983 Div. of SF/ADF&G
Judd Lake	1973-75		4,720-10,364(E)				Stream Survey Data ADF&G
Saturday Creek	1983	600(E)					Per.Comm. 1983 Div. of SF/ADF&G
Talachulitna Creek	1973		1,350(E)				Stream Survey Data ADF&G
Talachulitna River	1976, 77, 79	1,319-1,856(E)	2,699-29,935(E)			30,000(E)	Stream Survey Data ADF&G
Twentymile Creek	1983		2,000(E)			1,000(E)	Per.Comm. 1983 Div. of SF/ADF&G

Legend B Stream Survey Data courtesy of Alaska Department of Fish and Game, Division of Commercial Fisheries, Division of Sport Fish and Fisheries Rehabilitation, Enhancement and Development Division, and Cook Inlet Aquaculture Association
Sport Fish Harvest - State Harvest Study 1980 Data, Alaska Department of Fish and Game, Division of Sport Fish
Personal Communication, Division of Sport Fish, Alaska Department of Fish and Game
Escapement data (E)
Harvest data (H)

NOTE: Escapement and harvest data do not necessarily estimate the total stream escapement.

*Escapement estimates from several years of observation

TABLE 1(c). Salmon Escapement/Harvest Data for Susitna River Tributaries

Area	Year	Chinook	Sockeye	Coho	Chum	Pink	References
Alexander Creek	1976-79	5,412-13,385(E)					Stream Survey Data ADF&G
	1979			1,560(H)			Sport Fish Harvest ADF&G
	*		5,000(E)			250,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Upper & Lower Sucker	1983	500(E)					Per.Comm. 1983 Div. of SF/ADF&G
Wolverine	1983	500(E)					Per.Comm. 1983 Div. of SF/ADF&G
Birch Creek	1972					3,051(E)	Stream Survey Data ADF&G
Fish Lakes	1980		2,100(E)				Stream Survey Data ADF&G
Sheep Creek	1980					10,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Goose Creek	1983	500(E)					Per.Comm. 1983 Div. of SF/ADF&G
Indian River	1976	537(E)					Stream Survey Data ADF&G
Kashwitna River-North Fork	1981	557(E)					Stream Survey Data ADF&G
Kroto Creek	1976-79	21,693-39,642(E) --	Entire Deshka System (EDS)		--		Stream Survey Data ADF&G (EDS)
	1979			2,290(H)			Sport Fish Harvest ADF&G
	*			10,000(E)		500,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Trapper Creek	1983	300(E)	500(E)	250(E)			Per.Comm. 1983 Div. of SF/ADF&G
Twentymile Creek	1983	200(E)		500(E)		500(E)	Per.Comm. 1983 Div. of SF/ADF&G
Montana Creek	1976-79	881-1,445(E)					Stream Survey Data ADF&G
	1979	312(H)		1,735(H)		2,472(H)	Sport Fish Harvest ADF&G
	1980	559(H)		2,684(H)		8,230(H)	Sport Fish Harvest ADF&G
Portage Creek	1976	702(E)					Stream Survey Data ADF&G
	1981	659(E)					Stream Survey Data ADF&G
Question Creek	1980					1,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
	1980					1,000(E)	Per.Comm. 1983 Div. of SF/ADF&G
Rabiduex Creek	1983	200(E)		200(E)			Per.Comm. 1983 Div. of SF/ADF&G
Sheep Creek	1978, 79, 81	778-1,209(E)					Stream Survey Data ADF&G
	1979					2,412(H)	Sport Fish Harvest ADF&G
	1980					6,362(H)	Sport Fish Harvest ADF&G
Sunshine Creek	1980			1,534(H)		2,408(H)	
Trapper Creek	1980					1,000(E)	Per.Comm. 1983 Div. of SF/ADF&G

Legend C Stream Survey Data courtesy of Alaska Department of Fish and Game, Division of Commercial Fisheries, Division of Sport Fish Fisheries Enhancement Division, and Cook Inlet Aquaculture Association
Sport Fish Harvest - State Harvest Study, 1979 and 1980 Data, Alaska Department of Fish and Game, Division of Sport Fish
Personal Communication, Division of Sport Fish, Alaska Department of Fish and Game
Escapement data (E)
Harvest data (H)
NOTE: Escapement and harvest data do not necessarily estimate the total stream escapement.
*Escapement estimates from several years of observation

TABLE 1(d). Salmon Escapement/Harvest Data for Talkeetna River Subdrainage of the Susitna River

Area	Year	Chinook	Sockeye	Coho	Chum	Pink	References
Chunilna Creek	1974, 76, 77	769-1,237(E)					Stream Survey Data ADF&G
	1979			1,248(H)			Sport Fish Harvest ADF&G
Mama & Papa Bear Lakes	1976, 78, 80					7,700-20,250(E)	Stream Survey Data ADF&G
Larson Lake	1977, 81		2,500-5,500(E)				Stream Survey Data ADF&G
Prairie Creek	1976-78, 81	1,900-6,513(E)					Stream Survey Data ADF&G
Stephan Lake	1978		1,022(E)				Stream Survey Data ADF&G

Legend D Stream Survey Data courtesy of Alaska Department of Fish and Game, Division of Commercial Fisheries, Division of Sport Fish, Fisheries Rehabilitation and Enhancement Division, and Cook Inlet Aquaculture Association
Sport Fish Harvest - State Harvest Study 1979 Data, Alaska Department of Fish and Game, Division of Sport Fish
Escapement data (E)
Harvest data (H)
NOTE: Escapement and harvest data do not necessarily estimate the total stream escapement.

TABLE 1(e). Salmon Escapement/Harvest Data for the Chulitna River Subdrainage of the Susitna River

Area	Year	Chinook	Sockeye	Coho	Chum	Pink	References
Byers Creek	1979		1,000(E)				CIAA
Chulitna River Middle Fork	1976-78	900-1,870(E)					Stream Survey Data ADF&G
Troublesome Creek	1980					1,000(E)	Per.Comm. 1983 Div. of SF/ADF&G

Legend E Cook Inlet Aquaculture Association (CIAA)
Stream Survey Data courtesy of Alaska Department of Fish and Game, Division of Commercial Fisheries, Division of Sport Fish, Fisheries Rehabilitation and Enhancement Division, and Cook Inlet Aquaculture Association
Personal Communication, Division of Sport Fish, Alaska Department of Fish and Game
Escapement data (E)
Harvest data (H)
NOTE: Escapement and harvest data do not necessarily estimate the total stream escapement.

TABLE 2. Susitna Area Plan Sport Fishing Effort Days/Year

10,000	5-10,000	1-5,000	1,000
Sheep Creek	Moose Creek	Chuitna River	Straight Creek
Deshka River	Chunilna Creek	Chuit River	Theodore River
Alexander Creek	Sunshine Creek	Talachulitna River	Olsen Creek
Montana Creek		Kashwitna River	Nikolai Creek
Lake Creek		Goose Creek	Lewis River
Caswell Creek		Peters Creek	Prairie Creek
		Beluga River	Portage Creek
		Skwentna River	Indian Creek
		Black Creek	Red Creek
		Martin Creek	Shell Creek
		Sucker Creek	

Ref: Sport Fishing Location, Access and Effort Map, Alaska Department of Fish and Game, Sport Fish Div., South Central Regional Staff 1983.

of populations and the carrying capacity of their habitats is to be maintained.

1. The Alaska Department of Natural Resources should not allow an appropriation of water from a river, lake or wetland to cause the flow or water level to fall below the amount determined necessary to protect fish, wildlife and waterfowl habitat and production, unless, under the procedures outlined in AS 46.15.080, the commissioner of ADNR makes a finding based on public review that the competing use of water is in the best public interest and no feasible and prudent alternative exists.

2. To minimize negative impacts on natural stream flows and water quality, the appropriate land management agency should retain a publicly-owned vegetated (if naturally occurring) strip of land or an easement as a buffer on lands adjacent to fish habitat. A buffer is preferred on streams and rivers important to the production of anadromous fish or with important public use values. The sizes of the river, lake, or wetland buffers should be decided on a case-by-case basis and may vary, depending on the nature of the activity proposed and the particular values of the river, lake, or wetland. Generally, public land disposals for rural homesites, recreational facilities, recreational land disposals, and similar low density, non-water dependent uses should have a minimum buffer of 200 feet landward of the ordinary high water mark(s)[6].

[6]Guidelines for Protection of Onshore and Nearshore Fish and Wildlife Areas, Habitat Division July 1983.

Where buffers are smaller than the minimum, soil erosion should, to the extent feasible and prudent, be minimized by restricting the removal of vegetation adjacent to fish-bearing waterbodies and by stabilizing disturbed soil as soon as possible. Adequate stabilization practices should be determined on a case-by-case basis. Private land owners are encouraged to maintain development setbacks equivalent to the buffers described here and to follow soil erosion mitigation practices.

3. Rivers, streams, or lakes that support important commercial, subsistence, or recreational fish species should not be dammed, diverted, or drawn down by hydroelectric projects unless the project will be designed or mitigated to provide adequate instream flows so as to cause no net loss to fish production.

4. Significant amounts of snow and ice cover should not be removed from shallow lakes, wetlands and rivers with low winter flows that are important to overwintering anadromous fish. Water withdrawal shall be limited as to not reduce limited overwintering fish habitat in ice-stressed (frozen) systems.

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