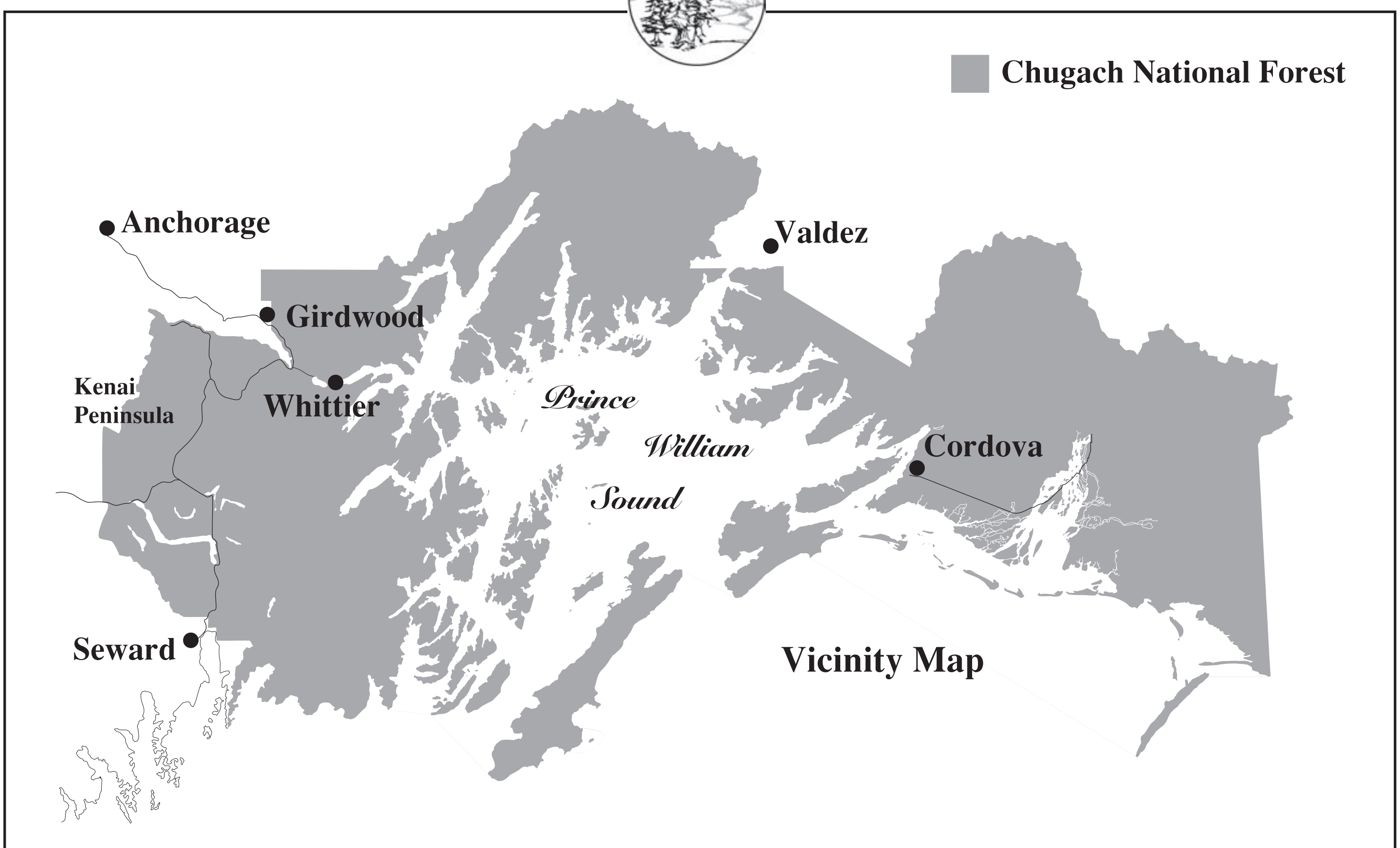
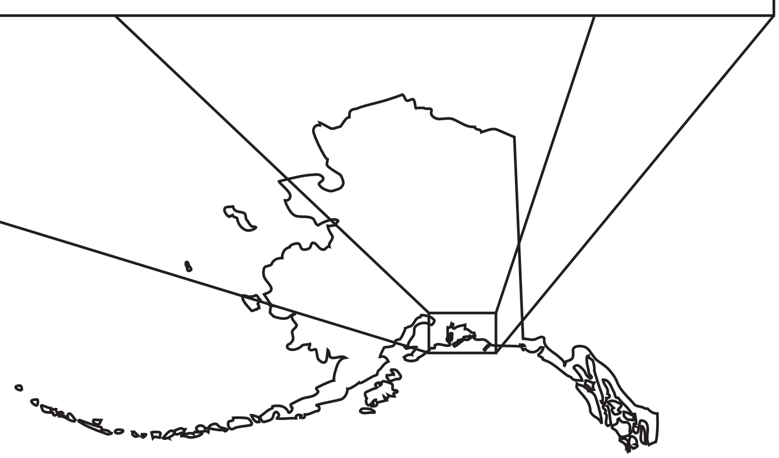
Chugach National Forest

Forest Plan Monitoring and Evaluation Report

Fiscal Year 2003





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Introduction and Background

The *Revised Land and Resource Management Plan* (RLMP) was completed in the Summer of 2002. It is based on the Preferred Alternative in the *Chugach Land and Resource Management Plan Revision Final Environmental Impact Statement* (FEIS), with modifications as further explained in the Record of Decision. The maps of record for the Plan are dated May 2002 and labeled "Revised Land and Resource Management Plan," "Summer Motorized Recreation Access, Chugach National Forest," and "Winter Motorized Recreation Access, Chugach National Forest".

The *Revised Land and Resource Management Plan* is part of the long-range resource-planning framework required by the Forest and Rangeland Renewable Resources Planning Act of 1974, as amended by the National Forest Management Act (NFMA) of 1976. NFMA requires each Forest Supervisor to develop a plan that directs management activities on the Forest. Forest plans are to be revised when conditions have significantly changed, or at least every 10-15 years. The *Revised Land and Resource Management Plan* was developed under the direction of 36 CFR Part 219 (1982, as amended). The Plan and ROD will guide the management of the Forest for the next 10 to 15 years.

A primary goal of the Revised Plan is to provide for the sustainability of the resources of the Chugach National Forest, while directing the coordination of multiple uses, such as outdoor recreation, timber, wildlife, fish, water, wilderness, and minerals. To accomplish this goal, it utilizes an array of land allocations ranging from allowing no resource development to allowing substantial resource development. It establishes a set of standards and guidelines that ensure that management objectives for these land allocations are met. Recognizing that conditions on the Forest do not remain static, the plan contains a monitoring and evaluation plan and identifies additional information needs.

The monitoring plan is described in Chapter 5 of the *Revised Land and Resource Management Plan*. It provides for three types of monitoring: 1) implementation monitoring to determine if the direction given in the plan is being followed; 2) effectiveness monitoring to verify if standards and guidelines are achieving the desired results; and 3) validation monitoring to determine if underlying assumptions remain valid. The monitoring and evaluation plan also provides for the collection of information as needed to improve the baseline information for future planning efforts.

Monitoring items are prioritized to focus on Forest Plan standards and guidelines for which the Forest Service has the primary responsibility. Each monitoring item is linked to a specific part of the revised plan. There is a particular concern with obtaining more information about the effects of winter snow machine use on ungulates and bears and human use patterns and their effects on goats, wolverines, and black oystercatches. This information will be used to inform future decisions on resource protection. The data gathered under the monitoring plan will be used to improve future mitigation measures (standards and guidelines), assess the need to amend or revise the Forest Plan, and as noted above, update or add to resource inventories.

The monitoring and evaluation strategy will provide an ongoing assessment of the effectiveness of the revised plan. The results of monitoring will be used to evaluate the assumptions used in developing the revised plan, and may be the basis for amendments or revisions through the process of adaptive management. It may be amended at any time if changes are needed. Monitoring will also ensure that management area prescriptions and standards and guidelines are being correctly applied and that local, state and federal legal requirements are met. Monitoring results will be used to evaluate progress toward achieving goals, objectives and desired conditions.

This Monitoring and Evaluation Report is the first report summarizing activities occurring under the revised plan. The revised plan has set the schedule and described the foundation for the development of draft monitoring guides within two years of implementation, which includes both a list of proposed activities for implementation during the next planning period (15 years). It also provides the foundation for the development of an Information Needs Assessment which will identify the need for new information necessary for the next plan revision.

A draft Monitoring Guide was completed in the spring of 2004. It is a web based document available to everyone. The guide is intended to be a dynamic document. So as protocols are finalized or developed, they can be easily included into the document and implemented on the forest. An Information Needs Assessment is being developed this year, with the intent to have a draft by the end of 2004, which will provide preliminary direction as to need information that should be collected for future management and the next version of the forest plan. Both the Monitoring Guide and the Information Needs Assessment present guidelines to help direct monitoring and inventory activities. They can be changed as a result in amendments or other significant changes in the Forest Plan.

This report consists of monitoring/evaluation reports for on-going and completed activities during the previous year (2003), which document results obtained through the various monitoring activities.

The report is divided into the following sections:

Monitoring – Final Reports, includes reports initiated under the original Forest Plan

Monitoring – Interim Reports; includes projects that are on-going and not yet completed

Monitoring – Project Initiation Reports; includes new projects proposed for initiation during fiscal year 2005

Monitoring and Restoration of Acquired Lands Annual Report; includes the annual report on the restoration and monitoring activities on the Knowles Head land acquisition

Monitoring

Final Reports

Management of Indicator Species (MIS)
and Species of Special Interest (SSI)

Goal

Maintain habitat to produce viable and sustainable wildlife populations that support the use of fish and wildlife resources for subsistence and sport hunting and fishing, watching wildlife, conservation, and other values.

Objectives

- Implement standards and guidelines to protect species and their habitats through protection, conservation and restoration of important terrestrial and aquatic habitats.
- Monitor wildlife and fish species and their habitats to answer questions described in the monitoring strategy.

Monitoring Question(s)

What are the population trends for black oystercatchers and the relationship to habitat? Has the population or the nesting habitat on beaches increased or decreased, and what are the characteristics of the nesting sites of the black oystercatchers?

What are the population trends of the Coho salmon and their relationship to habitat?

What is the distribution and relative abundance of cutthroat trout throughout the Forest?

What are the populating trends for moose and the relationships to habitat? What are the characteristics of moose habitat by season?

Is the forest management maintaining favorable conditions for sustaining mountain goats? Forest wide guidelines have identified specific distances to be maintained between activities and goats that their critical habitat. Is management respecting these guidelines and are they effective?

The process being implemented first establishes the populations, locations, and habitat of the mountain goat, and subsequently determines the location of the motorized use and effects on the mountain goat.

Black Oystercatcher Surveys of Prince William Sound

2003 Final Report

ABSTRACT

We surveyed 75 km of shoreline on eastern Montague Island for black oystercatchers and other water birds during 27 May–1 June 2003. Surveys ran from Zaikof Point through to Beach River on the SE shore of Montague Island. A portion of the south shore was also surveyed from San Juan Bay to Jeannie Cove. We encountered 20 species, nearly 1600 individuals, and 2 possible seabird colonies. We found 30 black oystercatcher nests. Highest nest density occurred in Jeannie Cove and the shoreline on the northeastern section of the island. Possible seabird colonies consisted of a large congregation of glaucous-winged gulls and double-crested cormorants on offshore rocks and a small congregation of pigeon guillemots sighted near shore on the morning high tide. Unusual sightings included and osprey and a peregrine falcon nest. Knowledge of these nesting areas is important in making permitting decisions and educating receptionists on low impact use.

INTRODUCTION

The black oystercatcher (*Haematopus bachmani*) is a Management Indicator Species (MIS) on the Chugach National Forest. One of the purposes of MIS is to look at effects of management activities on target ecosystems. MIS generally fall into one or more of the following categories:

- Threatened or endangered
- Sensitive
- Ecological indicators
- Important for recreational, commercial, subsistence, or aesthetic values
- Representative of special habitats, habitat components, or plant and animal communities
- Species of high concern

The black oystercatcher fits several of these classes. Perhaps most important is its role as an ecological indicator. Human activity in Prince William Sound is increasing at a rapid rate largely due to better access from Anchorage via the Whittier tunnel. Much of this activity takes place in shoreline habitat where black oystercatchers nest. By monitoring oystercatcher populations, we can better assess the effects of human activities on shoreline ecosystems, and we can locate areas that may be sensitive to disturbance.

This monitoring program began in 1999 with a shoreline survey from Nelson Bay to Red Head. During this survey, we recorded all water bird locations, with an emphasis on black oystercatchers. In subsequent years we have surveyed the shoreline from Red Head to Galena Bay and the northwest shoreline of Montague Island. Here we report on the 2003 survey of the eastern shore of Montague Island.

METHODS

Surveys were conducted 27 May–1 June 2003. This survey differed from previous surveys in that we walked the shoreline rather than surveyed from a boat. Regular swells and extremely rocky conditions make this section of shore impossible to effectively survey from offshore. In addition surveys were conducted without regard to tide. Offshore surveys were done within 2 hours of high tide.

Surveys were conducted with groups of two observers. One group began at the northern end of Zaikof Bay and worked south, while the other began at the southern end of San Juan Bay and worked north around the southern tip of the island (figure 1). The intent was to meet midway at Beach River. When possible, the shoreline was walked near the high tide mark, and inside the vegetation line. In places where the beach widened to an area too large to completely survey, the area was scanned with binoculars for the presence of a sentry. All oystercatcher sightings were investigated for the presence of a nest unless the sighting was well within the intertidal zone. In those cases, the bird was considered to be feeding.

Upon encountering any water bird, the location was recorded on an aerial photograph, and GPS coordinates were taken. For black oystercatchers, we searched for nests and recorded the number of eggs and exact GPS location of the nest. Oystercatcher nests can be difficult to find when the bird is not seen coming off the nest. When nests could not be found, we determined whether the site was a nesting area by observing the behavior of the birds.

We stored these data in a GIS. These data will also be shared with the US Fish and Wildlife Service for use in updating the Beringian Seabird Colony Catalog, which can be accessed via the internet.

RESULTS AND DISCUSSION

The southern survey totaled about 32 km and was cut short because of an impassable promontory at the north end of Jeannie Cove. The northern survey totaled about 43 km. In total, we surveyed 75 km of coastline (figure 1) and encountered 20 species of water birds. We recorded nearly 1600 individuals and 2 possible colonies (table 1). This compares well with surveys of the northwest coast of the island, which covered 110 km with 19 species and 2000 individuals. The mainland surveys of 2001, however, produced only 8 nests in 300 km of shoreline.

Several differences due to different survey technique were apparent from the previous year. First, we tended to see more cryptic birds, such as spotted sandpipers that would not necessarily be flushed with an offshore survey. Also we saw fewer pelagic birds. This survey produced generally more shorebirds and fewer seabirds.

Birds were present on nearly the entire survey route (figure 2), as were black oystercatchers (figure 3). Along the southern section we saw highest densities of oystercatcher nests in Jeannie Cove. Along the northern section, where the shoreline was straighter, we encountered birds and nests on a more continuous basis. Cliffy areas with little beach supported the fewest number of species.

In the northern survey, the substrate gradually changed from rock to sand as we moved south, yet oystercatcher nest density did not seem to be affected. Nests generally were shallow bowls lined with gravel, cobble, or shells. Of the 30 nest found, 11 were in sand, 10 in rock or boulders, and 9 in cobble or pebbles. Oystercatchers appeared to be equally able to nest on all of these substrates, and their distribution was probably more affected by other factors, such as food availability and width of intertidal zone. Most nests were near gently sloping intertidal areas.

One empty nest was found that could have been depredated or constructed and not used. All other nests contained eggs. We recorded eight nests that could not be found but were credited as nests because of behavioral observation. All nests were above the high tide line.

We observed 8 pigeon guillemots during the morning high tide just north of Neck Point (figure 4). No birds were seen flying into land, but given the time of day, stage of tide, and the number of birds, a breeding colony may exist there. In addition a mixed flock of glaucous-winged gulls and double-crested cormorants were seen on a small rock island just offshore of Neck Point. We were unable to confirm nesting activity, but this may also have been a breeding colony.

Harlequin ducks were seen in 8 locations (figure 5) in numbers ranging from a single pair to a flock of 62. These birds were generally associated with freshwater streams flowing into the sea. This species nests inland along rivers that flow to the coast. Many of these sightings may indicate the presence of inland nesting habitat.

Missing from the survey were marbled murrelets. This result was probably due to surveying from land. Murrelets were probably present but were further offshore. Unusual sightings included 2 pair of Wandering Tattlers, a pair of Whimbrels, and a nesting Peregrine Falcon. Whimbrels are uncommon in summer and are not know to breed in this area (Isleib and Kessel 1973). It is likely that the Wandering Tattlers were nesting, however. This species is common along the north Gulf coast but has rarely been seen the Cordova Ranger District.

MANAGEMENT IMPLICATIONS

Compared to surveys on the mainland, Montague Island has a very high density of nesting black oystercatchers. This island is also one of the most inaccessible areas in the Sound. Currently the rugged coast and exposed nature of the shoreline north of Beach

River makes it difficult to access for recreational use. The southern survey area sees more use because access is easier and recreational cabins are present. However, this area is only accessible by airplane and still considered remote. Relative to other areas in the Sound, this coastline sees little human use. These low-use areas are important benchmarks with which to compare trends in higher-use areas. These comparisons may help indicate whether increases and declines are due to human use.

Water birds occurred in most of the surveyed shoreline, and it would be impossible to avoid all disturbances by recreationists. Beach combers especially are bound to encounter feeding and nesting birds. The most sensitive areas are nesting sites. We labeled 30 black oystercatcher nesting areas. Because this species returns to previous nesting sites (Andres and Falxa 1995), they will probably be used in subsequent years. Presence of these nests should be considered in permitting applications. Education of recreationists may reduce potential disturbance. In addition, the production of a short pamphlet on how to avoid disturbance of nesting water birds may be useful.

In addition to oystercatcher nests, we recorded 2 possible seabird colonies. The gull/cormorant colony was offshore and stands little chance of being disturbed by recreationists. The possible guillemot colony is within walking distance of the recreational cabins around Patton Bay, but the point just north of the colony is passable only at low tide. This area currently sees little recreational use.

The presence of inland nesters such as harlequin ducks may indicate nearby breeding areas. Nesting areas for this species are relatively inaccessible for recreationists, and most encounters with humans will occur when the birds are foraging. Disturbance in these feeding areas may increase energetic demands somewhat, but overall, these birds can easily avoid boats and hikers. These data may be valuable, however, for use in inland permitting.

Table 1. Comparison of birds seen on the northwest and eastern shore of Montague Island.

Species	North and Northwest Coast (110 km surveyed in 2002)	East and Southeast Coast (75 km surveyed in 2003)
Arctic Tern	100	0
Black-legged Kittiwake	961	709
Black Oystercatcher	90	102
Bonaparte's Gull	3	0
Black Brandt	1	0
Canada Goose	138	15
Common Loon	14	2
Common Merganser	79	23
Double-crested Cormorant	1	75
Great Blue Heron	6	5
Greater Yellowlegs	5	0
Glaucous-winged Gull	87	119
Harlequin Duck	231	116
Marbled Murrelet	66	0
Mew Gull	241	15
Osprey	0	1
Parasitic Jaeger	0	1
Pacific Loon	0	35
Pelagic Cormorant	0	9
Peregrine Falcon	0	4
Pigeon Guillemot	5	9
Red-breasted Merganser	2	0
Semi-palmated Plover	6	6
Spotted Sandpiper	0	7
Surf Scoter	3	0
Tufted Puffin	0	12
Wandering Tattler	0	3
Whimbrel	0	2
White-winged Scoter	0	40

Figure 1. Shoreline survey route for eastern Montague Island, Prince William Sound, AK. May–June 2003.

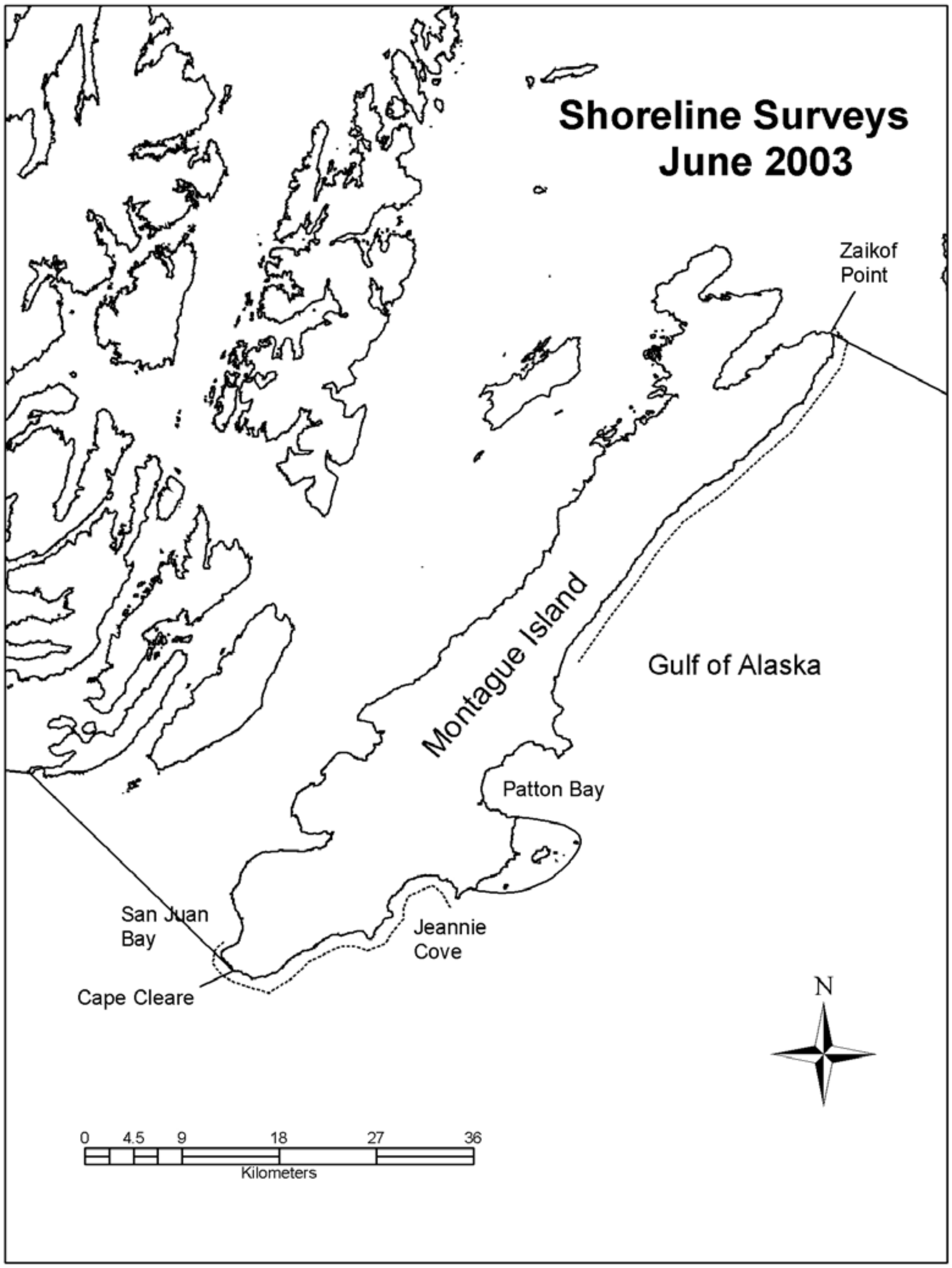


Figure 2. All bird locations recorded during shoreline surveys of eastern Montague Island, Prince William Sound, AK. May–June 2003.

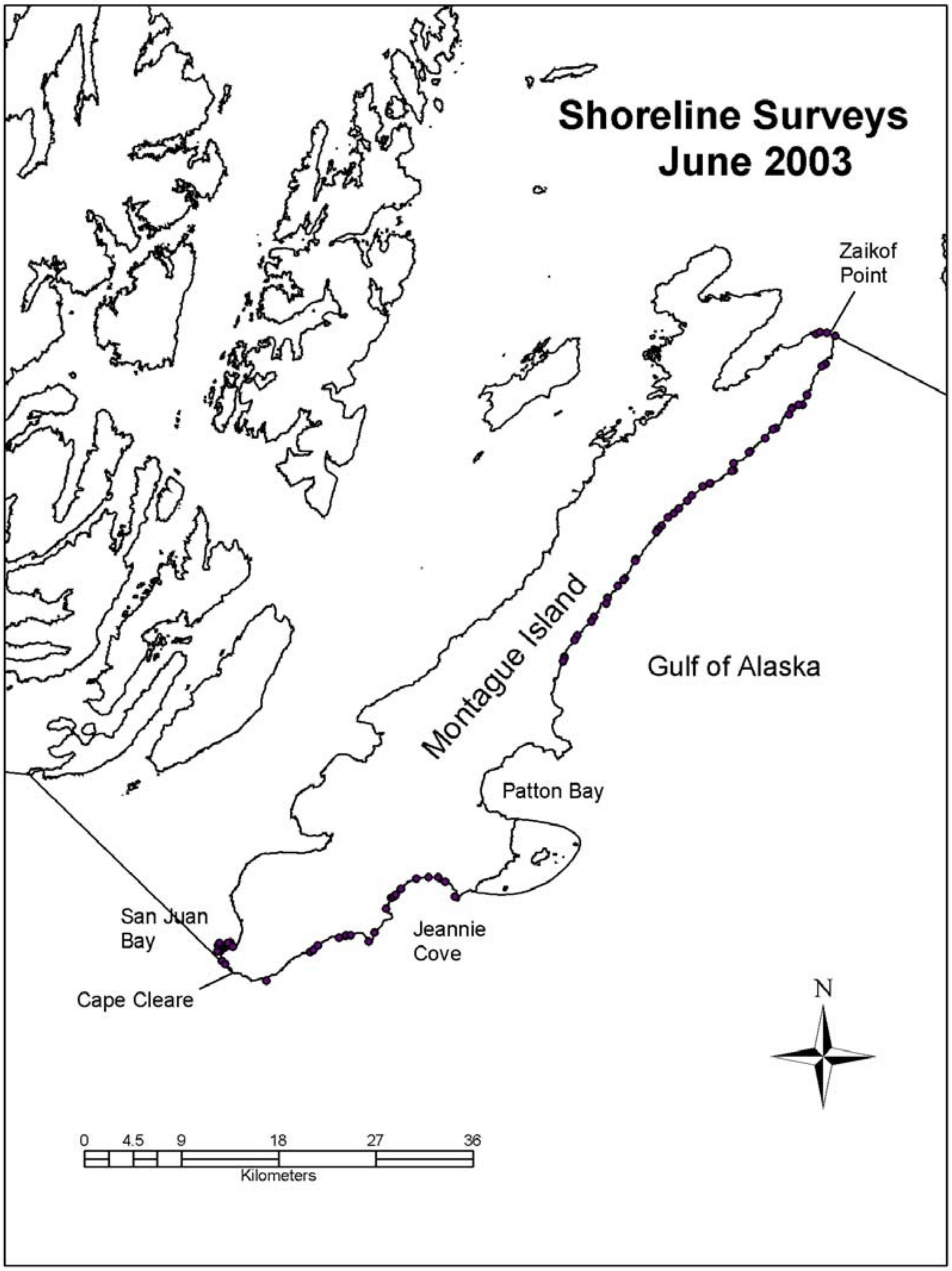


Figure 3. Black oystercatcher distribution on northern Montague Island, Prince William Sound, AK. May–June 2003.

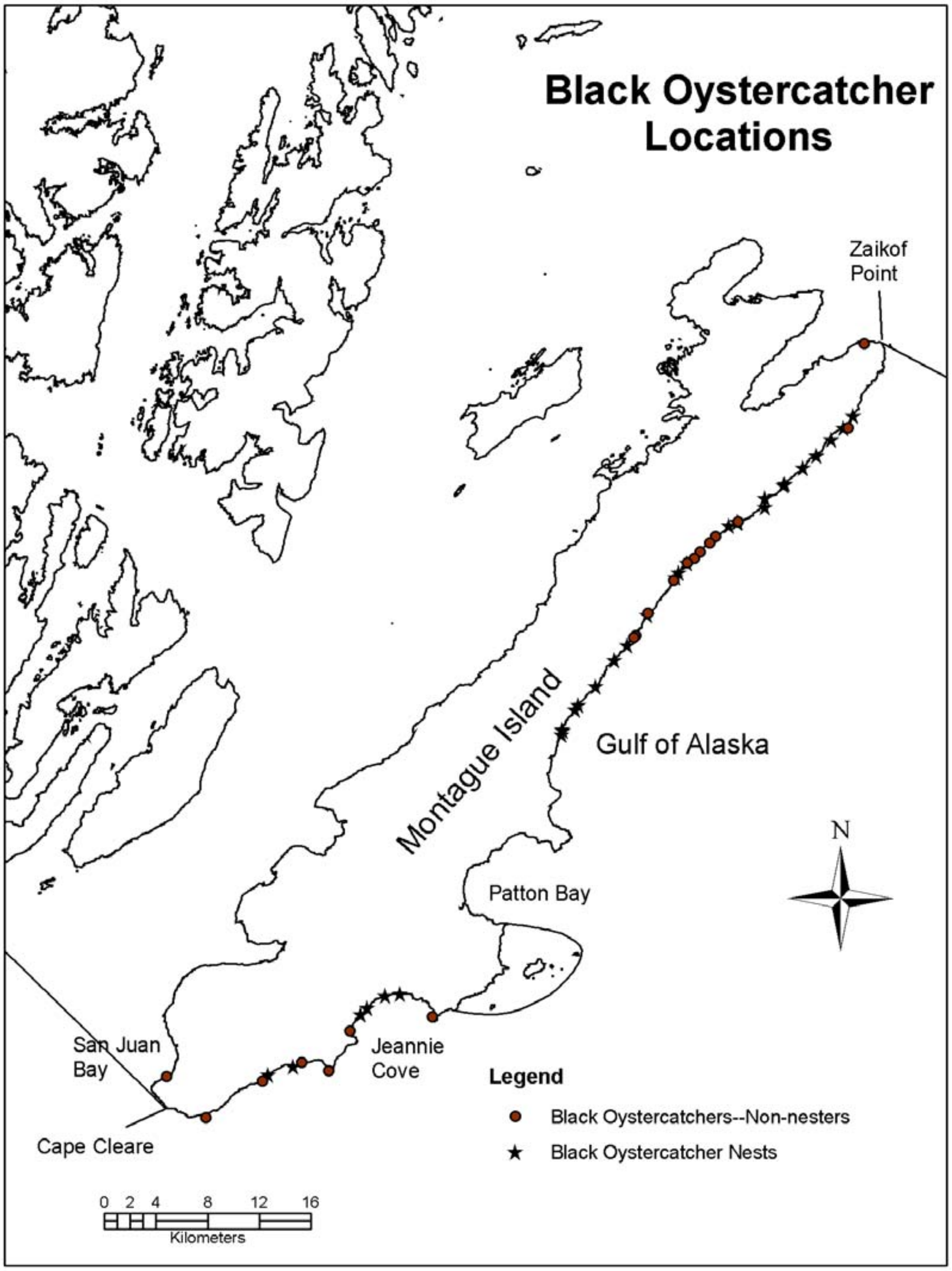


Figure 4. Possible Gull/Cormorant and Pigeon Guillemot Colonies on eastern Montague Island, Prince William Sound, AK. May–June 2003.

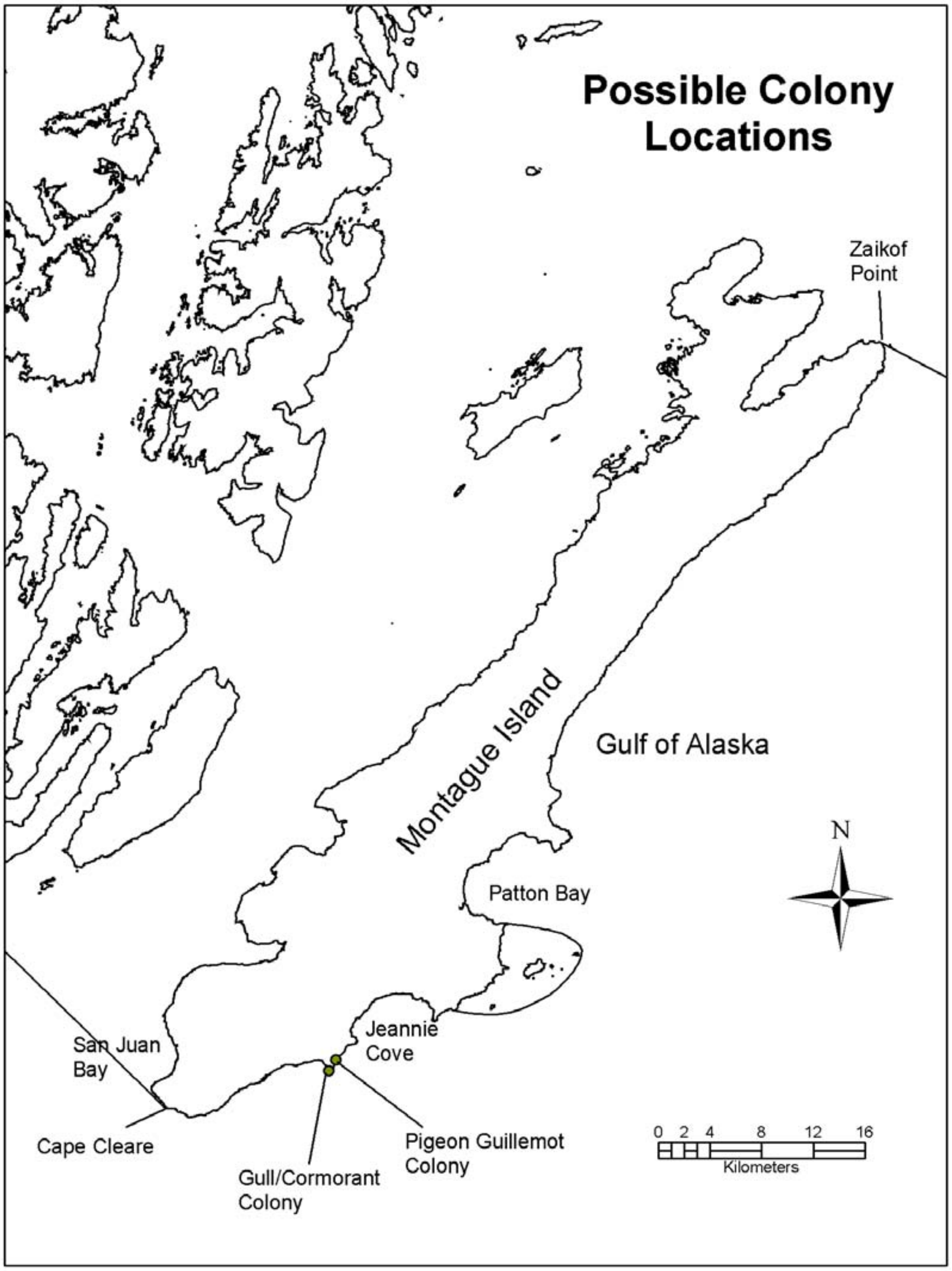
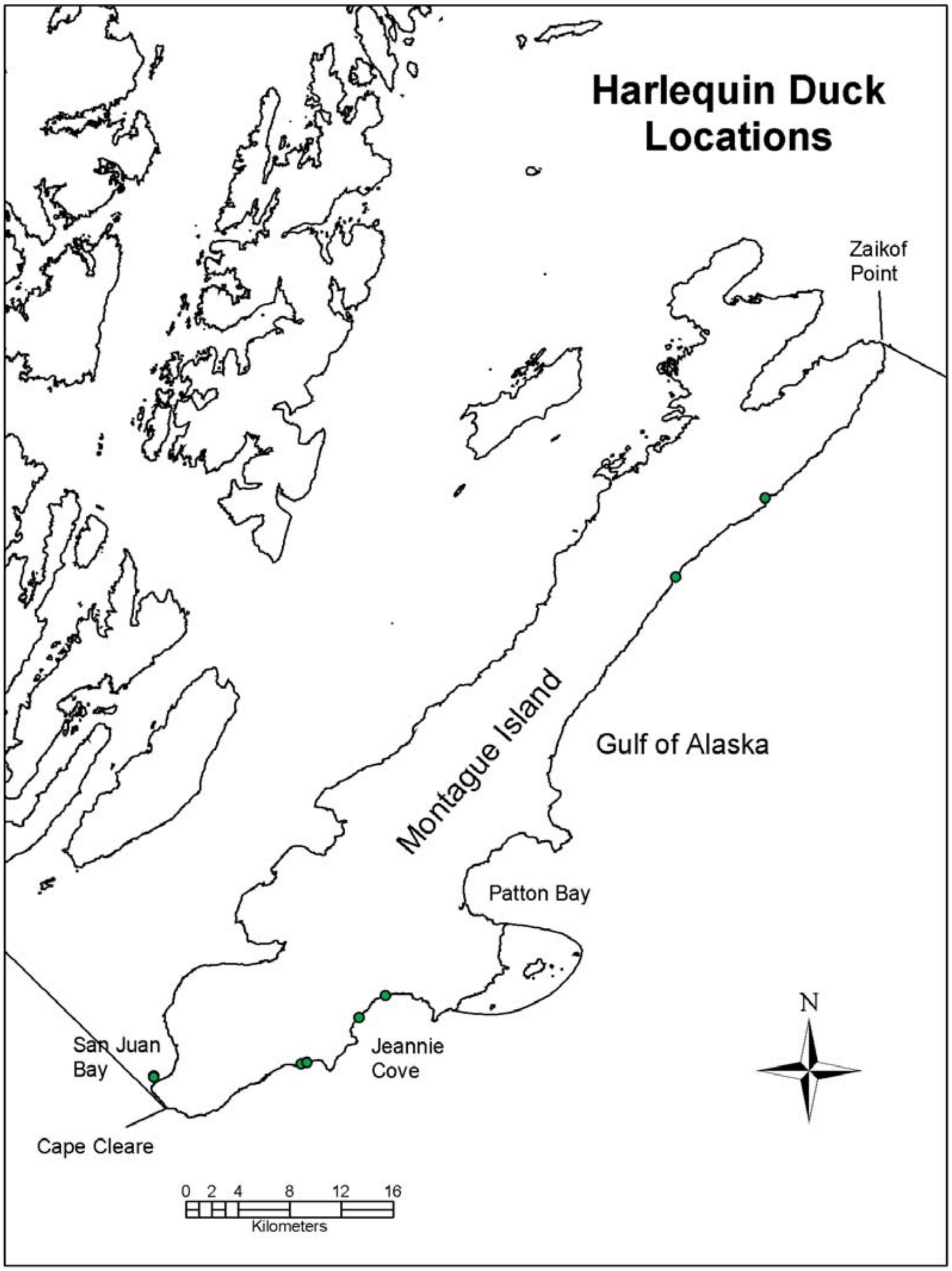


Figure 5. Harlequin duck locations on eastern Montague Island, Prince William Sound, AK. May–June 2003.



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Isleib, M.E. and B. Kessel. 1973. Birds of the North Gulf Coast-Prince William Sound Region. University of Alaska Press. Fairbanks.

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Assessing Carrying Capacity of Moose on the Copper River Delta through Analysis of Body Condition

Final Report 2002

Moose were introduced on the Copper River Delta in the late 1940s and early 1950s by state management agencies. Since that time they have flourished and now represent a sustainable, harvestable population. Soon after the introduction, the Good Friday earthquake of 1964 uplifted the Copper River Delta, creating large tracts of willow and alder communities. Although the area is now prime moose habitat, it is in a state of rapid succession, and moose browse production is changing over time.

Moose numbers have been regulated in the past by hunting pressure. In an effort to increase the moose population in game management unit 6-C from 250 to 400 animals, the local fish and game advisory committee in consultation with the managing agencies reduced the number of cow permits in 1996. This action was largely successful, and the current population is about 360 animals. The implications of this increase to the long-term health of the herd, however, have never been assessed. To guide future management decisions, we must know first whether the area can sustain the current population, and second how many moose the area can ultimately sustain.

Carrying capacity is a theoretical concept that fluctuates with the environment. Although we often refer to carrying capacity for management purposes, in practice we have only rarely attempted quantification of it for moose in Alaska. This knowledge is essential for selecting the appropriate management actions within a given population. Further complication exists because the vegetation on the Delta is changing over time, and the area will probably support fewer moose in the future. Most attempts at determining carrying capacity involve vegetation analysis and browse utilization. This technique is labor intensive and can lead to large variations in estimates. In addition, vegetation work performed in the fall tells us little about the amount of browse available during winter when snow covers much of the shrubby vegetation. Using these techniques McCracken et al. (1997) suggested a carrying capacity of 400 on the West Copper River Delta in years of severe winter to 1600 in years of mild winter.

An alternative to vegetation analysis is to look at the body condition of individual moose. Portable ultrasound units have been used to measure body fat in large mammals in the field for several years (Stephenson et al. 1993, 1998). By measuring body fat of cows in the fall (the period of highest fat accumulation) and the following spring (the period of lowest fat accumulation), we can look at fat loss through the winter and assess moose health during the most critical time of year. This would also give us an indirect index of the quality and availability of browse that the moose consume.

In collaboration with Alaska Department of Fish and Game, we initiated a study in 2000 to assess the change in body condition of moose over winter on the Copper River Delta. We collected data in the winters of 2000–2001 and 2001–2002.

STUDY AREA AND METHODS

The study took place on the Copper River Delta south of the Copper River Highway between the Scott River and P. Dahl slough. This area has been the historical winter range for many of the moose that live along the Copper River. The area is a coastal wetland with many dispersed ponds and sloughs and large tracts of willow (*Salix spp*.), alder (*Alnus spp*.), and myrica gale (*Myrica spp*.).

We captured moose for two winters in November and March. These months are preferred because November is long enough after the rut to determine pregnancy but early enough that animals are not starting to lose fat reserves. Also March is normally the period of highest winter stress. During the initial capture, we attempted to capture 10 cows with calves and 10 cows without calves. Subsequent captures were of all available previously collared animals.

We conducted reconnaissance with a fixed-wing airplane and darted moose from a helicopter. Chase times were kept to a minimum to reduce stress on the animal. Moose were immobilized with a mixture of carfentanil and xylazine (Schmitt and Dalton 1987). The carfentanil was reversed with naltrexone, and the xylazine was counteracted with the stimulant tolazaline. Dart placement was important to the drug's effect. We attempted to place the dart in the hindquarter below the fat deposits. Animals hit in the fat layer generally had to be darted a second time. After darting, the helicopter vacated the area, and the animal was monitored with the fixed-wing aircraft until the drug took effect. The animal was placed in sternal recumbancy (Pond and O'Gara 1996) for the first 3 capture periods. During the 4^{th} capture period, the animal's position was not altered unless it lay on its side. During this capture period we also attempted to keep processing time to less than 30 minutes to reduce the chance of nerve damage associated with loss of circulation. We continuously monitored the animal for respiration, gum color, and capillary refill. Shallow respiration or blue gums were treated with ¼ cc of tolazaline.

In 2000–2001, we checked for pregnancy by viewing the uterus with an ultrasound. We recorded fat thickness, animal length, and girth. We also collected blood, hair, and fecal samples. Operation data, such as chase time, time for the drug to take effect, and processing time were also recorded. Chase time began when the darter loaded the dart gun, and ended with the placement of the first dart.

The animal was radio-collared (or identified if a collar was already in place), the dart was removed, and an antiseptic lotion was applied to the wound. We measured length and girth and drew 13 ml of blood from the jugular vein (10 ml in a serum tube and 3 ml in an EDTA tube). We also collected hair and fecal samples. The first year of the study we tested for pregnancy by inserting the ultrasound into the colon and positioning it next to the uterus. The second year we relied on blood tests for confirmation of pregnancy.

We measured maximum rump fat (MRF) with a portable ultrasound as outlined in Stephenson et al. (1998). Briefly, we separated the hair in a line from the cranial process of the ischial tuber toward a point on the spine midway between the coxal tubers (hipbones). We looked at the tissue layers along this line with an ultrasound until we found the maximum depth in the fat layer and then measured this thickness.

When processing was complete, we injected 1/3 of the reversal dose intravenously and 2/3 intramuscularly. The moose was monitored until it stood and vacated the area. We rechecked the animals at the end of the day, the following morning, and again after about one week.

RESULTS

We conducted the study for two years for a total of 50 captures (table 1). The number of animals captured decreased over time. The final capture period showed the shortest chase and processing times.

Table 1. Capture and processing summary for cow moose on the Copper River Delta, AK.

	2000-2001		2001-2002	
	Fall	Spring	Fall	Spring
Capture Dates	29 Nov.– 1 Dec.	20–23 Mar.	14–16 Nov.	27–29 Mar.
Cows Captured	16	12	12	10
Mean Chase Time (min.)	2.4	–	3.2	1.5
Median Chase Time (min)	2	–	2	1
Mean Processing Time (min)	49	–	30	23

The mean percent body fat ranged from 10.1–19.8 (table 2). The lowest percent body fat for an individual was 7.9% for a 4-year old cow with a calf in spring 2001. Highest body fat was 26.5% for a 7 year-old cow without a calf in fall 2002. For both years fall body fat was significantly higher than spring body fat. Median body fat was 20.2% for fall and 10.2% for spring. Of the 27 fall captures, 13 cows had body fat >20%. All but one individual captured in fall had >10% body fat.

Table 2. Maximum rump fat and percent body fat for cow moose on the Copper River Delta, AK.

	2000–2001			2001–2002		
	Fall	Spring		Fall	Spring	
	Mean	Mean	***P***	Mean	Mean	***P***
MRF (mm)	5.8 ± 2.0	2.2 ± 0.81	<.001	6.9 ± 2.2	2.7 ± 2.2	<.001
% Body Fat	17.5	10.1		19.8	12.2	
n	15	12		12	9	

Within season MRF did not differ between years (table 3), so we combined both years of data for comparison (table 4). Fall MRF was significantly higher than spring MRF for cows with calves and cows without calves. Cows without calves had significantly higher MRF than cows with calves in both fall and spring.

Table 3. Comparison of mean MRF between years for cow moose on the Copper River Delta, AK.

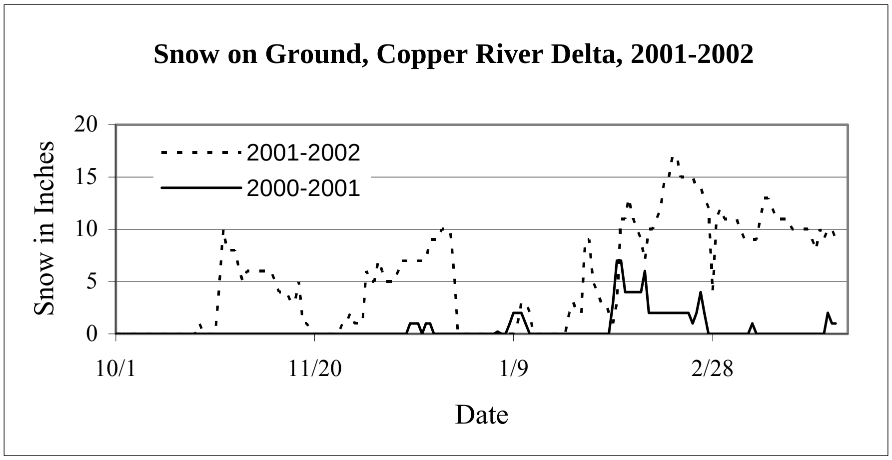
	Mean MRF (mm)					
	Fall 2000	Fall 2001	***P***	Spring 2001	Spring 2002	***P***
Cows w/ calves	4.3 (n = 7)	4.4 (n = 3)	0.93	1.7 (n = 6)	1.6 (n = 3)	0.74
Cows w/o calves	7.2 (n = 8)	7.7 (n = 9)	0.42	2.8 (n = 6)	3.2 (n = 6)	0.46

Table 4. Comparison of mean MRF for cow moose on the Copper River Delta, AK. Data for two years combined.

	Fall MRF (mm)	**Spring MRF (mm)**	***P***
Cows w/ calves	4.3 ± 2.0	1.6 ± 0.39	< 0.001
Cows w/o calves	7.4 ± 1.2	3.0 ± 0.95	< 0.001
P	< 0.001	< 0.001	

Winter of 2000–2001 had little snow cover. A greater amount of snow accumulated in 2001–02 than in the previous year (figure 1). Peak ground cover was about 17 inches in 2001–02 and about 8 inches in 2000–01. Highest ground accumulation occurred from late Jan–Mar in both years.

Figure 1. Snow on the ground from 2000–2002. Copper River Delta, AK.



A strong relationship existed between fall and spring body fat levels (figures 1 and 2). The relationship appeared to be different for cows with and without calves. In 2000–01, the data displayed a linear relationship for cow with calves and a curvilinear relationship for cows without calves. In 2001–02, the data showed a linear relationship for cows without calves (figure 3). When we combined the 2 years, both groups showed a strong linear relationship (figure 4). Cows without calves began winter with much higher fat reserves but lost more of those reserves by spring. Cows with calves started with lower fat reserves but lost less fat over winter.

Figure 2. Percent body fat for cow moose in Fall 2000 and Spring 2001, Copper River Delta, AK.

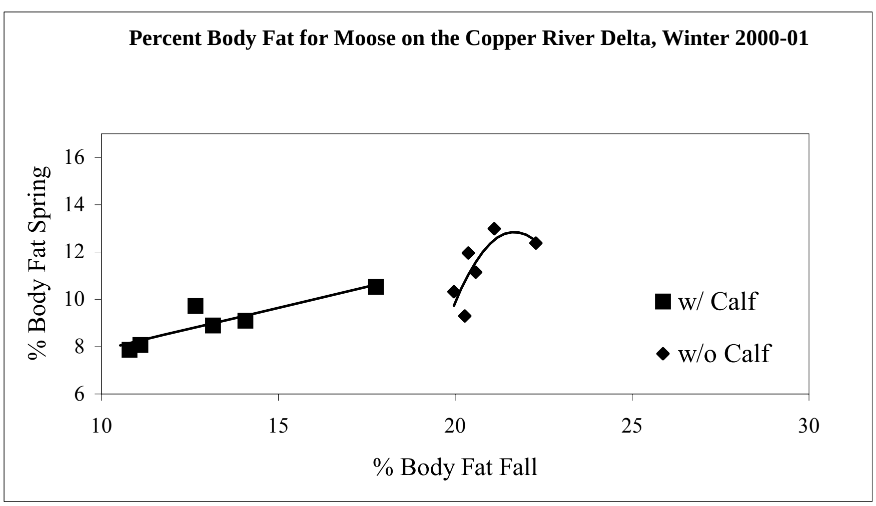


Figure 3. Percent body fat for cow moose in Fall 2001 and Spring 2002, Copper River Delta, AK.

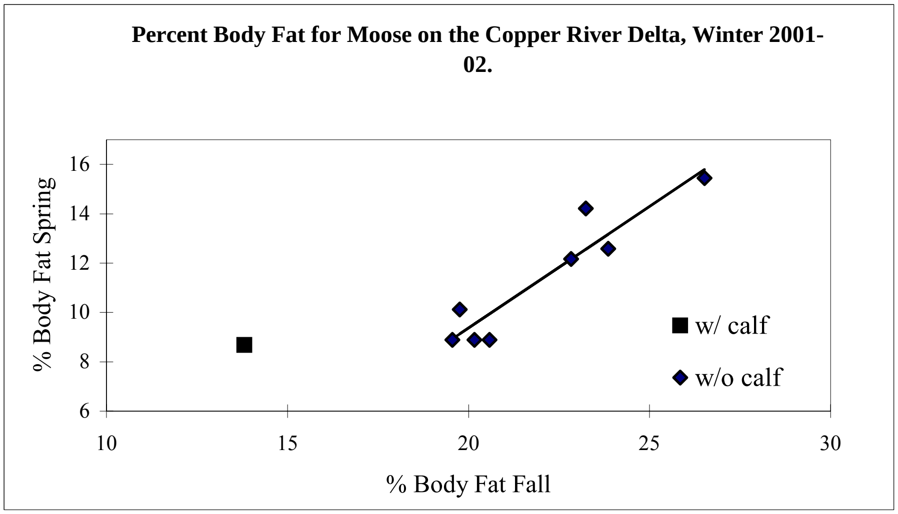
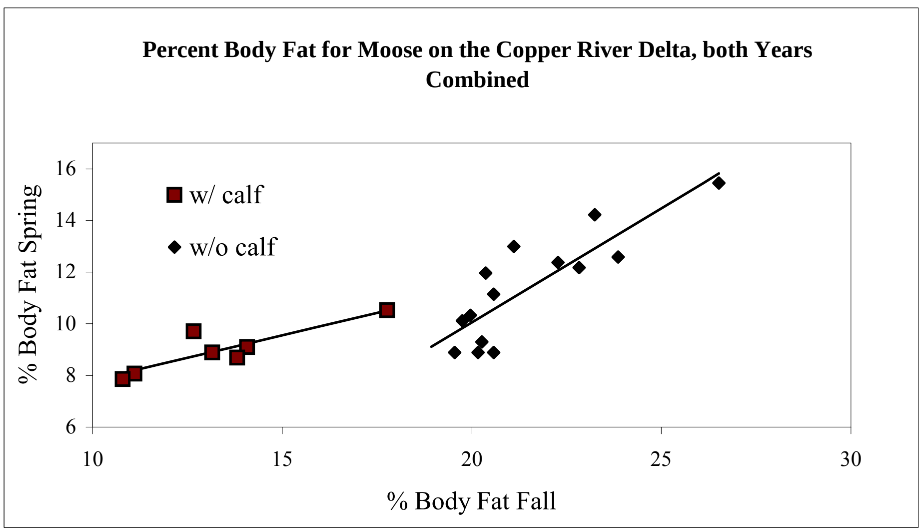
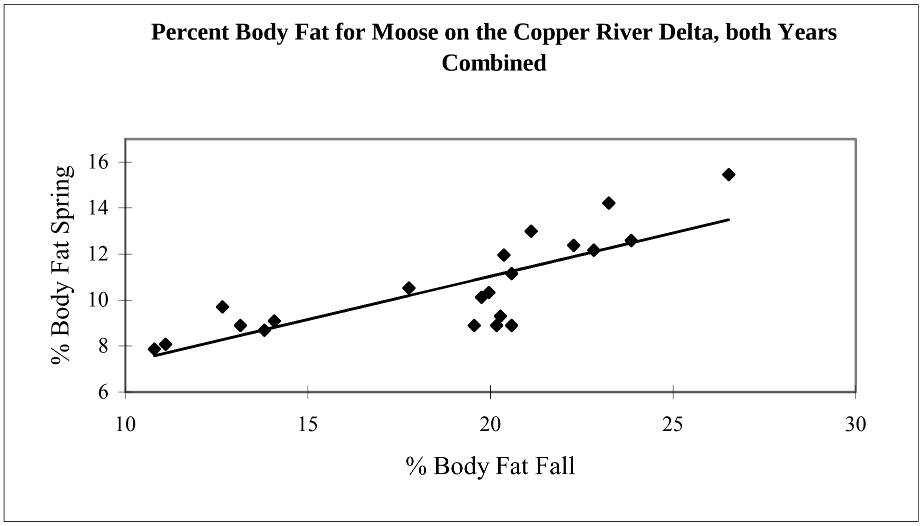


Figure 4. Percent body fat using combined data for cow moose in Fall 2001 and 2002, and Spring 2001 and 2002, Copper River Delta, AK.



A significant relationship also existed when all data were regressed regardless of year or presence of calves (figure 5).

Figure 5. Linear regression of fall vs. spring body fat for cow moose on the Copper River Delta, AK. All data combined.



Analysis of fecal samples showed that moose foraged mainly on willow stems (table 5) in both late fall and early spring. The extent of willow stem use went up toward the end of winter but remained the largest single contributor to diet in both time periods. Ingestion of alder stems decreased slightly from fall to spring. Leaf matter made up >21% of diet in fall and >12% in winter.

Table 5. Diet analysis from fecal samples for late fall and early spring on the Copper River Delta, AK.

	29 Nov–1 Dec 2000	20–23 Mar 2001
Alnus stem	13.5	5.4
Populus spp. Leaf	6.5	
Populus spp. Stem	10.4	4.6
Salix spp. Hair		8.7
Salix spp. Leaf	14.8	4.6
Salix spp. Stem	43.8	65.8
Vaccinium leaf		7.1
Vaccinium stem	5.1	2.2
Shrub leaf		0.8
Shrub stem	2.2	0.8
Grass	1.5	
Equisetum spp.	2.2	

DISCUSSION

More than half of the cows captured in fall had >19% body fat, and nearly all but one had >10% ($\bar{x}$ = 18.5%). Anything over 25% is considered obese. One individual—a 7 year-old without a calf—topped this mark. Fall body condition appears to be exceptional. The leanest individual in fall was a 10–12 year-old cow with a calf that had 9.7% body fat.

Spring body condition was significantly lower than that seen in fall. Cows in spring ranged from 7.9–15.5% body fat and averaged 10.6%. Even though spring figures are significantly lower than fall figures, they are equal to or higher than fall conditions for some interior populations. We consider these levels to represent a healthy spring condition.

One of the most notable differences we observed was body condition between cows with and without calves. This difference is to be expected because lactation requires an increase in energy expenditure. Also more energy may be expended in predator avoidance behavior due to increased predation risk for calves. Because of these increased energy demands, cows with calves should lose fat reserves at a higher rate than cows without calves. Our data suggest that the opposite is true (figure 5). Cows with calves tend to have much lower fat reserves in fall but lose that fat at a much slower rate. It is possible that cows with calves spend a greater proportion of their time budget foraging during winter. Although they still have fewer fat reserves in spring than cows without calves, the difference between the 2 groups is much smaller in spring than in fall. Cows with calves still average 9.0% body fat in spring.

Cows without calves, on the other hand, began winter with greater fat reserves. Rather than forage intensively, their strategy may have been to reduce overall energy expenditure until foraging became easier in late spring. Moose diet changes from summer to winter (table 5, McCracken et al. 1997), and winter foraging is probably less efficient than summer foraging. Moose in winter forage mainly on willow stems, and they must search out current annual growth, while moose in summer can forage on stems, leaves, aquatic vegetation, forbs, and grass. Not only is forage less available in winter, moving through snow requires more effort than summer travel. Behavioral observations to determine time budgets would be needed to confirm whether cows with calves spend more time foraging.

When we regress all data regardless of year or presence of calves, a significant relationship between fall and spring body fat also exists (figure 5). This may suggest that the percent fall body fat is the major predictor in percent spring body fat. If this were the case, the major effect of a calf on adult spring body fat would be to reduce the amount of fat the adult has going into winter. The individual regressions produce a better fit than the regression of all data combined, however, suggesting that fat loss rates may indeed be different for the two groups. When viewing the combined data, there appears to be a group of 4–6 points that do not fit well with the rest of the data. These individuals may be old or young moose that do not forage as competitively during the winter months. At this point, the models for the separate groups appear to be more realistic, but more data or better age analysis would be useful to determine whether we can group all data into a single model.

The key point here is that fat loss over winter appears to be very predictable. Given fall body fat figures, we can predict with some accuracy what spring body fat levels should be in mild winters. This relationship may vary year-to-year with winter severity, and may change over time as forage becomes less available, but we now have a baseline with which to compare future years.

These data represent body fat only down to about 8%, and changes below this level are unknown. We would expect to see an increasing level of foraging activity as body condition drops. The relationship between fall and spring body condition is not likely to be linear below some threshold because the rate of foraging intensity would change as the moose approaches starvation. Ultrasonography cannot measure body fat below 5.6%, and we will be unable to track changes below this level.

Winter of 2000–2001 saw more snow accumulation than the first year of the study. The first year was extremely mild, and little snow accumulated all winter. We can deduce that the loss in body fat during winter was largely due to a reduction of forage biomass and colder temperatures, and not due to difficulties in travel or availability of shrubs. Although more snow fell the second year, highest snow accumulation was only 17 inches and most of the winter saw fewer than 10 inches of snow on the ground. This amount of snow should pose few problems for mobility, and most current annual growth will occur above this height. It is not surprising, then, that no differences in body fat occurred between these winters.

Fecal analysis showed the importance of willow stems in moose diet on the Copper River Delta. Leaves made up 21% of the diet in late fall. Fall samples were collected in the last few days of November and early December, and most leaves were on the ground during this time period. Although little snow had accumulated by fall capture, fall samples are probably more typical of winter foraging. McCracken et al. (1997) showed an increase in leaf ingestion in late summer and fall and increased use of aquatics in spring and early summer.

The number of moose captured per time period declined over time. Initial captures were relatively easy because we could choose nearly any cow we encountered, as long as we obtain an even number with and without calves. Subsequent captures however were of collared cows only, which greatly reduced the chance of getting the same number of animals. The wintering area was mainly shrubby, but some moose spent time in trees and could not be captured. Others moved out of range of the telemetry equipment or moved into areas where their signals were difficult to find. To consistently capture 16–20 moose, we would need to put out additional collars each time period.

In addition to the difficulty of recapturing animals, mortality occurred for a number of collared moose each year. Over the course of the study 5 moose died. Three of these mortalities were probably related to capture and 2 were probably natural causes. A sixth moose was killed by a hunter in fall of 2002. Of the 3 possibly induced mortalities, 2 of these could probably have been avoided. These 2 moose had difficulty in standing after capture, and close observation suggested that one rear leg would not support weight. We hypothesize that these moose suffered a lack of circulation during processing, and nerve damage developed during that time. Unfortunately the moose were unwilling or unable to stand long enough to increase circulation through movement.

We suggest 3 possible reasons that the loss of circulation occurred in our study. This study represents one of the first times this technique of capture and ultrasound has been used on wild moose. Hundreds of captures have been performed by Alaska Department of Fish and Game (ADF&G) on captive moose on the Kenai Peninsula. However most of these captures occurred on snow or smooth or unfrozen ground. Captures on the Copper River Delta often occurred on frozen, uneven ground with little snow cover. In addition, we repositioned all four legs of the moose so that they were all facing forward and in line. This technique was borrowed from work on other large game and has been effective in limiting nerve damage. We hypothesize that this technique is detrimental to moose, and we suggest that if an individual lies down naturally that its position not be altered. In addition, long processing times may exacerbate this problem. During our final capture in March of 2002, we reduced processing time and did not reposition the legs unless the moose lay on its side. No mortalities occurred during this capture.

Much of the reason for the long processing time in our first capture was the length of time needed to conduct pregnancy tests. We did not do these tests in 2001-02. Processing time also decreased from fall to spring the second year of the study. This was mainly due to an effort to make processing more efficient. During spring 2002, the helicopter manager helped with processing by drawing blood and taking measurements while the other biologist conducted the MRF analysis. We also made an effort to shorten chase time. Mean chase time was highest for the fall 2002 capture. Note that median chase time was much lower than mean chase time. The high mean was largely due to 2 chases that were over 7 minutes. Most chases during that capture period were 1–2 minutes long.

MANAGEMENT IMPLICATIONS

One of the challenges in using this method will be to set a reasonable limit of body condition for determining carrying capacity. This technique cannot detect body fat below 5.6%. At 0% the moose cannot survive. Clearly this range is much lower than what we've seen during 2000-2002 on the Copper River Delta, and 5.6% body fat may be a reasonable limit for determining carrying capacity. Five percent body fat is not out of range for some interior Alaskan moose, and populations may be able to sustain themselves at this level.

In addition to setting a limit to percent body fat, we must decide what proportion of the population we can allow to drop below this level. We expect that some of the older, younger, and unhealthier animals will not compete as well as the healthy, experienced individuals and will be the first to show signs of deteriorating body condition. Also, carrying capacity is likely to display dramatic shifts between years depending on winter severity. Tracking carrying capacity year by year may not be the same as looking at average carrying capacity in 10- or 20-year increments. The most conservative approach would be to limit the population to a number that would not allow any cows of breeding age to drop below 5% body fat during severe winters. This would put the population well below carrying capacity for most years.

To properly model the effects of body condition on population, we would need to know much more about its relationship to age, fertility, and recruitment, and we would need to model random severe winters. All of this information is beyond the scope of the current study and are probably not necessary for broad management decisions. The data we've collected have already given indications that the current moose population is below carrying capacity during years with mild winters.

In order to determine the lower limit of carrying capacity, we will need to monitor body condition over a very severe winter. As we cannot predict whether a winter will be severe, we have 2 choices. The first is to carry out this study each year until a severe winter occurs. This alternative is reasonable and will result in a solid data set over time. We will, however, have to closely monitor mortality to determine our own effect on the population. Also, we would need to explore the effects of carfentanil on miscarriage rates. A large proportion of darted cows had no calves the following year. Whether this proportion is comparable to the natural birthing rate needs to be determined. Finally, this alternative does not set a definite time for ending the project. We would have to collect data until a severe winter occurred.

The second alternative is to use our current data as a baseline, and when a severe winter occurs, conduct the study in spring only. This alternative has the advantage of being able to wait until we know a severe winter has occurred. The disadvantages are that we will only be able to look at body condition in spring, and we will be unable to perform any paired comparisons with individuals in fall. Another practical consideration would be the necessity of conducting a fairly expensive project midway through the funding year.

A suitable aging technique should also be developed for the Delta. We suspect that young and old individuals probably do not compete as well for resources and that nutritional stress would show up in these individuals first. Without an adequate way to sample these ages, we must group all data. Currently we do not have enough data to determine whether age differences occur.

This data represents a valuable baseline for future monitoring and research. As the delta changes over time, we should be able to use this technique to track changes in body condition over time and changes in body fat over winter. We have determined that the current population levels on the Copper River Delta are probably well below carrying capacity, and resources do not seem to be a limiting factor in this area. Further study will be needed to determine body condition over severe winters.

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Winter Mountain Goat Surveys on the Cordova Ranger District in Areas of Motorized Use

Final Report

INTRODUCTION

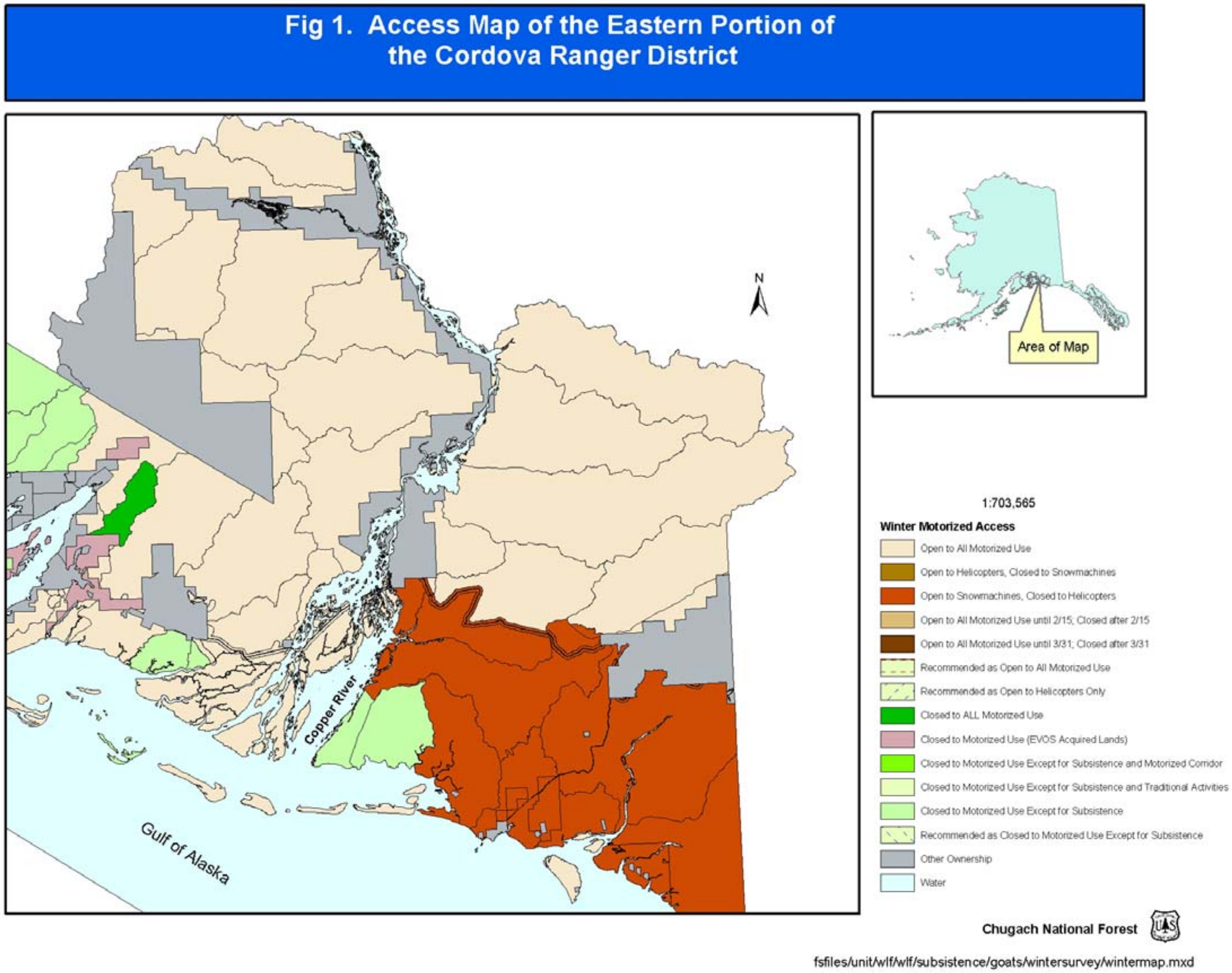
The mountain goat is a Management Indicator Species for the Chugach National Forest. The Cordova Ranger District (CRD), on the eastern side of the Chugach, contains large tracts of mountain goat habitat. With the implementation of the new Forest Plan, many of these areas are open to motorized access (fig 1.). Mountain goats are important to the local communities around the Chugach for wildlife viewing, sport harvest, and subsistence harvest. The areas that goats inhabit are important to both Alaskans and tourists for outdoor recreation. With outdoor recreation on the rise in Alaska, we can expect an increased number of requests for commercial motorized operations in areas that have formerly seen little use. Recently a commercial heliski permit was granted for the remote area around the Tasnuna River valley. With this increase in motorized traffic, more human/mountain goat interactions are likely to occur.

Mountain goats are sensitive to disturbance (Chadwick 1973) and when disturbed on a regular basis, they become highly stressed and can abandon ranges. Physiological responses to disturbance include elevated heart rate and metabolism. Continued disturbance may lead to poor physical condition during the kidding season from mid-May to mid-June.

Winter is a period of severe nutritional deprivation and food scarcity for mountain goats (Fox et al. 1989). Quantity and quality of winter habitat are the most limiting factors for mountain goats in Southcentral Alaska (Suring et al. 1988). Although the CRD and ADF&G conduct fall surveys in game management units around Prince William Sound, much of the CRD has not been surveyed, and few surveys have ever been conducted during the critical winter months. Currently, when a request for a motorized permit is received, we must rely solely on habitat models to make management decisions. Although models are generally accurate, they are often not specific and are never exact. Our current model states that mountain goats in winter occupy primarily south-facing slopes under 900 m (2950 ft) in elevation, normally within 800 m of timbered areas. These slopes are usually 25° or greater, within 800 m of escape terrain. Escape terrain is defined as slopes of 50° or greater with the terrain surface being broken up, usually by rock outcroppings (Fox et al. 1989).

The National Forest Management Act requires the Forest Service to manage fish and wildlife habitat to maintain viable populations of existing native and desired non-native vertebrate species in the planning area. Part of this process is to determine where and how many individuals occupy a given area. We can then overlay this information with potential motorized activities to determine the best course of action. The Chugach National Forest Revised Resource and Management Plan (p 4.61) states that recreational

Figure 1. Acces Map of the Eastern Portion of the Cordova Ranger District.



activities may be seasonally restricted to meet wildlife habitat objectives or to reduce wildlife-human interactions in important habitat areas or movement corridors. However, these important habitat areas and movement corridors have not yet been identified for wintering goats over much of the CRD.

The purpose of this project is to conduct winter surveys of all motorized areas of the CRD that contain potential mountain goat habitat. The ultimate goal is to create a GIS with mountain goat locations so that we can rapidly respond to permit, informational, and research requests.

OBJECTIVES

1) Define potential wintering habitat for mountain goats in areas of the Chugach National Forest, Cordova Ranger District, which are open to winter motorized use.
2) Gather information about mountain goat population size and composition in areas not traditionally surveyed on the Cordova Ranger District.
3) Create a wildlife GIS that includes winter goat locations.

METHODS

We conducted surveys from 17 Feb–31 March 2003. Survey areas included those areas on the CRD open to winter motorized use. Areas near Cordova and around Prince William Sound were excluded at this time because of the large number of fall surveys conducted there. The primary survey area ran from roughly the Rude River Valley east to the Bering River. We divided this area up into 18 separate units (fig. 2).

We conducted surveys with a PA-18 Supercub (Nichols 1978). A contour route along ridge complexes was flown with a pilot and observer as described in Smith (1986), at an elevation of 500 ft or more. Flight lines followed contours starting from the top of a ridge with each repeating pass at lower in elevation. Wider contour intervals of up to 500 ft were used in areas with deep unbroken snow where no tracks were visible (Lentfer 1955). Width of the search area on the ground was limited to 500 ft in elevation or 1/8 mile. Flights were conducted only in the morning hours when goats are more active (Nichols 1978). We marked goat locations and track locations on a topographic map and recorded GPS locations. Large glaciers were excluded from sample units, although edges of glaciers (up to 300 ft) were searched.

Sample units are separated by geographic barriers to minimize variability due to movements of goats among units. Temperature, wind speed, and visibility were recorded. Overall survey conditions were described as excellent, good, fair, or poor. Excellent conditions for observing tracks were clear skies, bright light, and no turbulence. Good conditions were combinations of partly cloudy to clear skies, direct light, and mild turbulence. Fair conditions were combinations overcast skies, moderate turbulence, and some low clouds obscuring ridge tops. We did not fly in poor conditions. Surveys were aborted if wind speed was above 26 knots. Start and stop times for the survey were recorded, and search effort (minutes/mi^2) was calculated.

Figure 2. Map of Mountain Goat Winter Survey Units, Cordova Ranger District, 2003.

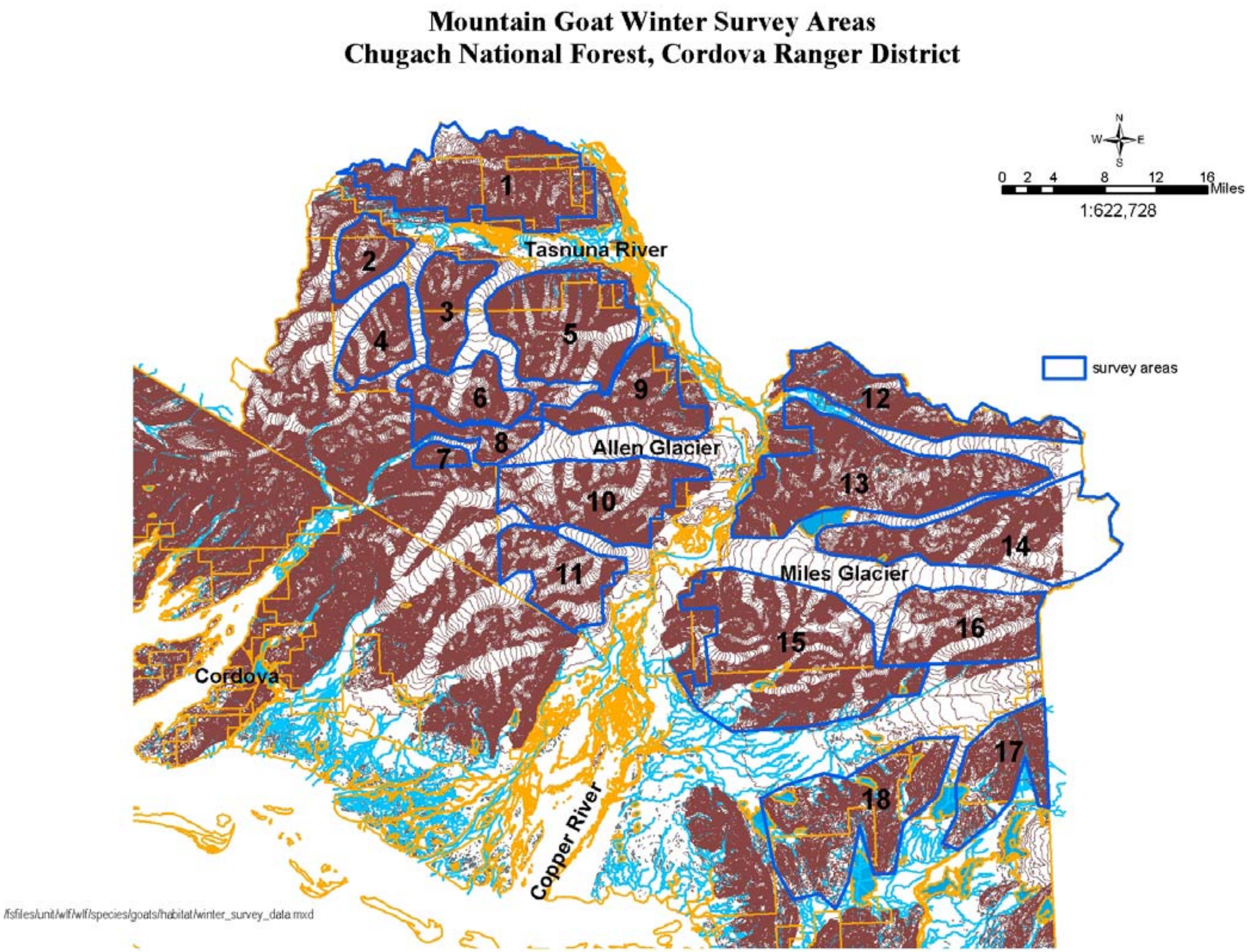


Figure 2. Map of Mountain Goat Winter Survey Units, Cordova Ranger District, 2003

Any goats observed were counted and classified as adult, kid, or unidentified goat (Holdermann 1991). Tracks and locations were entered into a GIS database. Aspect of slopes was classified as northerly (270^0-89^0) or southerly (90^0-269^0) and recorded on data sheets. Elevation for trails was defined as the elevation at the midpoint of the trail.

RESULTS AND DISCUSSION

We completed 7 survey units in 2003 (units 1–5, and 7–8). All of these units were near the Tasnuna River Valley in an area that was recently approved for commercial heliskiing. All surveys were flown in good to excellent conditions by three different observers and the same pilot. The total survey time was approximately 425 minutes, covering 400 mi^2, for a search effort of 1.06 minutes/mi^2.

We recorded 34 goat trails and 6 adult goats (fig. 3). Goat trails were present in all areas surveyed. Goat locations occurred in or adjacent to areas 2 and 8. All observed goats were between 3000 ft and 3200 ft elevation ($\bar{x}$ = 3066 ft.) and were on southern aspects. Goat trail midpoints ranged from 600–4300 ft elevation ($\bar{x}$ = 1860 feet). Of 34 trails observed, 68% (23 of 34) had southern aspects. One bear and one bear trail were observed in Unit 1 on 25 March.

Locations of goats and tracks generally agree with the model developed by Suring et al. (1988), however there is considerable variation. Although most of the goat tracks occurred on south-facing slopes, nearly one-third did not. Also, though the mid-point of the trails was within the expected elevation, trails ranged up to 4300 ft. (1291 m). This information suggests that relying solely on habitat models for management decisions may ignore some unique areas of goat activity. In this instance at least a third of the suitable goat habitat would have been missed. We suggest continued surveys of the motorized areas.

These data represent a single survey of the target areas. Snowfall shortly before surveys may obscure tracks that would normally be seen. Also, some trails that we observed probably represented sporadic movement from one area to another. These trails are given equal weight to other observed trails even though they may not indicate a high-use area. For this reason, surveying each unit multiple times is necessary. Our intent is to complete all units and then replicate all surveys. Only by conducting repeated surveys can we identify high-use areas and assure complete coverage.

Surveys of the entire district are to be completed over the next three winters, beginning from the west side of the Copper River and continuing systematically to the east. Additional surveys in following years should occur once every three to five years to monitor any population or habitat use changes on the district.

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Recreational Use

Goal

Improve knowledge and understanding of recreational activity and user satisfaction.

Objectives

- Develop information of recreational activities, parterres fuse and key recreational issuers.

Monitoring Question(s)

What are the characteristics of recreational visitors? What is their pattern of recreational use?

Exxon Valdez Oil Spill
Restoration Project Final Report

Western Prince William Sound Human Use and Wildlife Disturbance Model

Restoration Project 98339
Final Report - Part B

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Review Draft January 2004 **Review Draft**

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Western Prince William Sound Human Use and Wildlife Disturbance Model

Restoration Project 98339
Final Report - Part B

STUDY HISTORY

Project 98339 was proposed in 1997 by the USDA Forest Service and the Alaska Department of Natural Resources as a pilot project covering western Prince William Sound. Funding for the initial year of the project was received in December 1997 from the *Exxon Valdez* Oil Spill Trustee Council. Part A of the final product was submitted to the *Exxon Valdez* Oil Spill Trustee Council for review in December 1999. That report included a description of human use patterns in 1998, distribution of selected species injured as a result of the *Exxon Valdez* Oil Spill, results of a literature review on the effects of human disturbance on wildlife, and general management recommendations. This report constitutes Part B of the final product and includes predictions of future human use patterns, descriptions of potential areas of increased conflict with selected injured species, and specific management recommendations.

ABSTRACT

We describe the relationship of modeled future human use patterns with the distribution of harbor seals (*Phoca vitulina*) and pigeon guillemots (*Cepphus columba*) in western Prince William Sound. Predicted monthly use in 2015 within 1,000 m of individual pigeon guillemot nesting sites ranged from no change to increases > 4 times use in 1998 by kayakers and from no change to increases approximating 20 times by motorized recreational boats. Predicted monthly use in 2015 within 1,000 m of individual haul-out sites for harbor seals ranged from no change to increases approximating 12 times by kayakers and from no change to increases approximating 45 times by motorized recreational boats.

We recommend that education programs be developed that identify situations and habitats that should be avoided. New camp sites and upland recreation sites should be developed to help divert use away from sensitive areas. Consideration should be given to closing existing sites or discouraging their use in the vicinity of sensitive areas. A greater presence in the Sound by personnel of management agencies is needed to implement education efforts, enforce existing regulations, and assure adherence to closed area policies.

KEY WORDS

Alaska, *Cepphus columba, Exxon Valdez*, geographic information system, GIS, harbor seals, human use, *Phoca vitulina*, pigeon guillemots, Prince William Sound, wildlife disturbance.

PROJECT DATA

Predicted monthly and cumulative use data and use patterns of kayak and recreational motor boat user groups for western Prince William Sound for 2015 stored as MS Excel spreadsheets and ArcInfo geographic information system data files, respectively are held by Karin Preston, USDA Forest Service, Chugach National Forest, Anchorage, Alaska, 907-743-9574, kpreston@fs.fed.us. Spatial data are available upon request as Arc export files.

CITATION

Suring, L.H., K.A. Murphy, A. Iliff, S. Howlin, and K. Preston. 2004. Western Prince William Sound Human Use and Wildlife Disturbance Model, *Exxon Valdez* Oil Spill Restoration Project Final Report - Part B (Restoration Project 98339), Chugach National Forest, Anchorage, Alaska.

EXECUTIVE SUMMARY

Prince William Sound provides spectacular scenery and essential habitat for thousands of seabirds, marine mammals, 5 species of salmon, as well as habitat for upland birds and mammals. It also provides an economically important fishery for salmon, black cod, Pacific herring and other species. As human activities in the Sound have changed, so have the distribution and abundance of wildlife and fish populations that occur in the Sound. Over the last 15 years, the *Exxon Valdez* oil spill in 1989 was the most notable human-caused impact to the Sound's ecosystem. However, the opening of the Whittier Access road in the summer of 2000 is likely to bring new challenges to the Sound and to the species recovering from the spill as a result of increasing human use and associated development. Prior to construction of this road, access to western Prince William Sound was limited to float planes, the Alaska Railroad, Alaska State Ferries, and other boat traffic from Seward and Valdez. The new road provides easy and immediate access to the Sound for ½ of the State's population.

As human use in Prince William Sound increases, there is an increasing potential that human disturbance will play a major role in the distribution and population dynamics of many wildlife species. What effect this change may have on the recovery of species injured by the spill will depend on resource managers' abilities to understand and mitigate the effects of human activity in areas important to the injured species. While increased human activity in the Sound may affect the recovery of species injured by the spill, little information has been available to document and monitor the changing patterns of human use in the Sound. This project was designed as a tool for resource managers in the western Sound to help them understand the potential relationships between human activity and local wildlife populations.

Human activity in the western Sound is strongly tied to the water of the Sound. People participating in upland activities generally access upland sites via the water. The greatest potential for disturbance to injured species is also most likely to be from water-based

activities. For these reasons, this portion of our project focused entirely on kayakers and recreational motor boat users. We gathered information on use levels and distribution of use for each of the user groups through examination of public and private records. We incorporated this information with the results of user surveys and developed GIS techniques to assist us in describing use patterns. We also evaluated the resulting patterns with field data.

To evaluate the projected distribution of vessels in each user group throughout the western Sound, aerial surveys were conducted during summer months in 1998 to record the density of water vessel use on weekends and weekdays. Members of user groups were also surveyed to better describe current use patterns and to determine what their likely response would be to increased use of the Sound and potential crowding. To compare human use levels near concentrations of sensitive species, distribution maps of concentration areas were created for 2 species. Harbor seals and pigeon guillemots were selected to represent 2 classes of animal species injured as a result of the *Exxon Valdez* oil spill. We also evaluated current human activity patterns associated with cutthroat trout (*Oncorhynchus clarki*) habitat and decided that our data were not sufficient to evaluate potential future use of this resource.

Seventeen aerial surveys were flown from June through September 1998 to provide information necessary to evaluate patterns of use developed for water vessels in the western Sound. We also conducted simultaneous aerial and water-based surveys to evaluate the ability to sight water vessels during aerial surveys. Comparisons of the relative number of water vessels predicted to occur in the western Sound through our GIS analyses with the results of the aerial surveys revealed strong correlations. These results are presented in Part A of this report.

Generalized linear models of current use by month were fit for kayakers and recreational motorboat users. The number of occurrences of each user group was assumed to follow a Poisson distribution. Twenty-eight variables describing distance to and density of sites and characteristics of interest to water-borne recreationists in the western Sound were available to develop models of human use patterns. Values for explanatory variables were derived through GIS techniques and were used to model the number of occurrences of each user group from a sample of grid cells throughout western Prince William Sound. Explanatory variables described distance to and density of features assumed to affect human distribution in the Sound, such as scenic features, recreation opportunities, and campsites. The candidate variable set for each month for each user group was reduced to 7 variables by ranking the univariate models by the lowest Akaike's Information Criterion value.

Univariate analyses relating each of the 28 individual variables to existing-use patterns showed similarity in top-ranked variables among months for distribution of kayaks and motorized recreation boats. Minimizing the distance to harbor, distance to shore (that is, avoiding open water), and distance to camp sites were consistently important to kayakers. Other characteristics that influenced distribution of kayakers were glaciers, wildlife viewing opportunities, and upland recreation sites (including access to trails).

Minimizing distance to the harbor was also important for motorized recreation boat users, as was distance to anchor buoys and safe anchorage sites. Distance to shore was less important to this user group. Glaciers and upland recreation sites also attracted these users. Sport fishing opportunities consistently influenced distribution patterns of motorized recreation boat users. Opportunities for hunting black bear in the spring and Sitka black-tailed deer in the late summer and fall also had limited influence.

Multivariate model selection using these variables involved selecting the top 7 models from all possible models for each month. Final multivariate model selection attempted to minimize bias and variance and was based on model predictions made using a test data set. Separate distributions of the number of existing occurrences of each user group for each month were calculated for the entire dataset for the western Sound using the regression equations of the top 7 final models from the model fitting dataset. Spatial use patterns resulting from each of these models were compared with the spatial pattern of existing use. The models that best matched the spatial pattern of existing use for each month were selected for use in the process to estimate future use patterns.

Variables that entered these selected models to estimate monthly use patterns of kayakers included distance to campsites, shore, tidewater glaciers, upland recreation opportunities, and Whittier. As distance to these sites and characteristics increased, use decreased. The magnitude of the individual effect of each of these variables remained relatively constant among months. Distance to Whittier had a moderate effect on use levels predicted by models selected for all of the months. Distance to camp sites had a greater effect in all models. Distance to shore had a large effect in the models for June and July.

Variables that entered selected models to estimate monthly use patterns of motorized recreational boaters included distance to upland recreation opportunities, upland glaciers, safe anchorage sites, sport fishing opportunities, and Whittier. As distance to these sites and characteristics increased, use decreased. The magnitude of the individual effect of each of these variables also remained relatively constant among months. Distance to Whittier had a large effect on use levels predicted by models selected for all of the months. Upland recreation opportunities affected use patterns in May and June. Safe anchorage sites had a large influence on use patterns in July. Sport fishing opportunities influenced use in August and September.

Predicted monthly use in 2015 of kayaks within 1,000 m of individual Pigeon guillemot nesting sites ranged from no change to increases > 4 times current use. Mean monthly increases at all sites ranged from 150 to 250%. Predicted monthly use in 2015 of motorized recreational boats within 1,000 m of individual nesting sites ranged from no change to increases approximating 20 times current use. Mean monthly increases ranged from 380 to 660%. Predicted monthly use in 2015 of kayaks within 1,000 m of individual haul-out sites for Harbor seals ranged from no change to increases approximating 12 times current use. Mean monthly increases at all sites ranged from 110 to 290%. Predicted monthly use in 2015 of motorized recreational boats within 1,000 m of individual haul-out sites ranged from no change to increases approximating 45 times current use. Mean monthly increases ranged from 340 to 390%.

Many authors that presented approaches for managing people to reduce the effects of disturbance on wildlife identified the same range of protective measures including (1) public education, (2) enforcement of existing laws and regulations, (3) exclusion of specific forms of transportation, (4) exclusion of dogs and the removal of other introduced predators, (5) excluding people from large or small areas, (6) redirecting public access, and (7) habitat manipulation. Because land management jurisdiction in the Sound is so complex, public education may be one of the strongest tools available to managers.

Monitoring

Interim Reports

Vegetative Composition/Biodiversity

Goal

Maintain a full range of naturally occurring ecological processes and flora native to South-central Alaska including a variety of vegetation types, patterns, and structural components.

Objectives

- Develop a baseline estimate of current vegetation types, patterns and structural components on the Chugach National Forest. Monitor changes to these components to determine how well the plan is maintaining desired landscape conditions.
- Restore vegetation on landscapes affected by activities, natural events or processes to meet desired conditions.

Monitoring Question(s)

To what extend is ecosystem composition and structure changing and has forest management influenced these changes?

Focus this work on the Kenai Peninsula portion of the Chugach National Forest where the greatest level of natural disturbance effects on vegetation (ie, spruce beetle impacts) and restoration project activity is occurring. Utilize permanent vegetation plots and remote sensing to identify current vegetation conditions. Estimate past conditions based on paleoecological data. Compare past and current conditions.

Vegetation Compositional Change in Forests of the Kenai Mountains

PROJECT DESCRIPTION

The spruce bark beetle (*Dendroctonus rufipennis*) has caused widespread mortality to spruce (*Picea*) trees in southcentral Alaska. Undergrowth compositional change is anticipated in response to changes in overstory canopy closure. The objective of this work is to quantify overstory and undergrowth vegetation compositional changes within forests of the Kenai Mountains, with emphasis on Lutz spruce (*Picea* X *lutzii*) forests affected by the spruce bark beetle.

Continued monitoring and evaluation of these plots will provide invaluable baseline information on natural succession within the forest types of the Kenai Mountains. These results can be used to calibrate models predicting rates and directions of compositional change in response to bark beetles (and other natural disturbance phenomena).

ACCOMPLISHMENTS

Since 1993, a network of 27 forest monitoring plots has been established in the Kenai Mountains. Vegetation composition within these plots has been documented at intervals ranging from two to four years through 2002.

The plots are distributed among the following plant community types (DeVelice et al. 1999) representing a range of coniferous forest types of the Kenai Mountains:

1. Lutz spruce/bluejoint reedgrass (3 plots estab. 1993)
2. Lutz spruce/oak fern (3 plots estab. 1993)
3. Lutz spruce/rusty menziesia (3 plots estab. 1993)
4. Lutz spruce/lowbush cranberry (3 plots estab. 1993)
5. Lutz spruce/devil's club (4 plots estab. 1994)
6. Lutz spruce-mountain hemlock/rusty menziesia (4 plots estab. 1995)
7. mountain hemlock/rusty menziesia (3 plots estab. 1995)
8. mountain hemlock/moss (4 plots estab. 1995)

Table 1 lists the community type and years of measurement dates for each plot.

Each plot includes 16 microplots evenly distributed over 4 evenly spaced transects. Plot size is 66 by 66 meters (0.1 acre), with each transect spaced 13 feet from adjacent transects or from the edge of the plot. The 4 microplots per transect are also 13 feet apart. To assure that successive microplot sampling is done in precisely the same location; all microplots were permanently marked with reinforcing rods.

Canopy cover for shrub species and herbaceous species was estimated within each quadrant. Tree cover was estimated by measuring canopy intercept by species along each of the four transects.

Table 1. Measurement dates and the community type (CT)[1] for each sample plot.

Plot	CT	1993	1995	1996	1997	2000	2002	Times Sampled
93PRM001	1	X	X		X	X		4
93PRM002	1	X	X		X	X		4
93PRM003	1	X	X		X	X		4
93PRM004	2	X	X		X	X		4
93PRM005	2	X	X		X	X		4
93PRM006	2	X	X		X	X		4
93PRM007	3	X	X		X	X		4
93PRM008	3	X	X		X	X	X	5
93PRM009	3	X	X		X	X	X	5
93PRM010	4	X	X		X	X	X	5
93PRM011	4	X	X		X	X		4
93PRM012	4	X	X		X	X	X	5
94PRM013	5		X		X	X		3
94PRM014	5		X		X	X		3
94PRM015	5		X		X	X		3
94PRM016	5		X		X	X		3
95PRM017	7			X		X		2
95PRM018	6			X		X		2
95PRM019	6			X		X		2
95PRM020	8			X		X		2
95PRM021	8			X		X		2
95PRM022	6			X		X		2
95PRM023	7			X		X		2
95PRM024	8			X		X		2
95PRM025	6			X		X		2
95PRM026	7			X		X		2
95PRM027	8			X		X		2

[1] Community types (CT) are as follows: 1-Lutz spruce/bluejoint reedgrass; 2-Lutz spruce/oak fern; 3-Lutz spruce/rusty menziesia; 4-Lutz spruce/lowbush cranberry; 5-Lutz spruce/devil's club; 6-Lutz spruce-mountain hemlock/rusty menziesia; 7-mountain hemlock/rusty menziesia; and 8-mountain hemlock/moss.

The following statistical analyses were carried out on the data:

- **Cluster analysis** – to determine if observed compositional changes were of a sufficient magnitude to result in a change in a plots classification. The program

CLUSTR supplied in the PC-ORD computer package (McCune and Mefford 1999) was used for this analysis. Within CLUSTR, the run options selected were the Sorensen (Bray-Curtis) distance measure (Beals 1984) and the group linkage method selected was the unweighted pair group method with arithmetic mean (UPGMA; Lance and Williams 1967).

- **Ordination** – to display the direction and magnitude of overall compositional change within and among plots. The Non-metric Multidimensional Scaling (NMS) program supplied in the PC-ORD computer package (McCune and Mefford 1999, see Clarke 1993 for a summary of the method) was used for this analysis. Within NMS, the run options selected were "autopilot" mode with the "thoroughness setting" at "medium" and the Sorensen (Bray-Curtis) distance measure selected (Beals 1984).

The set of dominate (cover ≥ 15) species varied on many of the plots over the monitoring period (left side of Figure 1). However, cluster analysis (right side of Figure 2) indicates that, in most cases, these compositional changes were not of sufficient magnitude to result in changes in classification. In 26 of the 27 plots, the remeasurement records group together at distance values of less than 25 percent of the range (i.e., distance <1.183). Only plot 10 includes a remeasurement record that is suggestive of a change in classification. At a distance value of about 29 percent of the range (i.e., distance = 1.362) record 010X93 splits from the other records for the plot.

Overall, the plots cluster from species rich (number of species, S ≥ 20) communities with dominants including *Calamagrostis canadensis*, *Dryopteris dilatata*, *Equisetum arvense*, and *Gymnocarpium dryopteris* at the top of the dendrogram (Figure 1) to species poor (S ≤ 5) communities at the bottom of the dendrogram. Communities with intermediate richness values occupy the central portion of the dendrogram and include *Dryopteris dilatata*, *Echinopanax horridum*, *Empetrum nigrum*, *Gymnocarpium dryopteris*, and *Menziesia ferruginea* as dominant species.

Ordination results (Figure 2) mimic those obtained from cluster analysis. The remeasurement records within each of the 27 plots group together, suggesting that compositional changes have not been large within any given plot during the remeasurement period. However, within 22 of the 27 plots there is a trend in compositional change through time indicated by a decrease in ordination scores along axis 3 (Figure 2).

Figure 1. Unweighted pair group method with arithmetic mean (UPGMA) cluster analysis of the 27 permanent plots based on their undergrowth vascular plant composition.

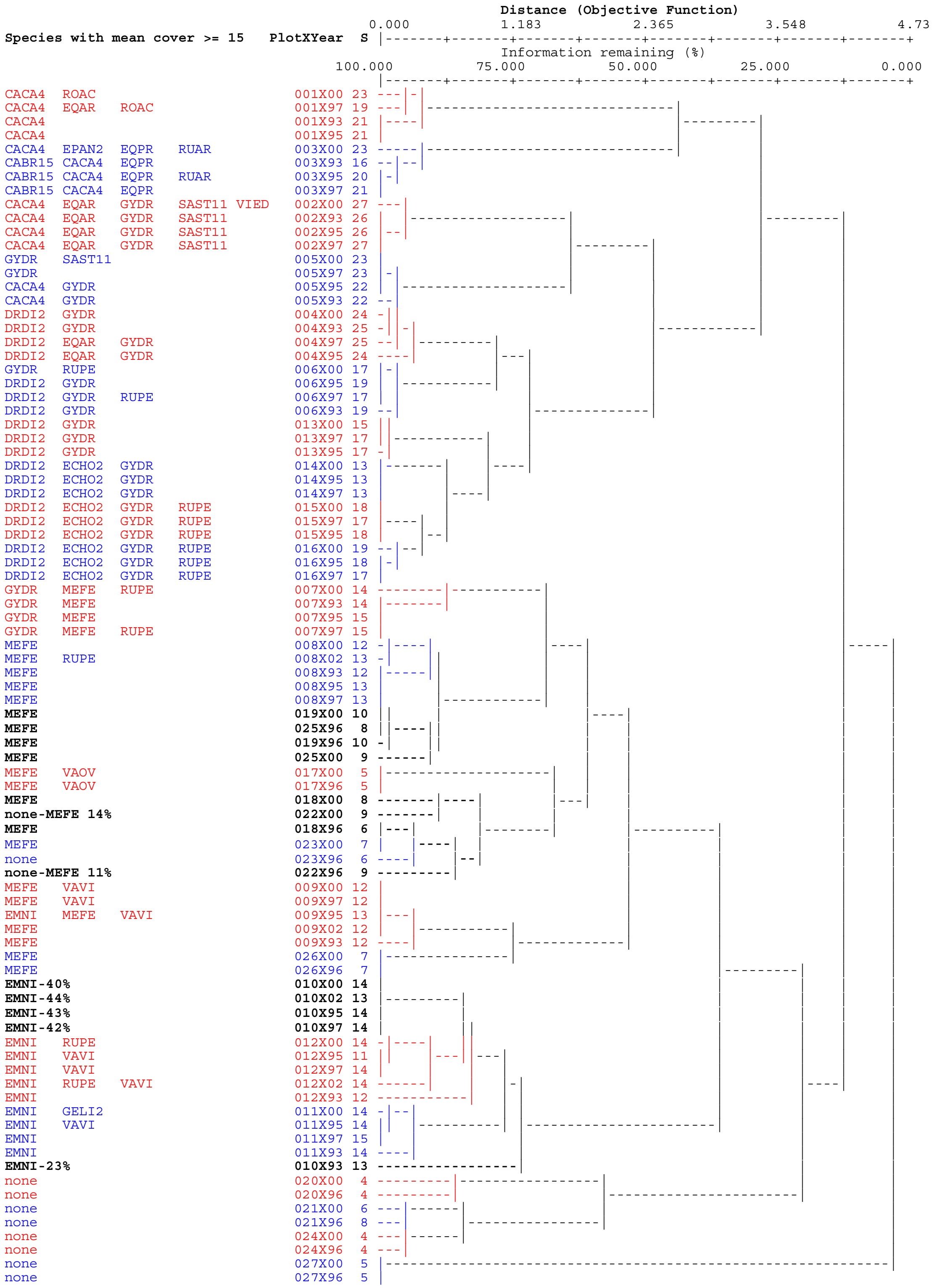
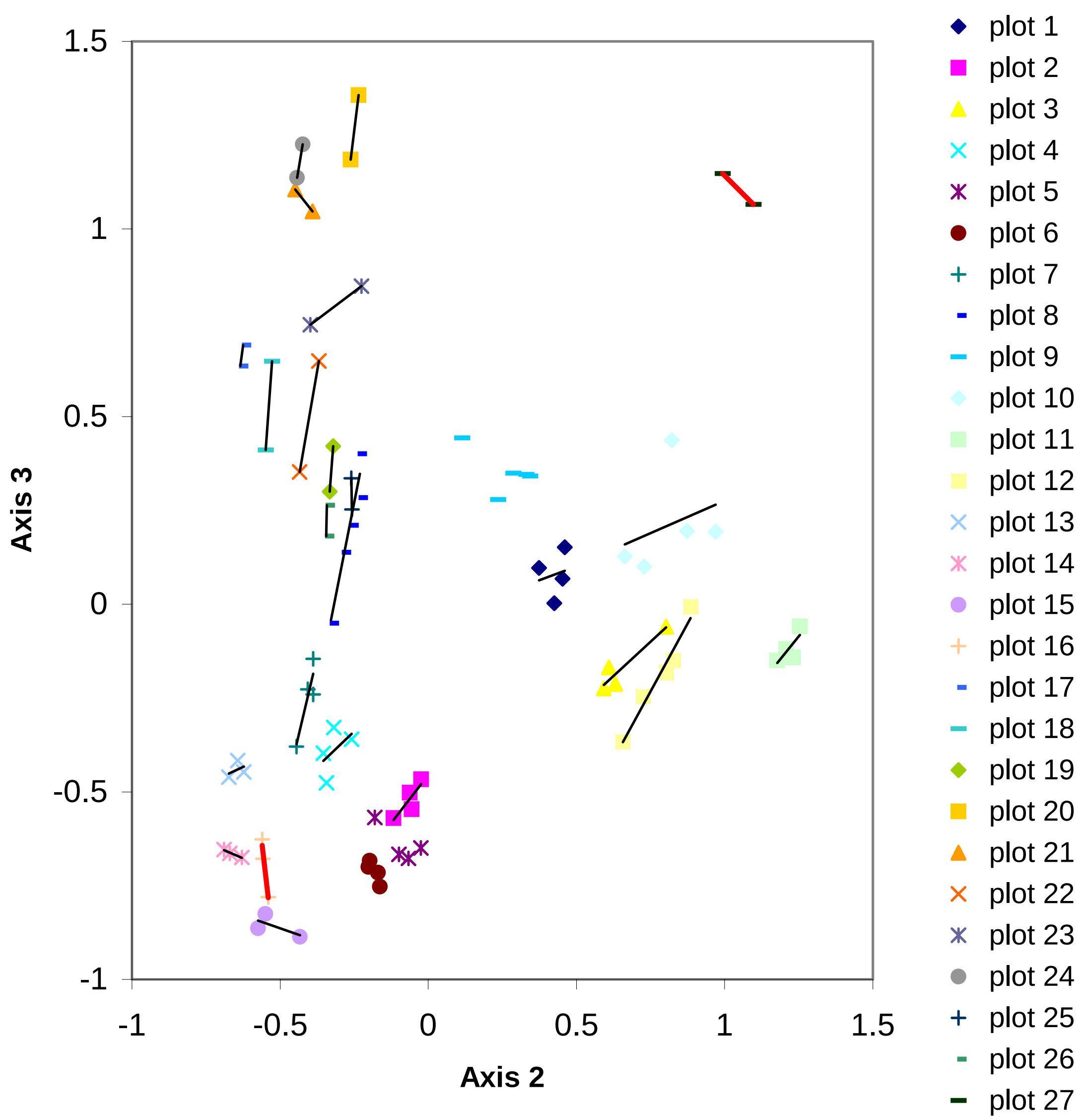


Figure 2. Non-metric multidimensional scaling (NMS) ordination of the 27 permanent plots based on their undergrowth vascular plant composition. Only axes 2 and 3 are shown. The thin black lines (22) indicate downward trends through time along axis 3. The thick red lines (2) indicate an upward trend through time along axis 3. The three plots without lines show no trend through time.



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Beals, E.W. 1984. Bray-Curtis ordination: an effective strategy for analysis of multivariate ecological data. Advances in Ecological Research 14:1-55.

Clarke, K.R. 1993. Non-parametric multivariate analyses of changes in community structure. Australian Journal of Ecology 18:117-143.

DeVelice, R.L., C.J. Hubbard, K. Boggs, S. Boudreau, M. Potkin, T. Boucher, and C. Wertheim. 1999. Plant community types of the Chugach National Forest: southcentral Alaska. USDA Forest Service, Technical Publication R10-TP-76, Anchorage, Alaska. 375 p.

Lance, G.N. and W.T. Williams. 1967. A general theory of classification sorting strategies. I. Hierarchical systems. Computer Journal 9:373-380.

McCune, B. and M.J. Mefford. 1999. Multivariate analysis of ecological data. Version 4.10. MjM Software, Gleneden Beach, Oregon.

Contact Person: Robert L. DeVelice, Supervisor's Office, 907-743-9437.

Kenai Lake Photo Point Survey
Regeneration Monitoring

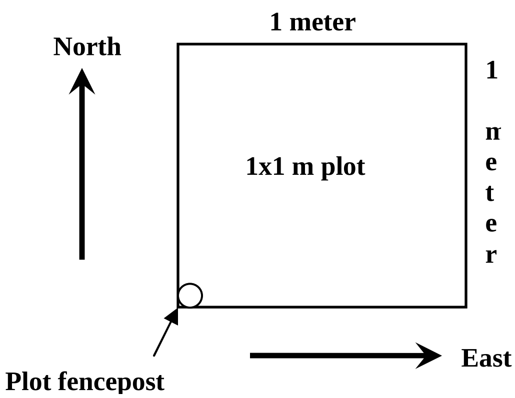
Photo points were set up in fifteen locations within the Kenai Lake burn in August 2003. Plot locations were permanently marked with metal fence posts firmly affixed into the ground. Plots locations were recorded with a handheld GPS unit. All plot locations are within walking distance of the Trail River Campground. Logistics in setting up plot locations in more distant locations were too difficult.

The survey was initiated two years after the Kenai Lake burn to capture succession following a major fire disturbance. Sites for photo points were subjectively selected to reflect a variety of burn severity conditions and moisture conditions. Some were placed in uplands, some in drainages, some in severe burn areas, and some in patchy burn areas. Fifteen plots were put in during the 2003 field season.

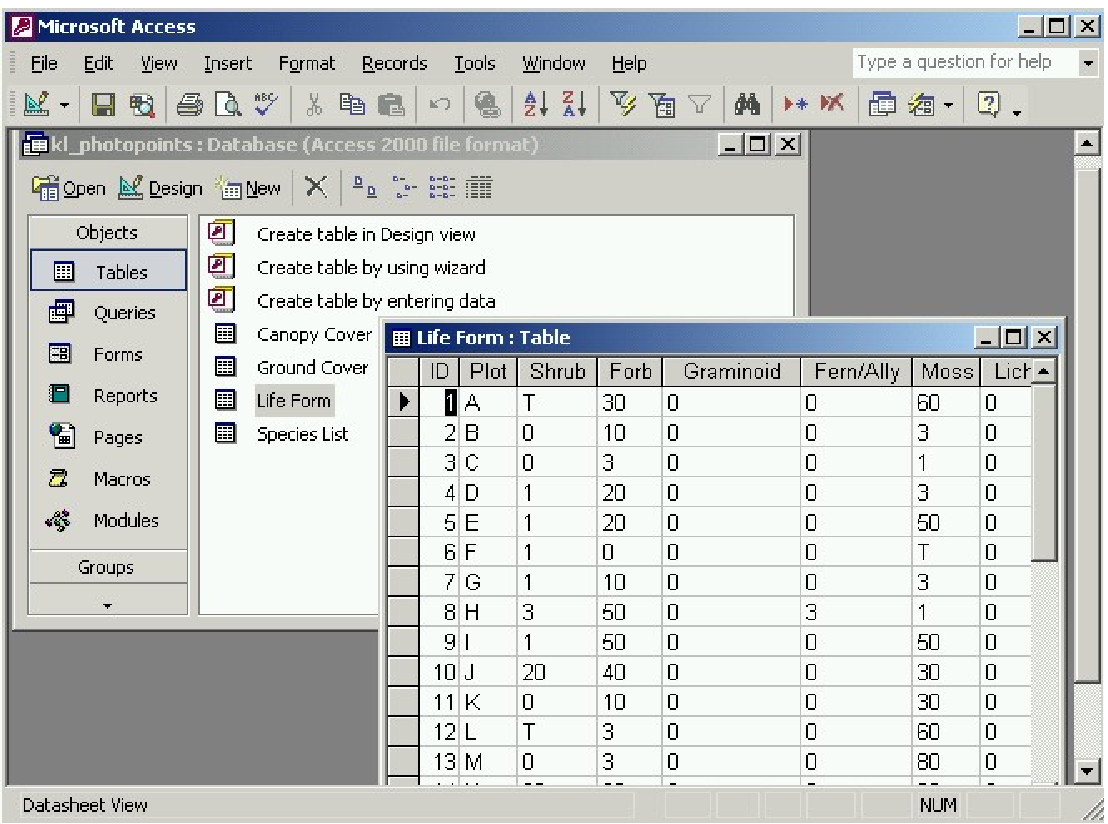
At each plot, a series of photos were taken. Techniques were taken from the Hall (2002) publication but modified in the following ways: Strict location and distance location was not taken from the starting point as GPS was used, and is sufficient for exact plot re-location. Also, a digital camera with a fixed aperture was used instead of a film camera. Digital technology is sufficient to capture a repeatable 35 mm picture of each point. Data sheets from the Hall publication were used to record the photograph site description and location, the camera location, and the number of and description of photos taken at each site.

A photo was taken facing the plot at a recorded distance from the base of the fencepost to the tip of the photographer's shoes. Distance from shoes to post varied by terrain and vegetation cover. The compass bearing in degrees from the post to the photographer was recorded. Compass declination was set at 27 degrees. The height of the photo point form affixed to the post was set at the same distance from the ground in every photo, at one meter. A photo was also taken to the right and then left side of the post at 1.5 meters from the base of the post to the photographer's shoe tips. A photo was taken standing at the post, with the photographers back on the post, facing back to where the first photo point was taken.

Other data collected included vegetation data taken within a 1x1 meter plot which was aligned so that the plots face north and east on the corner of the plot. Ground cover, lifeform, and species were recorded in cover classes, using the typical Chugach National Forest 1x1 meter plot procedures. A diagram below illustrates this:



The 1x1 meter plot data was entered into an MS Access database. Separate tables were created for canopy cover, ground cover, and life form. A separate table gives a species list for all species found within the 1x1 meter plots. An example of data entry is below:



ID	Plot	Shrub	Forb	Graminoid	Fern/Ally	Moss	Lich
1	A	T	30	0	0	60	0
2	B	0	10	0	0	3	0
3	C	0	3	0	0	1	0
4	D	1	20	0	0	3	0
5	E	1	20	0	0	50	0
6	F	1	0	0	0	T	0
7	G	1	10	0	0	3	0
8	H	3	50	0	3	1	0
9	I	1	50	0	0	50	0
10	J	20	40	0	0	30	0
11	K	0	10	0	0	30	0
12	L	T	3	0	0	60	0
13	M	0	3	0	0	80	0

<u>Future Plans:</u>

The ease of access to these sites and relatively quick data collection and photography make this project a good candidate for repeated visits, each year for five years, and then every other year for ten years. The expected result is a paper illustrating success ional change over time on part of the Chugach National Forest that experienced a change back to stand initiation conditions as a result of disturbance.

GPS Point Table for Kenai Lake Photo Point Survey

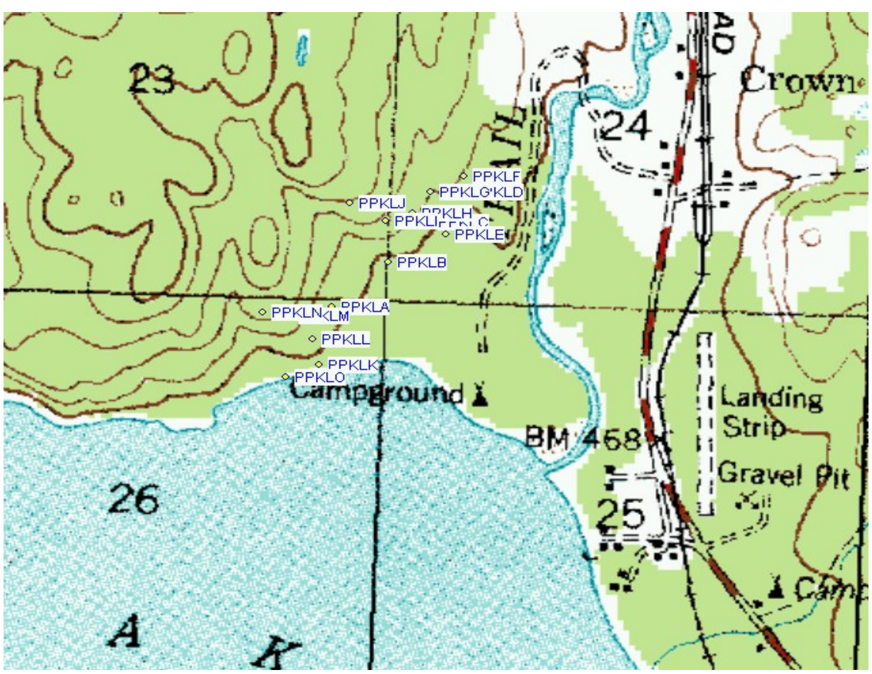
Start ATMGPS 9/24/2003 12:24:58 PM

Point	Northing	Easting	GPS Name*
A	60.4155551	-149.3897135	PPKLA
B	60.4171555	-149.3863947	PPKLB
C	60.4185986	-149.3839796	PPKLC
D	60.4196622	-149.3820306	PPKLD
E	60.4181836	-149.3829716	PPKLE
F	60.4201869	-149.3820618	PPKLF
G	60.4196001	-149.3839824	PPKLG
H	60.4188538	-149.385034	PPKLH
I	60.4185879	-149.3866834	PPKLI
J	60.4191566	-149.388828	PPKLJ
K	60.4135785	-149.3903105	PPKLK
L	60.4144566	-149.3907298	PPKLL
M	60.4152049	-149.3922076	PPKLM
N	60.4152931	-149.3938383	PPKLN
O	60.4130931	-149.3923096	PPKLO

End ATMGPS 9/24/2003 12:24:58

*PPKL = Photo Point Kenai Lake
Following Letter = Plot Name

Project Map with GPS Points:



Examples of Plot Photo Point Series:

Looking Towards Plot O

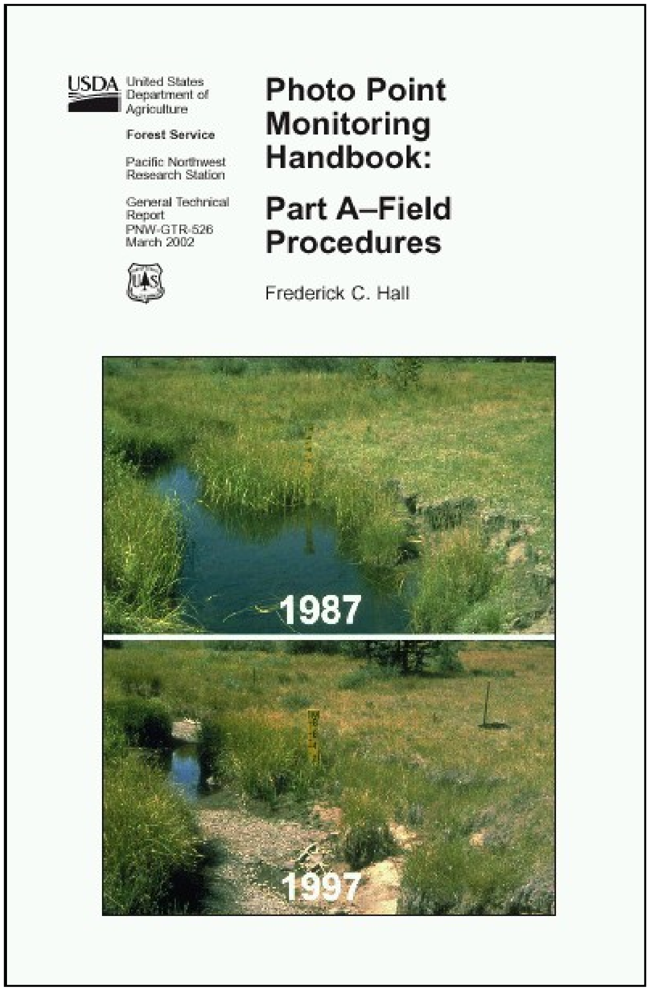
Right Side Plot O

Left Side Plot O

Looking out from Plot O

LITERATURE CITED

Hall, Frederick C. 2001. Photo point monitoring handbook: Part A—field procedures. Gen. Tech. Rep. PNW-GTR-526. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 48 p. 2 parts.



Contact Person: Elizabeth Bella, 224-4130

Management of Indicator Species (MIS) and Species of Special Interest (SSI)

Goal

Maintain habitat to produce viable and sustainable wildlife populations that support the use of fish and wildlife resources for subsistence and sport hunting and fishing, watching wildlife, conservation, and other values.

Objectives

- Implement standards and guidelines to protect species and their habitats through protection, conservation and restoration of important terrestrial and aquatic habitats.
- Monitor wildlife and fish species and their habitats to answer questions described in the monitoring strategy.

Monitoring Question(s)

What are the population trends for black oystercatchers and the relationship to habitat? Has the population or the nesting habitat on beaches increased or decreased, and what are the characteristics of the nesting sites of the black oystercatchers?

What are the population trends of the Coho salmon and their relationship to habitat?

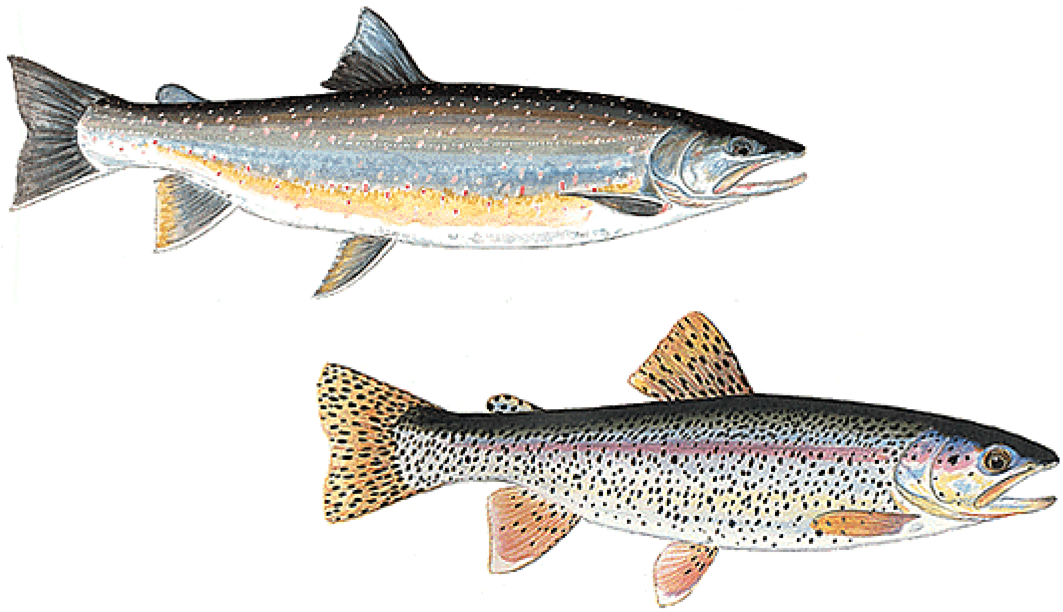
What is the distribution and relative abundance of cutthroat trout throughout the Forest?

What are the populating trends for moose and the relationships to habitat? What are the characteristics of moose habitat by season?

Is the forest management maintaining favorable conditions for sustaining mountain goats? Forest wide guidelines have identified specific distances to be maintained between activities and goats hat their critical habitat. Is management respecting these guidelines and are they effective?

The process being implemented first establishes the populations, locations, and habitat of the mountain goat, and subsequently determines the location of the motorized use and effects on the mountain goat.

Population Structure and Distribution of Coastal Cutthroat Trout and Dolly Varden in Eyak and McKinley Lakes



by
Tim Joyce & Matthew Sloat

Cordova Ranger District
Chugach National Forest

February 2004

INTRODUCTION

Eyak and McKinley Lakes are two of the largest lakes on the West Copper River Delta that support Dolly Varden (Salvelinus malma) and coastal cutthroat trout (Oncorhynchus clarki clarki). Dolly Varden are a Management Indicator Species (MIS) and coastal cutthroat trout are a species of special interest on the Chugach National Forest. As such, these species are subjects of several general management questions related to population trends and habitat relationships outlined in the current Land and Resource Management Plan (USFS 2002).

The life histories of cutthroat trout and Dolly Varden are among the most complex and diverse of the Pacific salmonids. Within both species several variations in movement patterns may occur, sometimes within the same drainage (Armstrong 1978, Saiget et al. 1997). Of special importance for both Dolly Varden and coastal cutthroat is management of key wintering areas such as lakes and larger river systems (Armstrong 1978, Jones and Seifert 1997). Anadromous Dolly Varden over winter in lakes throughout Alaska. After leaving these lakes in the spring, these fish may migrate a considerable distance, enter other stream systems and before winter return to the sea and migrate back to the lake system. In southeast Alaska, Dolly Varden were recovered in 25 different stream systems up to 116 km from the lake system where they were marked (Armstrong 1978). After an average of 116 days, 43% of the marked fish returned to the original lake system before winter, indicating that Dolly Varden have some fidelity to over wintering habitats (Armstrong 1978). Anadromous cutthroat trout show similar migration patterns to those described above for Dolly Varden. In southeast Alaska, cutthroat trout dispersed all directions along the coastal shoreline from mixed-stock over wintering lakes to access streams for spawning (Jones and Seifert 1997). Lake systems are also important winter habitats for adfluvial fish that spend their entire life in freshwater, but migrate from lakes into rivers and streams to spawn (Armstrong 1978, Jones and Seifert 1997, Saiget et al. 1997).

Despite current management interest, very little information is available on the population size or distribution of cutthroat trout and Dolly Varden from specific habitats on Forest lands of the West Copper River Delta. This lack of information makes decisions concerning the effects of land management on these species very difficult. Eyak and McKinley lakes may provide over wintering habitat for many reproductively isolated populations of coastal cutthroat and Dolly Varden. For example, Saiget et al. (1997) found that radio tagged cutthroat trout originally captured in 18 Mile Creek over winter in McKinley Lake. Because wintering areas may harbor fish from many spawning streams scattered over a large area, a depletion of the fish in one wintering area could severely reduce or eliminate populations belonging to many stream systems.

Specific issues related to the management of Dolly Varden and coastal cutthroat in Eyak and McKinley lakes include impacts from sport and subsistence fishing, as well as effects of land management. For example, from 1996 to 2000 the estimated number of recreational anglers fishing in the Eyak Lake drainage has increased from 967 to 1316 (M. Miller, ADF&G, personal communication). Subsistence fishing for whitefish

(Coregonus sp.) occurs irregularly in both Eyak and McKinley lakes but very little information is available on the amount of whitefish harvested or the incidental mortality of other salmonids captured in the fishery. Road construction near Eyak Lake appears to have negatively impacted the amount of available spawning habitat for cutthroat trout. In 1995, a survey by Forest Service crews on Eyak Lake estimated that almost half (44%) of the historic cutthroat trout spawning habitat around Eyak Lake had been lost to road construction (Hodges 1995). However, the impact of this habitat loss is impossible to determine without baseline data on the current fish populations. Recent hook-and-line and trapping surveys conducted by the CRD fisheries personnel have indicated cutthroat population declines in other lake systems across the West Copper River Delta (Stash 2001). Monitoring will help managers assess whether these declines are due to local habitat conditions or are synchronous responses to broader scale environmental patterns.

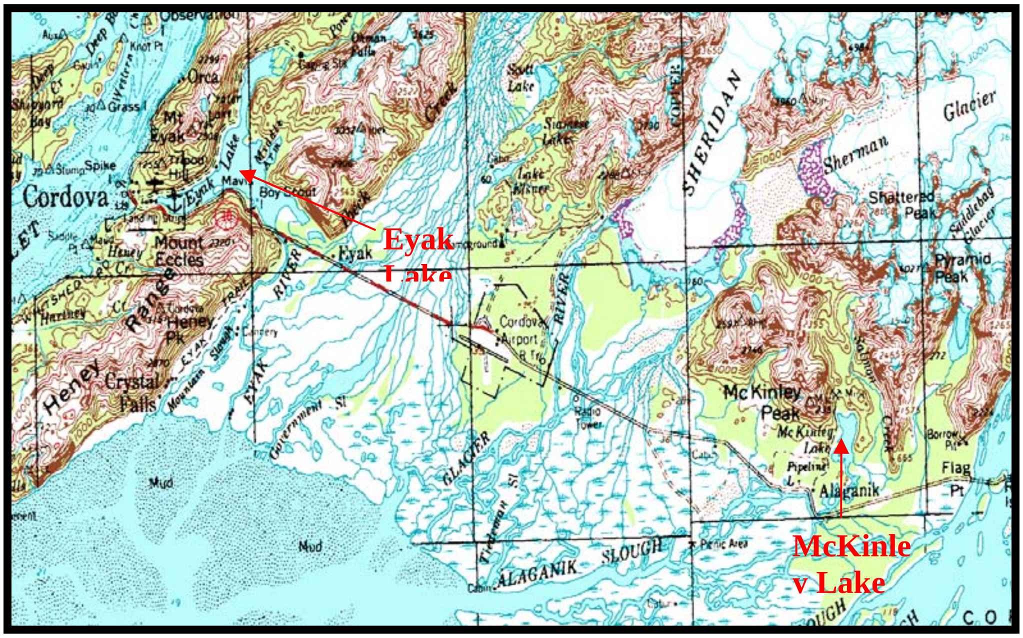
This report details a monitoring program to assess the population structure, including population age classes, growth and distribution of coastal cutthroat trout and Dolly Varden in Eyak and McKinley lakes. This monitoring program will help managers answer general questions about population trends and habitat relationships of Dolly Varden and cutthroat trout across Forest lands, as well as provide baseline data towards answering specific questions surrounding the management of Eyak and McKinley lakes.

The specific objectives of this project are to: 1) develop reliable sampling protocols to estimate the seasonal abundance of coastal cutthroat trout and Dolly Varden char populations in Eyak and McKinley lakes; 2) determine stock composition, through life history identification, of cutthroat and Dolly Varden populations; 3) determine age and growth characteristics of cutthroat and Dolly Varden populations.

STUDY AREA

Eyak and McKinley lakes are the two largest lakes on the West Copper River Delta, Figure 1. Eyak Lake has a surface area of 1,000 ha. Eyak Lake has a relatively constant and shallow depth with a maximum depth of 7 m, and a mean depth of 1.7 m (Pellissier and Somerville 1987). The major inlet to Eyak Lake is Power Creek, and its outlet is the Eyak River, which flows approximately 10 km before reaching the Copper River flats. McKinley Lake has a surface area of 114 ha, maximum depth of 11 m and mean depth of 5.1 m. The bathometry of McKinley Lake is more U-shaped than Eyak Lake, with depths increasing rapidly from shore (Pellissier and Somerville 1987). McKinley Lake has a major inlet at the north end near the USFS cabin. Salmon Creek joins the Alaganik River at the outlet of McKinley Lake. However, at higher flows a portion of Salmon Creek flows directly into McKinley Lake. McKinley Lake is drained by the Alaganik River, which flows approximately 20 km before reaching the Copper River flats.

Figure 1. Location of Eyak and McKinley Lakes.



METHODS

Lake Sampling: Eyak and McKinley lakes were sampled from late May, through July, with monofilament gill nets, minnow traps, and beach seines. Timing and location of sampling was designed to minimize incidental capture of migrating sockeye (Oncorhynchus nerka) and coho (Oncorhynchus kisutch) salmon. However, since Dolly Varden and cutthroat trout commonly follow salmon spawning migrations their distributions in the lakes will not be random during these migrations. As discussed below, some sampling focused on areas routinely surveyed by Alaska Department of Fish and Game (ADFG) personnel for sockeye and coho salmon. All sample locations were referenced with a hand held GPS unit and input into ArcView hydrography layers.

Monofilament gill nets were similar to those used in the whitefish subsistence fishery. In addition to being an efficient means of sampling large lakes, these nets allowed us to document the incidental catch of Dolly Varden and cutthroat trout using similar gear to that used in the subsistence fishery. Past studies using gill nets have successfully produced mark-recapture estimates for lake populations of bull trout (Salvelinus confluentus), lake trout (Salvelinus namaycush) (Fredricks et al. 1998), and Bonneville cutthroat trout (Oncorhynchus clarki utah) (Ruzycki et al. 2001).

The monofilament gill nets used were 3.3 m deep and 33 m long. These nets had a uniform bar mesh size of 1.25” and extra material between ties so that fish tend to become entangled rather then gilled, or wedged, in the material (B. Perrine, personal communication). In the event that fish became gilled or wedged, the netting was cut around the fish to minimize injury from handling. Nets were set perpendicular to the shoreline in the mid to upper water column. To minimize injury to fish, nets were retrieved within 30 min of being deployed.

A total of 12 minnow traps were set on the lake bottom at 30 m intervals along two transects parallel to the shoreline. Past studies of cutthroat trout and Dolly Varden in Alaska have found that Dolly Varden were more likely to be captured in minnow traps than other gear types (Meehan et al. 1990). Traps were weighted so they rested on the lake bottom, baited with treated salmon roe, and attached to floats to facilitate retrieval. Minnow traps were deployed at the beginning of the workday and retrieved after gillnet sampling was complete.

Beach seines were used to capture Dolly Varden and cutthroat trout in selected shallow areas. Two sampling events were coordinated with ADFG to sample the middle arm of Eyak Lake and Power Creek with beach seines. Sampling protocols and gear followed the procedures used by ADFG for annual monitoring of sockeye and coho salmon.

Upon capture, fish were held in an aerated live tub. Captured fish were anesthetized in a clove oil bath (Anderson et al. 1997; Taylor and Roberts 1999) then lengths (fork length), weights, and scale samples were taken. Scales were taken from the left side of the fish along the first three rows above the lateral line, posterior to the base of the dorsal fin. Scales were mounted on acetate and examined under 70X magnification on a microfiche reader. Circuli and annuli were counted in the anterior portion of the scale. Life histories were inferred from differences in relative width of spacing of circuli. All cutthroat and Dolly Varden over 200 mm were tagged with a numbered, color-coded T-bar anchor, or Floy tag, inserted just below the dorsal fin. Floy tags served as the identifying mark for capture-recapture estimates and provided information on seasonal growth, and movement patterns of fish recaptured at later sampling dates. These identifying marks may also provide information on Dolly Varden and cutthroat movement patterns if recreational, subsistence, or commercial fishermen capture and identify marked fish, and report their catch back to the USFS office. In addition to Floy tags, a secondary mark, either a partial fin clip, or an opercle punch, was used to identify previously captured fish. When clipping a fin, scissors were used to make a straight vertical cut from the top or bottom of the fin approximately 1-3 mm deep at a location about 1-3 mm from the posterior edge of the fin. The secondary mark was used to evaluate tag retention and to ensure reliable population estimates. Tag loss is highly variable and depends on the size of the fish, duration of the study, and the experience of the tagger (Guy et al. 1996). In mark-recapture studies, tag loss inflates the apparent proportion of never-marked fish and consequently will overestimate the true population (Guy et al. 1996). After marking, fish were held in the live tub until they recovered from anesthesia and then released at the capture location.

Estimating the actual numbers of fish in a lake can be a difficult process for a number of reasons including: 1) populations of fishes in lakes are often large making it necessary to mark large numbers of fish; 2) Since any day's sample will include a small portion of the total population, many days of effort may be required to obtain an adequate sample of marked and unmarked fish; 3) sampling gear may be ineffective in deep water, and consequently, precision of the estimate depends of random mixing of marked and unmarked fish in areas that can be sampled (such mixing often occurs in spring and fall); 4) sampling gear may be selective for species and size (Schneider 2000). Additionally, the migratory patterns of both Dolly Varden and coastal cutthroat trout may cause dramatic fluctuations in the seasonal abundance of fish in Eyak and McKinley lakes. The sampling protocols for these lakes ideally would have samples collected during the spring, summer, and fall seasons. The incidental catch of salmon created difficulties using gillnets for sampling in July and prevented continued sampling in later months. During the initiation of monitoring efforts in Eyak and McKinley lakes a high degree of adaptability was necessary to refine sampling protocols through field experimentation.

RESULTS

McKinley Lake

McKinley Lake was initially sampled in June with two types of gear: monofilament gillnets and vexar minnow traps. The second June sample and the July sample only used monofilament gillnets. The vexar minnow traps were not successful at capturing any of the target species, but were very successful at capturing juvenile coho salmon. Gillnet samples were collected from a variety of locations that encompassed the entire lake shoreline.

All fish captured received a colored, gray or brown, numbered t-bar anchor tag and a secondary mark of a right, ventral fin-clip. Appendix 1 lists the fish captured in McKinley Lake by date, the individual lengths, tag color and number, and ages.

Two target species of fish were captured in McKinley Lake: cutthroat trout and whitefish. Table 1 summarizes the number of whitefish caught and their disposition.

Table 1. McKinley Lake Whitefish disposition.

McKinley Lake Whitefish				
Sample Date	# Caught	# Mortality	# Recaptured	# Marked and Released
June 2 - 4	46	3	0	43
June 11 - 12	239	11	3	115
July 24 - 25	97	14	9	74
Total	282	28	12	232

Table 2 summarizes the cutthroat trout that were caught in McKinley Lake and their disposition.

Most of the mortalities in the July 24 –25 sampling period occurred in one gillnet sample set because of an equipment failure that added 30 minutes to the gillnet soak time.

Table 2. McKinley Lake Cutthroat Trout disposition.

McKinley Lake Cutthroat Trout				
Sample Date	# Caught	# Mortality	# Recaptured	# Marked and Released
June 2 - 4	26	3	0	22
June 11 - 12	17	4	3	10
July 24 - 25	23	5	3	15
Total	66	12	6	47

Lengths were taken from 249 of the captured whitefish. Scales were taken from 88 whitefish. The scales were used to determine the size at age of the population. Figures 2A and 2B illustrate the length (A) and age (B) frequencies found in the whitefish samples.

Figure 2A. Frequency of occurrence by size class (mm) of whitefish in McKinley Lake - length.

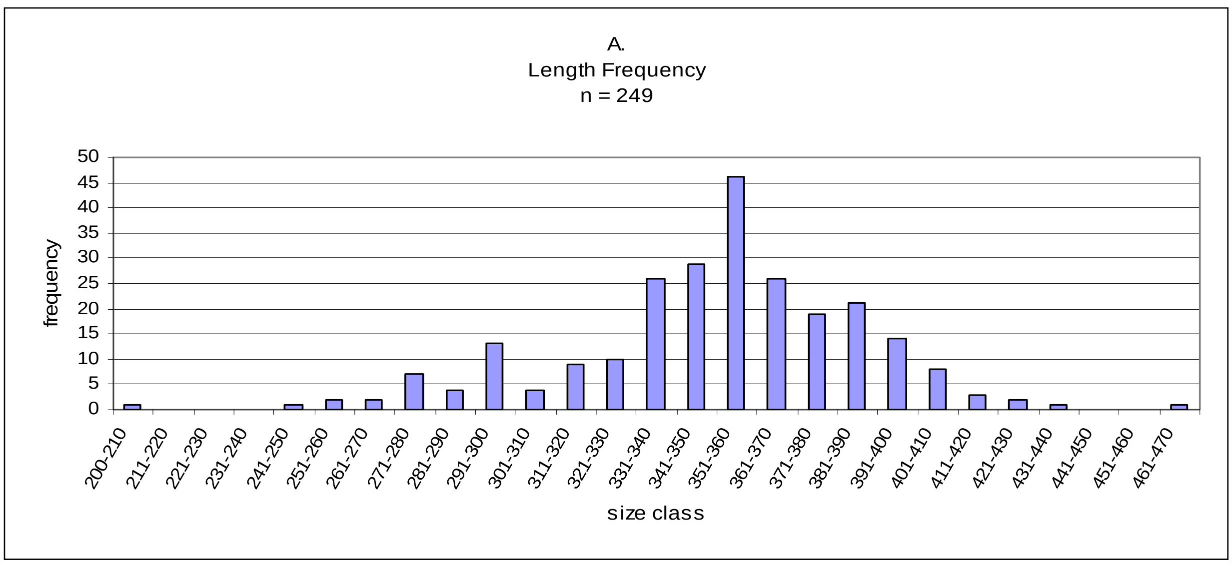
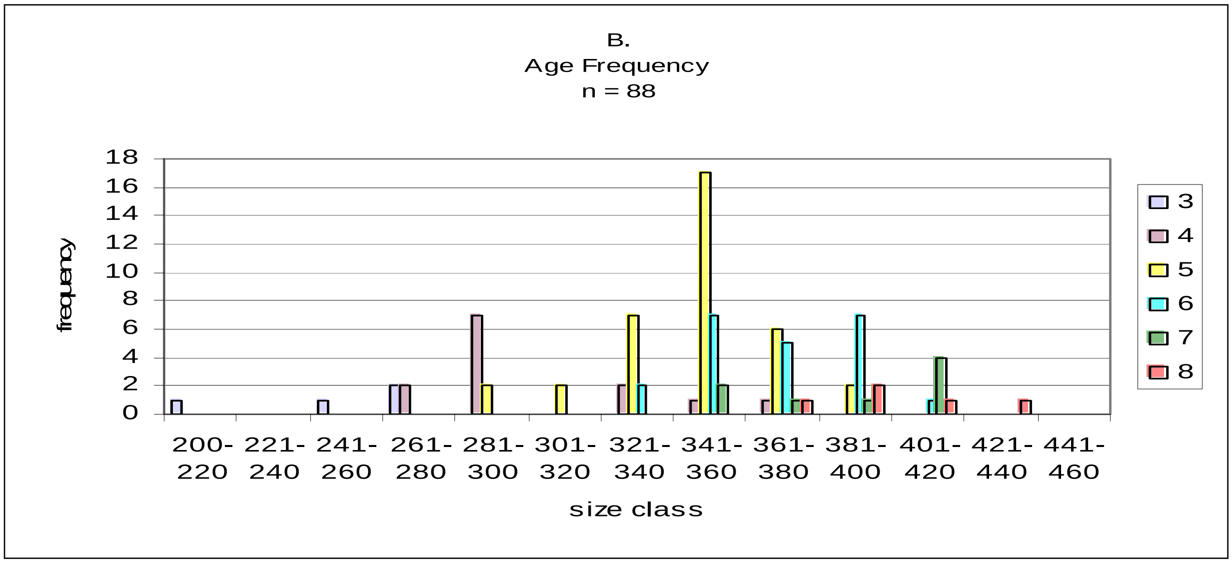


Figure 2B. Frequency of occurrence by size class (mm) of whitefish in McKinley Lake - age.



The length frequency in cutthroat trout was determined from 59 samples. Some cutthroat trout scales were regenerated and a sample of 49 cutthroat trout was used to determine age. Figure 3 shows the length (A) and age (B) frequency of cutthroat trout in McKinley Lake.

Figure 3A. Frequency of occurrence by size class (mm) of cutthroat trout in McKinley Lake - length.

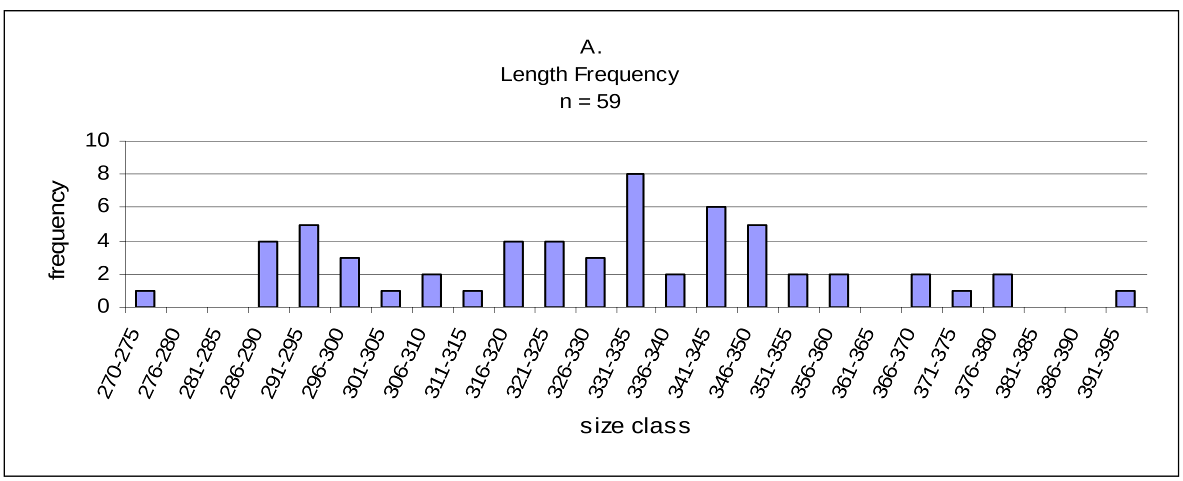
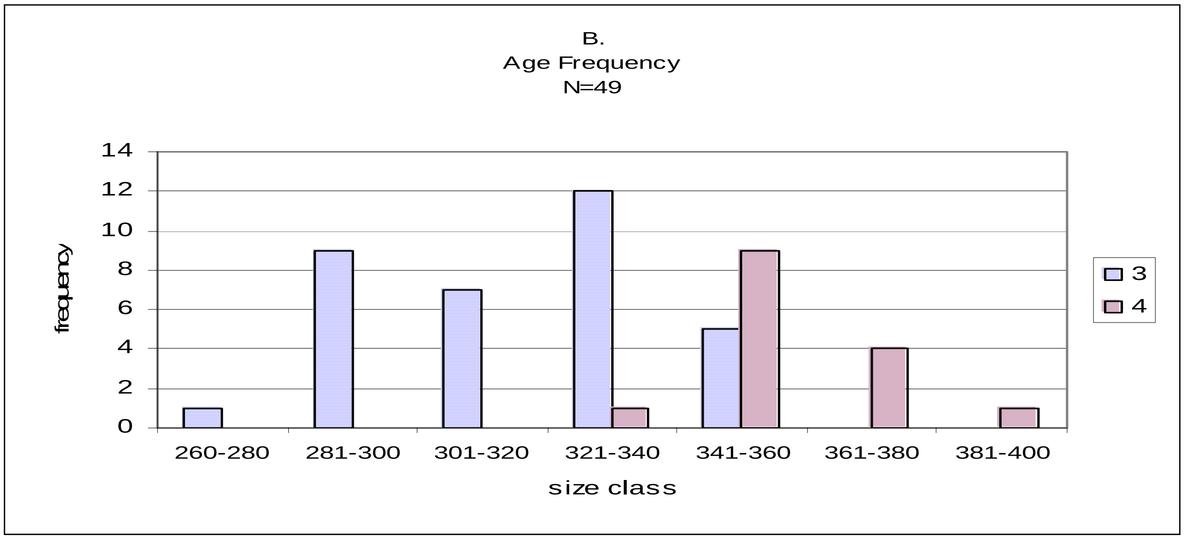


Figure 3B. Frequency of occurrence by size class (mm) of cutthroat trout in McKinley Lake - age.



Sport fishermen caught two of the tagged cutthroat trout during July in the McKinley Lake drainage. One trout was taken on 7 July near the upper end of the lake. The other trout was taken on 30 July in 23-mile pond, which is about 1 mile to the Southwest of McKinley Lake. This fish traveled downstream out of McKinley Lake about 1 mile and then up another stream about 0.25 mile to reach the location of its capture.

Eyak Lake

Eyak Lake was sampled four times during the season. Three gear types were used in sampling fish in Eyak Lake. The first sampling trip used vexar minnow traps and monofilament gillnets. Once again the minnow traps proved very effective at capturing juvenile coho salmon, but only captured one juvenile Dolly Varden trout and were not used in later sampling events. In the sampling events that occurred in June only monofilament gillnets were used. In the July sampling event a small shallow beach seine, 50 ft by 3 ft, was used in addition to the monofilament gillnets. The August sampling event was done in conjunction with sockeye salmon sampling in Hatchery Creek using a 150 ft by 10ft beach seine.

Captured Dolly Varden trout, cutthroat trout, and whitefish over 200 mm were tagged with a colored (blue or green) and numbered anchor tags. All of these species captured received a right ventral fin clip. Appendix 2 lists the fish captured in Eyak Lake by date, the individual length, tag color and number, and age.

Four areas in the lake were sampled: Power Creek Arm, Middle Arm, East Arm and Mavis Island. The third sample was conducted at the head of Middle Arm, because it was the only area that sockeye salmon could be avoided. The fourth sample was conducted in Hatchery Creek, which is a tributary to Power Creek, in conjunction with a sockeye salmon sample being conducted by the Alaska Department of Fish and Game. Tables 3 and 4 summarize the fish captured and their disposition. A total of 40 Dolly Varden trout captured were too small to tag and therefore were released with just a right ventral fin clip as an identifying mark if recaptured at a later date. Only one whitefish was captured in Eyak Lake during the June sample. That fish was tagged and released in the same manner as the trout species.

Table 3. Eyak Lake Dolly Varden Trout disposition.

Eyak Lake Dolly Varden				
Sample Date	# Caught	# Mortality	# Recaptured	# Marked and Released
May 27 - 29	23	0	0	22
June 9 - 10	34	1	3	30
July 15 & 18	270	0	0	231
August 22	6	0	0	6
Total	333	1	3	289

Table 4. Eyak Lake Cutthroat Trout disposition.

Eyak Lake Cutthroat Trout				
Date	# Caught	# Mortality	# Recaptured	# Marked & Released
May 27 - 29	0	0	0	0
June 9 - 10	3	0	0	3
July 15 & 18	5	1	0	4
August 22	0	0	0	0
Total	8	1	0	7

Lengths were taken from 325 of the captured Dolly Varden trout. Scales were taken from 141 Dolly Varden, which were used to determine the size at age of the population. The sampled Dolly Varden population in Eyak Lake ranged in age from 1 to 5 years. Figure 4 illustrates the length (A) and age (B) frequency found in the Dolly Varden trout samples.

Figure 4A. Frequency of occurrence by size class of Dolly Varden trout in Eyak Lake - length.

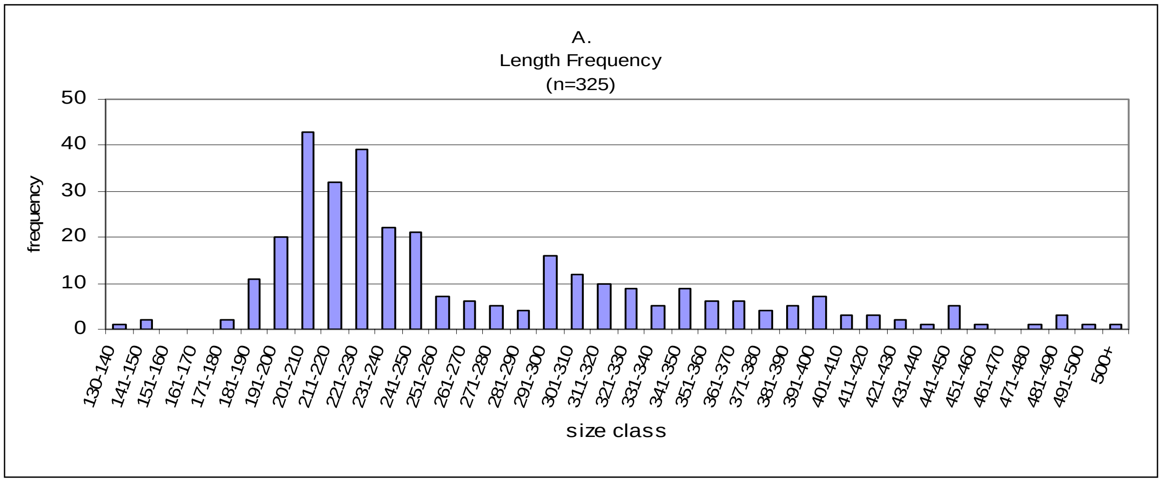
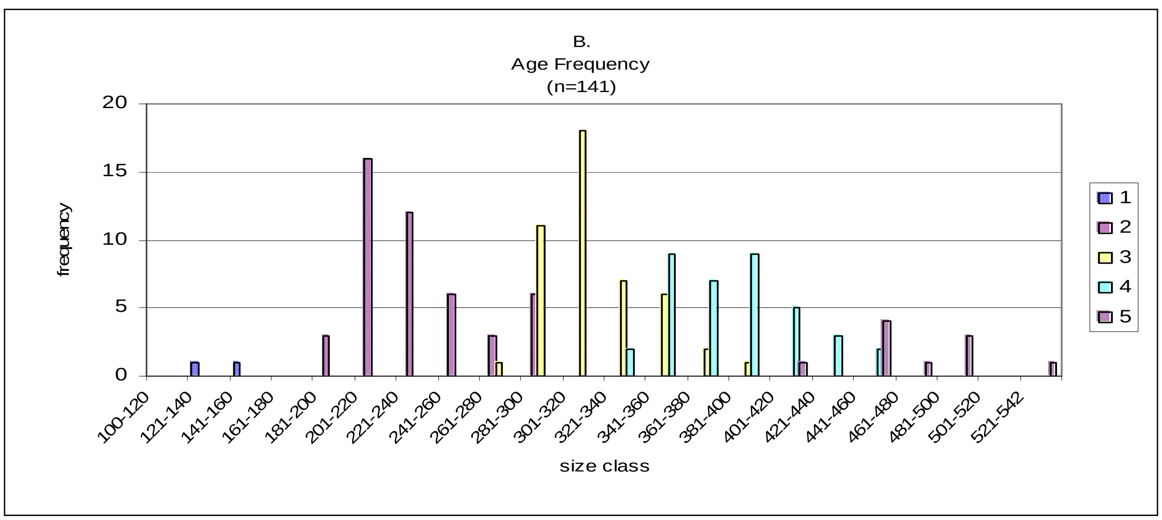


Figure 4B. Frequency of occurrence by size class of Dolly Varden trout in Eyak Lake - age.



Scales and lengths were taken from the eight cutthroat trout captured. The scales were used to determine the size at age of the population. The sampled cutthroat trout population in Eyak Lake were either age 3 or 4. Figure 5 illustrates the length (A) and age (B) frequency found in the cutthroat trout samples.

Figure 5A. Frequency of occurrence by size class of cutthroat trout in Eyak Lake - length.

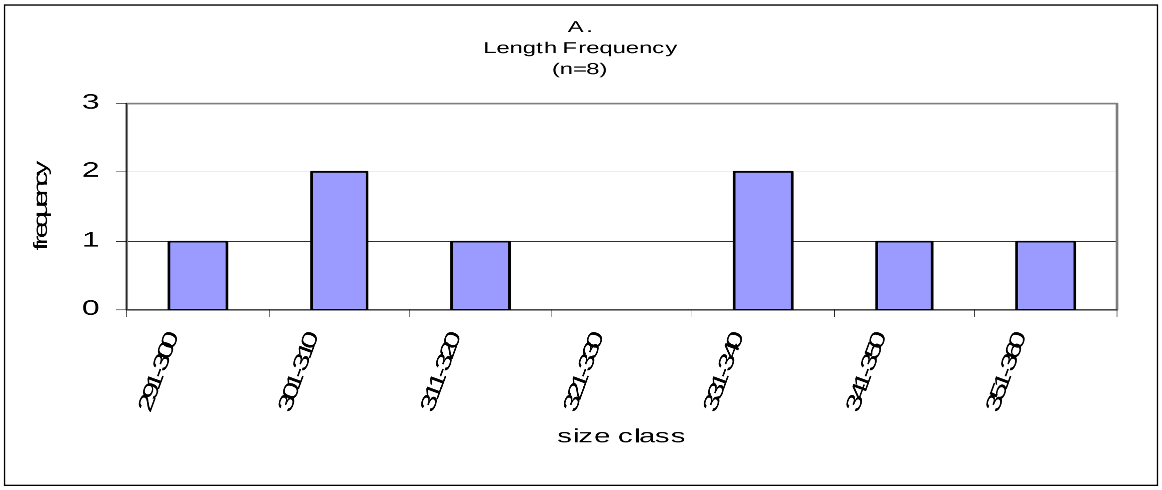
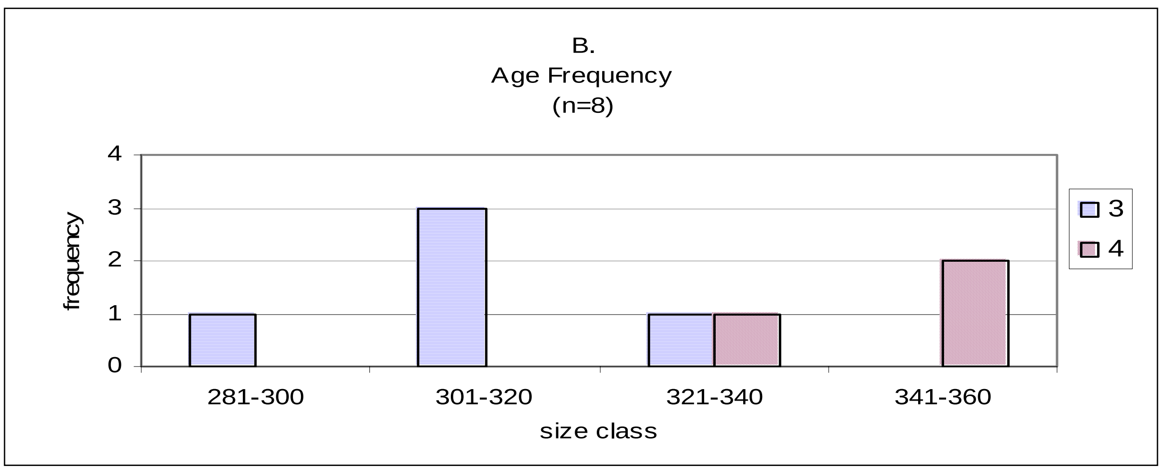


Figure 5B. Frequency of occurrence by size class of cutthroat trout in Eyak Lake - age.



Only one whitefish was captured in Eyak Lake. This fish was 5 years old and was 38.5 cm long.

DISCUSSION

Live capturing trout and whitefish in Eyak and McKinley proved challenging. Initial attempts with minnow traps failed to capture the target species. Depending on the location of the minnow traps large numbers of juvenile coho salmon or threespine stickleback (Gasterosteus aculeatus) were captured, but only one Dolly Varden trout was recovered in 120 hours of fishing.

Monofilament gillnets were more effective than other gear types, but they were size selective in that they did not catch the smaller fish in the younger age groups. However, these gillnets were effective in capturing the larger trout and whitefish. After adult salmon returned to the lakes on their spawning migration in mid-summer, gillnets could not be fished in all areas of the lakes because of the entanglement of salmon in the gear. The restriction in area fished because of salmon entanglement greatly compromised the recapture of tagged Dolly Varden trout in Eyak Lake as only three recaptures were made and those occurred prior to the arrival of migrating salmon. Entanglement of salmon in McKinley Lake only occurred on the Northeast shore of the lake and had only a small effect on the ability of the gear to catch and recapture fish.

A small beach seine was used to capture Dolly Varden and cutthroat trout at an inlet stream in Middle Arm of Eyak Lake during one sample period. The large cobble bottom in the area where trout were observed was not suitable for effective capture, but those that were captured were of younger ages than those captured in other locations by gillnet.

Eyak and McKinley Lakes proved to be quite different in their species composition. Both Lakes contained populations of migratory cutthroat trout. However, no Dolly Varden were captured in McKinley Lake, even though Dolly Varden are know to exist in Salmon Creek, which empties into the McKinley Lake outlet stream just below the mouth of the lake (S. Moffitt, ADF&G, personal communication). Whereas in Eyak Lake, Dolly Varden were the predominate species captured. McKinley Lake supports a population of whitefish that were captured at nearly all sample sites with the main concentration along the north shore of the lake. Only one whitefish was captured in Eyak Lake.

Population estimates proved to be difficult to calculate for cutthroat and Dolly Varden trout. Very few recaptures were made using the sampling gear in Eyak Lake. Sampling was abbreviated in the Power Creek arm of Eyak Lake because of salmon entanglement. This location was a staging area for Dolly Varden in the summer months prior to ascending Power Creek to spawn and was the only location where recaptures did occur. Dolly Varden also continuously entered into Eyak Lake during the summer on their spawning migration, which further complicated a population estimate from immigration into the population.

Cutthroat trout populations exist in both McKinley and Eyak Lake. It does not appear that either lake has a large population of cutthroat trout. Only eight cutthroat trout were captured in Eyak Lake and none of those were recaptured while sampling. One tagged cutthroat trout was harvested by a sport fisherman at the outlet of Eyak Lake indicating emigration could be taking place.

Low water conditions in September prevented access to McKinley Lake and a fall sample did not occur. This sample could have supplied a larger recapture population and possibly some insight to the pre-spawning activity of whitefish in McKinley Lake. It is unknown if emigration of whitefish occurs in McKinley Lake or the location of spawning. Anglers have reported whitefish in the Alaganik River which empties this lake, but it is not known if these fish are river residents or are migrating into or out of the lake.

Little is known about the white fish populations on the Copper River Delta. As angling pressure increases on the more popular fish stocks, such as cutthroat and Dolly Varden trout, and harvest restrictions increase, angler attention could turn to species such as whitefish. Application of radio tags to a small number of white fish could provide some insight to the spawning and wintering locations and possible determine if emigration occurs.

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Cutthroat Trout Distribution and Abundance

Western Prince William Sound, Alaska

Annual Report
FY 2003

INTRODUCTION

Populations of coastal cutthroat trout (*Onchoryncus clarki*) are at the northern extent of their range in western Prince William Sound. Documented populations are small and relatively isolated from one another (Whitmore, et. al. 1991). With the increased fishing pressure from the Whittier access project (completed 7/2000), there is concern that even small levels of harvest may affect the viability of these sensitive populations. This ongoing study was proposed to investigate lakes and streams within western Prince William Sound to further describe cutthroat distribution and abundance.

Coastal cutthroat occur from Prince William Sound, Alaska, south to the lower Eel River, California (Morrow, 1980; Benhke, 1992 *in* Trotter, 1997). Three life history forms are found within this range: 1) anadromous 2) potadromous – stream and lake dwelling populations that spawn in tributaries, and 3) a non-migratory form that resides in small streams and headwater tributaries (Trotter, 1997). In Alaska, females spawn in the spring at 5 or 6 years of age(Fuss 1982 in Trotter, 1997), typically in small tributaries and headwater streams. Juveniles usually reside in the streams for two or more years, if there are no cohabitating species, and prefer pools and other slow water habitats (Heggenes et. al., 1991). Young of the year appear to be displaced by coho (pools) and steelhead (riffles), if present. These interactions between juveniles may set a "natural" limit or negatively affect cutthroat populations where these species occur together (Langford, 1977, Trotter et. al., 1992).

Anadromous cutthroat movements are complex. Spawning occurs in the spring after ice break up. Emigration to saltwater occurs after spawning, typically from early May into July. The fish then move into estuaries, bays and shorelines to feed, seldom crossing open water (Morrow, 1980; Trotter, 1989, Hepler et. al. 1993). Cutthroats seldom over-winter in saltwater; most return to freshwater lakes (lacustrine watersheds) from July to November, with a peak in September and October (Trotter 1989). The fish don't always return to the natal stream (Jones, 1975; Trotter, 1997). Reports piecing together cutthroat distribution within Prince William Sound (PWS) can be found in various sources (Table 1). These documents are mostly government reports.

Table 1. Drainages with documented cutthroat populations (citation, year and drainages).

USFS 2000	Gillikin 1999	Schelske* 1998	Reeves* 1996	Hodges* 1995	Hepler* 1994	McCarron * 1993	PWSAC 1982-5
Billy's Cannery Chuck Cowpen Eshamy Gunboat Jackpot Otter Red Sockeye	Billy's Gunboat Otter Red	Bay of Isles (3) Chuck (1) Green Gunboat Hawkins (2) Hells Hole Hidden (1) La Ray (1) Milton Otter (1+2) Shelter (2) Stump	Gunboat Hawkins Milton Stump Unakwik Inlet (north)	Rocky	Boswell Eshamy Green Makaka Rocky	Alaganik Clear Canoe Pass Eyak Hawkins Makaka	Gunboat Sockeye Otter

* = et.al., (1) = Resident population, (2) = Resident and anadromous populations, (3) = unnamed

Two additional sources list 17 populations (Schmidt *in* Hall et. al., 1997) and 10 populations of anadromous cutthroat respectively (Sharr unpublished data *in* Hepler et al. 1994). U.S. Forest Service fisheries staff mention 10 known populations (Spangler, pers. comm. 2000). The main effort of this project is to locate populations in drainages where no information on cutthroat is available.

STUDY AREA

Surveys were conducted on federal lands within western Prince William Sound.

OBJECTIVES

1. Determine the distribution and relative abundance of cutthroat trout in western Prince William Sound.
2. Incorporate results into GIS for development of risk analysis model.
3. Submit newly discovered anadromous populations for inclusion to the ADF&G Anadromous Waters Catalog.

SITE IDENTIFICATION

Databases were queried within the Forest Service GIS system and Alaska Dept. of Fish and Game Anadromous Waters Catalog to find drainages that contained potential cutthroat habitat. The primary targets were lakes with barrier-free streams to the saltwater. Additional sites were selected based on anecdotal evidence or local knowledge of cutthroat populations.

STREAM SAMPLING

The sampling design used the R1/R4 Northern and Intermountain fisheries methodology (Overton et. al. 1997) based on Hawkins (Hawkins et. al. 1993) stream habitat classification system. Habitats were divided into fast and slow units. Since cutthroat trout are known to prefer slow water habitats (Heggenes et. al., 1991), every other slow water habitat, pocket pool or side channel was sampled. The presence of cutthroat trout was sampled using two techniques.

Slow water habitats were sampled with a Smith-Root electro fishing unit. Sampling started at the mouth of the stream unless heavy salmon spawning activity was occurring. Sampling ended where a significant barrier to anadromy was encountered, or when no fish were seen with adequate effort extended. Salmonids were identified to species and age class (Table 2). Other species of fish were noted but not counted (i.e. stickleback). Survey time was recorded from the start through the end of the reach, not time per individual habitat unit. Adult salmon observed while electro fishing were counted and tallied on the data sheets.

Table 2. Age class.

Age class 0 young-of-year	Age class 1 (1 – 2)	Age class 2 (2 – 3)	Age class 3 (3 – 4)	Adult (4+)

In a reach containing a high number of adult salmon, shocking was discontinued. Alternately, baited minnow traps (G-Type) were fished in every other slow water habitat and slow water of a fast water habitat. They were baited with beta-dyne treated salmon roe (in a punctured film canister); each trap was individually identified with flagging and a separate number. The traps were fished at least 120 minutes before they were removed. When the trapping was completed, fish were removed, placed in a 5-gallon bucket and counted by species and age class (see above). Survey time was recorded from the time the trap was placed in the water until it was removed

RESULTS

Due to scheduling conflicts, investigations were limited to three weeks in August. Poor weather further reduced the project to one four day period with a total of 3 streams sampled in 3 distinct drainages within Jackpot Bay, western Prince William Sound. No cutthroat trout were located in any of the drainages.

Individual Drainages

The following section describes the results from individual drainages surveyed. The drainages were surveyed in the following order:

 # 226-20-16130 Alaska Dept. of Fish and Game Stream number (ADFG, 1989).
This system is located at the south end of Jackpot Bay. The survey began above mean

high tide. The reach surveyed consisted of 580m of stream with an average width of 10m terminating at a potential velocity barrier. Substrate consisted of small to moderate size cobble. Adult pink and sockeye salmon that were present precluded the use of electro fishing. Fourteen baited minnow traps were used in two habitat units, one glide and one run and soaked for a minimum of two hours.
One sculpin was captured with no other species found.

#226-20-16--- Alaska Dept. of fish and Game Stream number (ADFG, 1989).
This small bedrock controlled step pool complex was sampled with electro shocker for 100m terminating at a velocity barrier. No fish were found within this survey area.

#226-20-16090 Alaska Dept. of Fish and Game Stream number
This small bedrock controlled step pool complex was electro shocked beginning above mean high tide for 50m terminating at a waterfalls / velocity barrier. No fish were found in this survey area. During the 2001 jackpot survey the area above the barrier was trapped and juvenile cutthroat trout were found.

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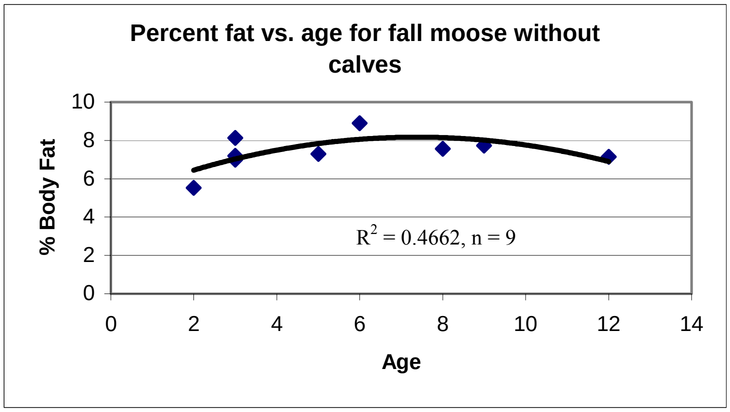
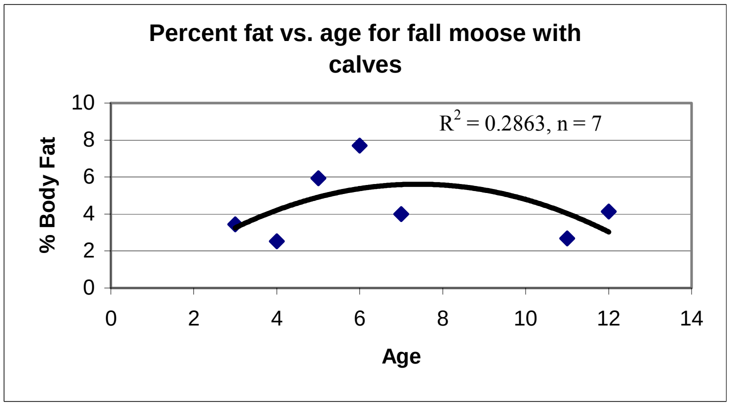
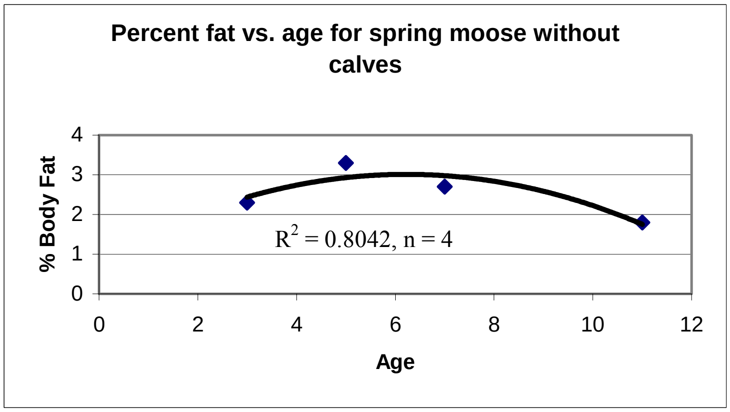
Contact Person: Sean Stash (907-754-2328)

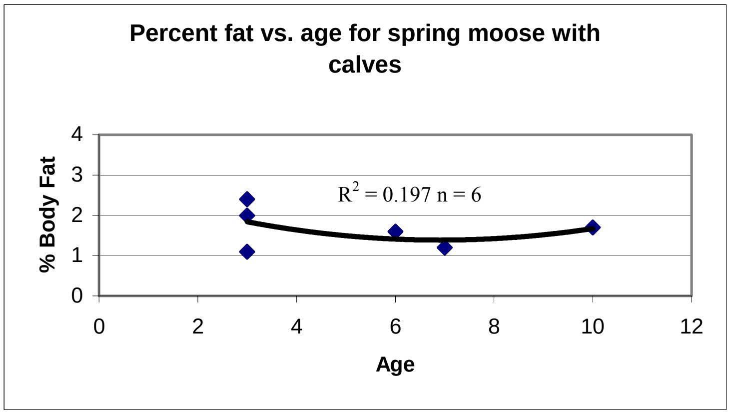
Appendix 1

Fat reserves and moose age for moose on the Copper River Delta, AK, 2000–2002.








Percent fat vs. age for spring moose with calves
% Body Fat
4
3
2
1
0
R2 = 0.197 n = 6
0
2
4
6
8
10
12
Age

Water Resources

Goal

Provide instream flows to maintain and support aquatic life and habitat, recreation and aesthetics, the natural conveyance of water and sediment, and other resources that depend on such flows on National Forest System lands.

Objectives

- Establish instream flow requirements or suitable mitigation measures for all water impoundments or diversions.

Monitoring Question(s)

What is the existing water quantity?

U.S.G.S. Water Gaging Stations

This activity consists of a long term contract with the U.S. Geological Survey to maintain and collect water flow data at three stations located on the Chugach National Forest. The purpose for this contract is to obtain long term stream flow data that can be used in the design of numerous projects and other management activities where hydrologic data is a necessary item. These stations are presently located on the Portage River, Six-mile Creek, and Twentymile River.

Contact Person: Dave Blanchet; 743-9538.

Soil Resources

Goal

Maintain long-term site productivity.

Objectives

- Maintain soil productivity by keeping soil disturbance to a minimum.
- Implement measures to protect the soil resource through the use of Best Management Practices and Forest Service Soil Quality Standards.

Monitoring Question(s)

What is the level of ground disturbing activity?

TEUI Inventory

SOILS

There were approximately 16,000 acres identified as a priority for Terrestrial Ecological unit inventory (TEUI) for fiscal year 2003, which is part of a multi year program that is documented in the national Inventory and Monitoring Program Planning (IMPP's) database. The intent of this inventory is to update and verify the present forest TEUI with the emphasis on collection new data in areas where there are proposed, potentially soil disturbing, management activities. These were sites proposed for mechanical fuel hazard reduction projects on the Chugach National Forest portion of the Kenai Peninsula. The intent was to go into these areas to collect detailed soil and vegetation information before heavy machinery began work. The data was used to validate and refine existing soil mapping units.

Fieldwork was initiated for project sites near Fuller Creek, Palmer Creek, Quartz Creek, and along the Hope Highway, all located on the Kenai Peninsula. Using aerial photography and existing soil maps, representative sites for soil pits were selected based on prevalent geomorphic landscape features and plant communities. The soil data compiled was correlated and extrapolated to recurring landtype associations and vegetation patterns in the immediate watershed area. All of the data has been entered into the Terra database during FY 2004.

In total, acres inventories were 2,000 in Fuller Creek, 3,800 in Palmer Creek, 6,800 in Quartz Creek, and 3,400 along the Hope Highway.

Monitoring

Project Initiation Reports

Management of Indicator Species (MIS) and Species of Special Interest (SSI)

Goal

Maintain habitat to produce viable and sustainable wildlife populations that support the use of fish and wildlife resources for subsistence and sport hunting and fishing, watching wildlife, conservation, and other values.

Objectives

- Implement standards and guidelines to protect species and their habitats through protection, conservation and restoration of important terrestrial and aquatic habitats.
- Monitor wildlife and fish species and their habitats to answer questions described in the monitoring strategy.

Monitoring Question(s)

What are the population trends for black oystercatchers and the relationship to habitat? Has the population or the nesting habitat on beaches increased or decreased, and what are the characteristics of the nesting sites of the black oystercatchers?

What are the population trends of the coho salmon and their relationship to habitat?

What is the distribution and relative abundance of cutthroat trout throughout the Forest?

What are the populating trends for moose and the relationships to habitat? What are the characteristics of moose habitat by season?

Is the forest management maintaining favorable conditions for sustaining mountain goats? Forest wide guidelines have identified specific distances to be maintained between activities and goats in their critical habitat. Is management respecting these guidelines and are they effective?

The process being implemented first establishes the populations, locations, and habitat of the mountain goat, and subsequently determines the location of the motorized use and effects on the mountain goat.

Vegetative Structural Stage and Wildlife Habitat Relationship Model

GOAL

Update stand development class descriptions and related wildlife habitat use values for Management Indicator Species. Relate these habitat values to the timber/vegetation classification system developed by the Kenai Peninsula Borough in preparation for updating the GIS vegetation layers with new data. Use these values to map habitat for MIS and track changes in habitat. (Forest Plan Table 5-1, pg. 5-12.)

ISSUE

Current stand development classes developed by Oliver and Larsen do not adequately portray what is happening in both conifer and hardwood dominated stands on a local level. A Habitat Capability Index was developed for Management Indicator Species using this model on the Seward Ranger District. In order to prepare for efficient analysis of wildlife habitat changes and effects in future landscape and project level analysis, a new model needed to be developed. This would update stand development class descriptions and relate them to habitat values for feeding, hiding and reproductive cover for Management Indicator species. These values could be connected to GIS, or input into Netweaver with other known habitat preferences, to create habitat maps for MIS.

Benefits: Habitat values could be displayed spatially for any district or forest level project. Large scale projects looking at habitat across the Kenai Peninsula could be initiated using a consistent vegetation classification system on Forest Service, Fish and Wildlife Service and state and borough lands.

FY 2003 PROJECT ACCOMPLISHMENTS

The SRD wildlife program associated stand development classes and wildlife habitat values for management indicator species with the vegetation classification system currently in use on the Kenai Peninsula by the Borough, State of Alaska, and Kenai National Wildlife Refuge lands.

We set up the database structure in Microsoft Access. We documented answers to important questions such as who will use the database, what questions will be asked, how will information be stored and linked to GIS. We revised stand development class definitions developed by Oliver to reflect conditions on the Kenai Peninsula, in concert with past efforts on the forest to update these stand development classes. We identified limitations of the model. We narrowed down the vegetation classifications to those that occur on the Seward district. We created relationships between vegetation classifications and stand development classes, and habitat values for feeding and reproduction for management indicator species based on values developed by Suring in the Chugach wildlife habitat relationship database.

Recreational Use

Goal

Improve knowledge and understanding of recreational activity and user satisfaction.

Objective

- Develop information of recreational activities, parterres fuse and key recreational issues.

Monitoring Question(s)

What are the characteristics of recreational visitors? What is their pattern of recreational use?

Prince William Sound Human Use Study

The Glacier and Cordova Ranger Districts developed a study plan to continue and expand the project started in 1997 by Karen Murphy and Lowell Suring. The project objective is to monitor the areas, intensity, and types of human use patterns in Prince William Sound. The impacts of increased human use of the shoreline in PWS are relatively unknown as are the numbers and locations of current use. The project will establish baseline information that can be used by resource specialists to maintain and provide sustainable recreation opportunities and relate use to potential impacts of other resources.

The opening of the Whittier Tunnel in 1999 improved access to western PWS but a change in human use of this part of the Sound has not been subsequently quantified. Through a comparison with data collected prior to tunnel opening, in 1997 and 1998, we hope to identify any changes in human use intensity and location. In 2005 the new high speed ferry is expected to increase travel and use in Easter Prince William Sound. Future management of Prince William sound will be tied to the use patterns that are identified in this study.

In preparation for the study plan, the Glacier Ranger District conducted three human use survey flights in 2003 that covered 188,043 acres. Data were collected for the following groups: kayaks, inflatables or skiffs, cabin cruisers, motor yachts, tour cruise, commercial fishing, and on-shore users (people or tents). This was the third year of this type of data collection, which is in the process of being analyzed.

Monitoring and Restoration of Acquired Lands

Annual Report

Monitoring and Restoration of Acquired Lands

This piece of land was purchased from the Tatilek Native Corporation with the direction that it would be managed for fish and wildlife. Therefore, all management activities that occur will be implemented with the objective or improving or protecting fish and wildlife habitat. The following report is a summary of the monitoring efforts and restoration activities that have occurred since the land was transferred.

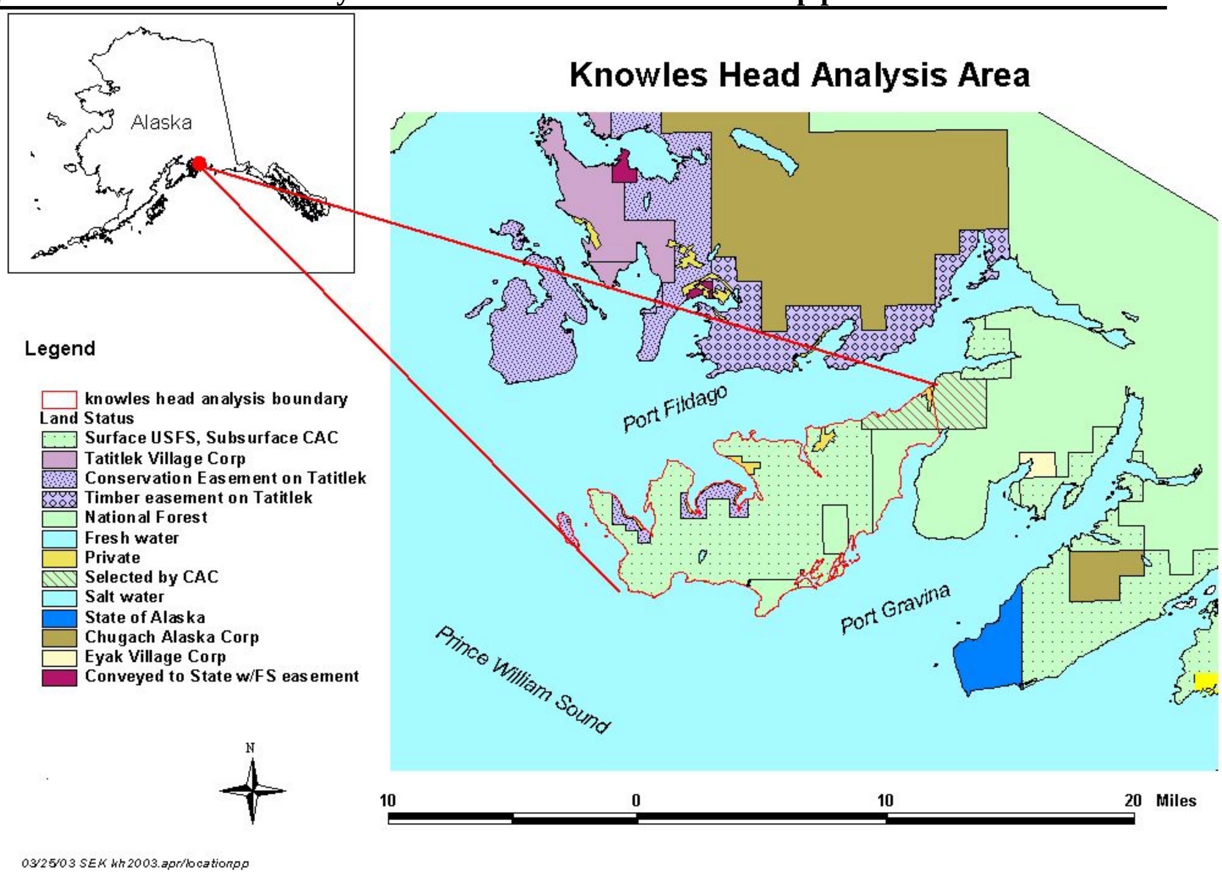
Knowles Head Watershed Restoration

Knowles Head Watershed Restoration
***Exxon Valdez* Oil Spill Restitution Project**
2003 Annual Report

INTRODUCTION

The Tatitlek Native Corporation established ownership of the Knowles Head peninsula through the Alaska Native Claims Settlement Act (ANCSA). The area was selected in 1975 and subsequently transferred to the Tatitlek Native Corporation between 1978 and 1997. The Corporation managed the area as commercial forest land and constructed roads and harvested timber between 1989 and 1996. In December 1996, the *Exxon Valdez* Oil Spill (EVOS) Trustee Council determined that the purchase of a fee simple interest and a conservation easement of the lands was an appropriate means to restore a portion of the injured resources and reduced services that resulted from the spill. In 1998, EVOS restitution funds were used to acquire the land and it again became part of the Chugach National Forest. Figure 1 displays the land ownership patterns in the analysis area.

Figure 1. Knowles Head Analysis Area location and land ownership patterns.



The Tatitlek Native Corporation retained Home sites in Two Moon Bay and Snug Corner Cove, an Exclusion Area Easement at Two Moon Bay, and two development sites. The Tatitlek Corporation also retained an easement along the existing road between the Exclusion Area Easement at Two Moon Bay and the development site near Hell's Hole. The conditions and restrictions of the sale and purchase are located in the "Agreement for Sale and Purchase of Lands and Interests in Land among the Tatitlek Corporation and the United States of America and the State of Alaska" (the Purchase Agreement) and the First Amendment to the Agreement dated June 4, 1998. The Purchase Agreement includes language that allows the Forest Service to unload and run heavy equipment on this section of the road being retained by the Tatitlek Native Corporation. It does not require Tatitlek Native Corporation to reinstall any bridges or culverts. A management concern is the amount and type of use expected on the road and appropriate minimum standards for road type and maintenance.

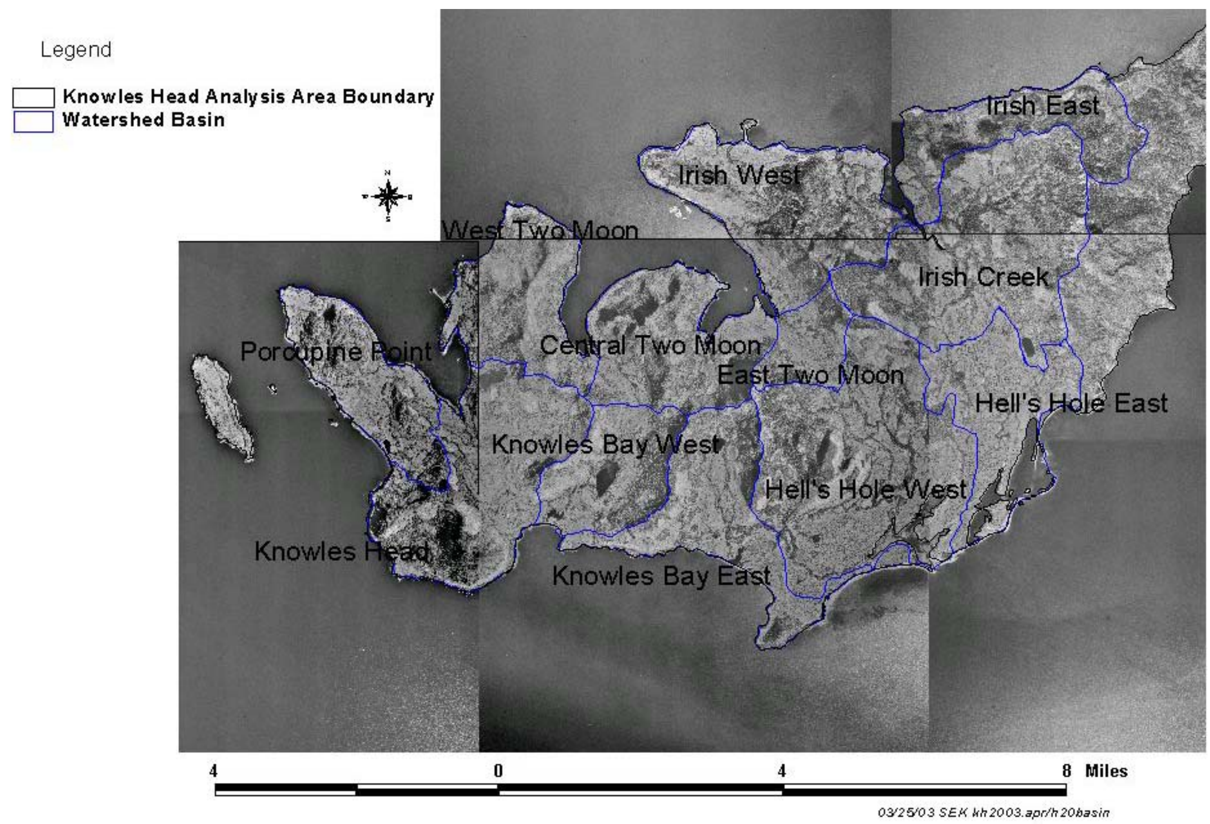
The Tatitlek Native Corporation was granted an easement across the wetlands between the existing road and their development site near Hell's Hole. Access is to be by foot on some type of trail surface sufficient to prevent degradation of the wetlands. The easement trail will be constructed in such a manner as to preserve the integrity of the fishery resource and maintain the natural functions of the wetland. The trail has not been started. The Corporation also considered opening a lodge at the Two Moon Bay camp catering to sport fishing. It will be important to monitor sport fishing use and its impact on fish populations and fish habitat. Valdez based guides and clients commonly sport fish for coho salmon in the two main streams in the Hell's Hole watershed. Local residents of Prince William Sound also sport fish and subsistence harvest in the area. An escapement-monitoring program for the cutthroat trout and coho salmon in this watershed would help managers determine population trends. Escapement counts can provide baseline data to help monitor the sport fishing pressures exerted on this resource.

Chugach Alaska Corporation retained the subsurface rights of all lands purchased fee simple and all lands with conservation easements. In 1998, they announced plans to conduct some exploratory work on Knowles Head in the next few years. However, none has occurred to date. If it does occur, restoration work may be modified to take advantage of any equipment on site and to reduce conflicts.

The Cordova Ranger District conducted a landscape level watershed analysis in 1998 and 1999. The twelve watersheds were prioritized for analysis and potential restoration projects using four criteria: fisheries value, fish species present, degree of impacts, and potential use. Figure 2 displays the watershed basin boundaries. West Hell's Hole, Irish Creek, Knowles Bay West, East Two Moon Bay, and Central Two Moon were identified as the top five watersheds. These watersheds were surveyed first and more critically analyzed with regards to stream surveys, road conditions, landslide potential, blow-down, and fish and wildlife habitat. Basic channel typing and soil inventories were completed. Updating the GIS database, collecting field data, conducting inventories, and programming future restoration projects were based on this prioritization.

During the 2000 and 2001 field seasons, the Cordova District fisheries staff used the data from the 1998 and 1999 surveys to identify and prioritize additional areas in need of restoration. Restoration activities concentrated on mitigating point sources of erosion and stream sedimentation resulting from failing stringer bridges, waterbars, culverts and steep-sided trenches that remained after culvert removal. Stream deposition of fine sediments originating from logging roads and associated structures has been shown to have negative impacts on salmonid reproductive success (Irving et al. 1984, Chapman 1988). Although these small first order streams are too high-gradient to provide adequate fish habitat where they cross mid-slope and upper-slope logging roads, they are fully capable of transporting fine sediments downstream into the spawning areas of coho and pink salmon and cutthroat trout. The priority sites for restoration work in 2000 and 2001 were located along the mid-slope section of the Tatitlek Native Corporation easement and at two stream crossings located on the Main Irish Creek road.

Figure 2. Knowles Head watershed basin boundaries.



In 2000, Cordova District staff surveyed the area in Snug Corner Cove that had been used by unauthorized off-road-vehicles to determine restoration needs and found the area to be rehabilitating well without mechanical efforts. In 2000 and 2001, staff continued to survey and map new blowdown and landslide locations. In 2000, blowdown occurred on an additional 259 acres and 8 new landslides were recorded. In 2001, new blowdown was found on 66 acres, 10 acres of old blowdown was mapped that had been missed the previous year, and 211 acres with past windthrow had additional windthrow. Two new landslides were recorded, both on slopes over 56% slope. In 2001 and 2002, six monitoring blocks were installed to track changes in the understory and forest in areas harvested in 1950's and 1960's.

In 2002, the Cordova District also identified harvested areas suitable for thinning projects to improve wildlife habitat, finished stream restoration work begun in 2001, seeded spur roads, surveyed two lakes, and surveyed 10 landslides to determine revegetation success and future rehabilitation needs. The old landslides were inventoried and categorized as to pre-1995 and post 1995 to estimate the rates and success of natural plant invasion and reforestation. This information will be used to develop methods for stabilization and revegetation of the disturbed areas. Review of upper slope roads by a hydrologist and soils scientist did not occur as planned due to weather and was rescheduled for 2003.

In 2003, the weather cooperated and Mike Furniss, hydrologist with Pacific Northwest Research Station in Corvallis, was able to review some of the past restoration work and upper slope roads. He was able to provide input on five impact sites. District staff surveyed 25 miles of road for new impact sites, revegetation success, and additional seeding needs and seeded 2 miles of road in the Knowles Head and Knowles Bay West watersheds. The district silviculturist and fisheries technician surveyed 1,813 acres in the southern half of the analysis area for regeneration development and future thinning potential. Of this acreage, 604 acres were identified for future thinning and 31 acres previously identified for treatment were dropped from further consideration due to steep slopes, adjacent blowdown or thin soils.

OBJECTIVES

The key management goals were to identify and conduct restoration work to facilitate the recovery of resources and services injured by the spill. The injured resources included marbled murrelet, kittlitz murrelet, harlequin duck, common loon, pink salmon, sockeye salmon, cutthroat trout, and Dolly Varden. Bald eagle and river otter have been listed as fully recovered since March 1999, and as of August 2002, black oystercatcher, pink salmon and sockeye salmon have also been listed as recovered. Affected services included commercial fishing, tourism, recreation, passive uses, subsistence and sport fishing. Management is focused on restoring the habitat for injured species with the main emphasis being maintenance and protection of fisheries habitat.

Identifying, rehabilitating, and stabilizing areas with high potential of slope or bank failure can reduce potential riparian and stream habitat loss and destruction. Preventing future road failures will reduce the amount of land taken out of production for all resources. Maintaining and restoring fisheries habitat can ensure that subsistence, commercial, and recreational use of silver salmon, pink salmon, Dolly Varden, and cutthroat trout continues. The goal of the fisheries work is to protect the fish populations, not only for human uses, but also for the wildlife that directly consume the fish, and the other plants and animals that depend on the nutrients the anadromous fish bring into the ecosystem. The primary objectives are to inventory the existing populations and habitat, and to identify any impacts to streams that might result from past logging activities.

There is a concern about the amount of mature, old growth forest that remains in the analysis area. Modifying young growth forests to accelerate formation of a complex stand structure to provide conditions that benefit fish and wildlife can aid in the recovery of injured species. Improving the structural diversity of the young growth forests can benefit other wildlife species present in the area including those used for subsistence such as black bear, coyote, deer, goat, grouse, marten, mink, ptarmigan, river otter, wolf, and wolverine.

The Record of Decision for revised Chugach Land and Resource Management plan was signed in May 2002. The revised Forest Plan contains management direction for all the EVOS acquired lands and includes a management prescription, ecological and social desired conditions, allowed activities, standards and guidelines, and a monitoring plan. It also refers to the individual purchase agreements for each parcel for further direction.

METHODS

The watershed analysis was conducted using the procedure established in the Alaska Region Watershed Analysis Handbook (July 1997 version). It was designed to be compatible with the Federal Guide for Watershed Analysis (1995), the National Forest Management Act, and the National Environmental Policy Act. The landscape-level assessment evaluates multiple watersheds, characterizes each watershed in the analysis area, identifies management issues and information gaps, and sets priorities for more detailed analysis of individual watersheds. The Federal Guide for Watershed Analysis (1995) was used as a framework for analysis and reporting. Information collection methods for each core topic (fisheries, human uses, hydrology, soils, vegetation, and wildlife) were described in the annual report for 1999 and in the 1999 Knowles Head Watershed Analysis available at the Cordova Ranger District.

Fisheries

The fisheries component of the project consisted of three main parts: identifying impacts to streams and fish habitat caused by roads or other past activities, conducting inventories of fish-bearing streams and fish populations, and controlling erosion at road crossings to reduce the sedimentation of the streams.

In 1998 and 1999, crews surveyed the roads identifying impacts or potential impacts to streams and fish habitat caused by landslides, tree blowdown, timber harvest, road crossings, or other road erosion. Crews noted the type and area of disturbance, the effect on fish habitat, and recommended restoration methods. In 1998, 55 miles of road were surveyed, and 28.5 miles of road were surveyed in 1999.

At each stream crossing, crews measured the stream gradient, bank full width, incision depth and other geomorphic features to determine the stream channel type. The presence of fish at the sites was determined by visual observation or electro fishing. Fish presence and species were inventoried in other streams using electro fishing methods. Hook and line sampling was used in three lakes to determine the presence of fish and to determine whether the populations in these lakes were sufficient for sport fishing. Escapement index surveys were conducted for cutthroat trout in seven stream systems and for coho salmon in the three main streams flowing into west Hell's Hole. Due to the remote locations, these surveys were limited to a single ground survey conducted at what was presumed to be the peak spawning time.

Restoration work during the 2000 field season consisted of removing excess fill material where culverts and bridges had been removed from stream crossing sites, revegetating the disturbed areas, and at two sites, building instream structures and reconstructing the banks to restore the natural channel widths. At other areas where erosion in roadside ditches or waterbar failures were introducing sediments into the streams, the crew repaired failed waterbars or built new ones to disperse flows on road surfaces and in drainage ditches. In addition, check dams were built in the ditches to trap sediments.

In 2000, a two-person crew seeded mid-slope sections of the Main Camp and Main Irish roads. An all-terrain vehicle equipped with a motorized grass seeder and another equipped with a trailer were used to transport and spread the seed. The grass seed mixture was composed of 70% arctic fescue (*Festuca rubra)*, 25% Bering hair grass (*Deschampsia beringensis*), and 5% annual rye (*Lolium* spp.). The grass seed was combined with a 20N-20P-10K fertilizer at a ratio of 100 lbs of fertilizer to 6 lbs of grass seed. Seeding concentrated on areas in which erosion was readily apparent and at stream crossings with sloped banks of a 1:1 or greater ratio. An excavator was used to rehabilitate several stringer bridges and culverts. At each log stringer bridge, road fill material was removed until only the logs remained. Road fill material was removed from box culverts. Pipe culverts that were not working properly were pulled and replaced with water crossings that more resembled the natural streambed prior to road construction. Additionally, waterbars were built or rebuilt where road surface erosion was occurring.

In 2001, restoration activities were limited to reseeding sites that had been rehabilitated by heavy equipment the previous year. The grass seed and fertilizer were premixed, placed in five gallon buckets with lids, and transferred to various locations using a helicopter. A four-person crew used hand spreaders to apply the same native grass seed composition that had been used the year before. Application rate was based on 25 lbs of seed per acre and 100 lbs of fertilizer per 6 lbs of grass seed. Reseeding occurred in early July to allow a longer growing period before heavy fall precipitation.

In 2002, work involved surveying stream crossings on previously mid- to upper-slope roads for potential impacts to fisheries resources, seeding 2 miles of down-cut logging roads and road banks traversing muskeg meadows, and hook-and-line sampled lakes in East and West Two Moon Bay watersheds to determine coastal cutthroat trout and coho salmon occurrence. The purpose of monitoring mid-slope roads (10.1 miles) in high-risk areas was to identify new slides and prevent deposition of silt into the spawning habitat of the streams. Influx of fine sediment into spawning habitat in streams prevents the proper aeration of developing salmon eggs, which can suffocate the developing eggs. The purpose of reseeding of down-cut sections of two logging roads traversing lowland muskeg was to stabilize raw road banks. East Irish Cove Road and the Knowles Head Road are down-cut in some sections, and the sides of the road have been slumping off into the drainage trenches that run parallel to the road. This is creating the potential for large amounts of sediment to be washed into nearby stream crossings and affect downstream habitat. Each section was approximately 0.7 miles long with an average width of about 25 feet.

In 2003, four sections of logging road down-cut through lowland muskeg were seeded to promote vegetative growth, reduce erosion potential, and increase stability. Cut slope and gully erosion are common impacts in the down-cut road segments. These impacts often create the potential for sediment to be washed into nearby stream crossings and affect downstream fish habitat. From June 20 – 22, a two-person fisheries crew used hand-held seeders to revegetate roads with native grass species using the same mixture used in previous years (Figure 4**)**. These road segments were located on the southwest end of the peninsula (Figure 3). Materials and equipment needed for seeding were transported to Knowles Head via floatplane and delivered to each site by helicopter.

On June 18 – 19 surveys of mid and upper-slope spur roads were conducted on several road segments of the Knowles Head peninsula (Figure 3). Two crews of two walked the roads, visually inspecting all water bars and stream crossings for signs of potential impacts to lower elevation anadromous streams in the form of fine sediment delivery. Personnel noted potential for sediment transport, slope angle and stability of trenches. A helicopter was used to transport crews to the starting points for some road surveys (Figure 5**)**. The purpose of monitoring mid-slope roads in high-risk areas was to identify new slides or road surface erosion that could lead to the deposition of silt into stream spawning habitat. Influx of fine sediment into spawning habitat in streams impedes aeration of developing salmon eggs and can suffocate the developing eggs. Mike Furniss, who specializes in road/stream interactions, participated in several of these surveys.

Figure 3. Locations of roads that were seeded and surveyed.

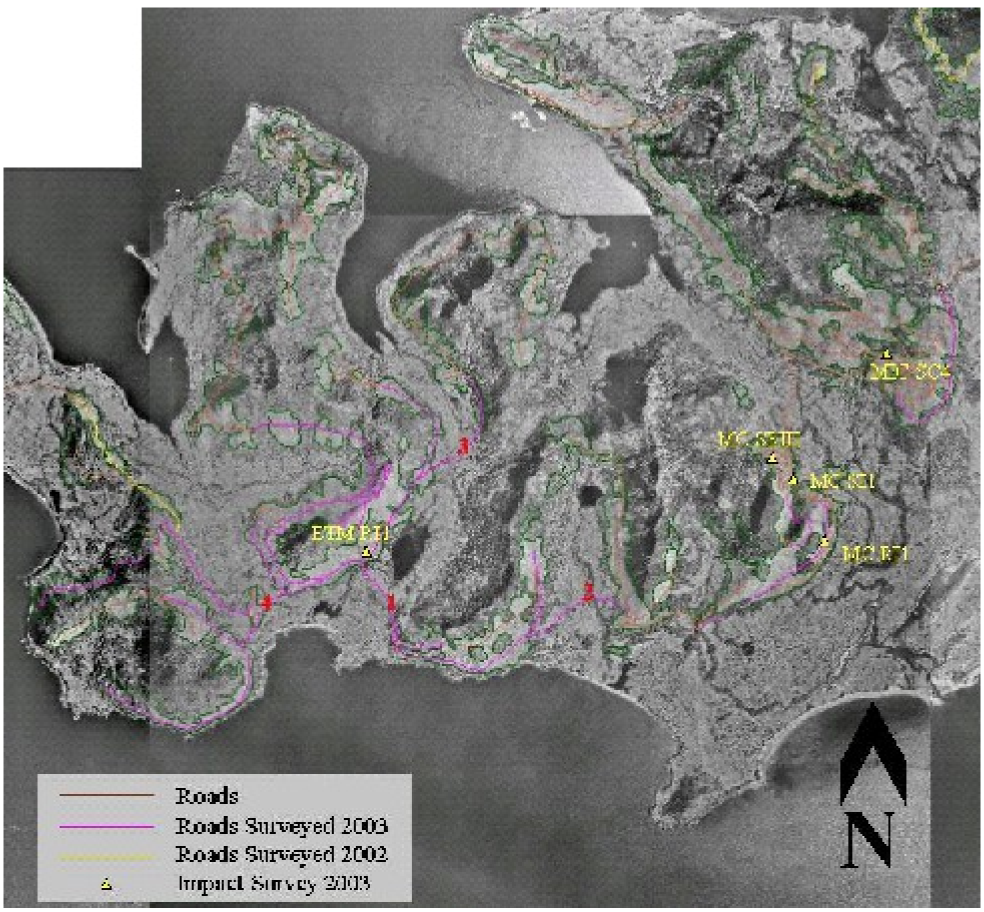


Figure 4. Mixing grass seed and fertilizer on Knowles Head peninsula.

Figure 5. Transport of crews by helicopter for conducting road surveys.

Landslides

In 1998, dominant soil erosion processes were determined by using existing geological, slope, and soil information. The percent area of high mass movement soils, percent of area harvested within 30 years, density of deeply incised, high gradient streams, total road density, and percent of road length on high mass movement soils were determined. Field surveys, both ground and aerial, were done in 1998 and 1999 to reconfirm landslide prone areas. The approximate year it occurred was estimated by the amount of revegetation present on the slide and interviews with the logging company employees who assisted with the road construction and timber harvest. Field surveys were done on a representative sample of the landslides. Information was collected about the amount of plant cover, landform, soil properties, slope, relationship to nearby roads, and hydrology. Subsequent aerial surveys and field observations were conducted in 2000, 2001, 2002, and 2003. No new landslides were observed in 2003.

The data collected in 1998 at the landslide sites were used in a landslide risk assessment (Swanson 1997) to determine conditions necessary for landslides to occur. This system uses soil properties such as texture, parent material, depth, drainage, and topographic characteristics as slope shape, length, gradient, and drainage density. The risk assessment weighs each of the characteristics as their relative importance in landslide production and provides a numerical landslide failure rating for the analyzed landform.

In 2002, monitoring data on the invasion of indigenous vegetation was gathered to estimate the rates and success of vegetation recruitment on landslides within the area. This information will be used to develop methods for stabilization and revegetation of the disturbed areas and to establish the revegetation rates. A network of 31 transects across 10 landslides was established. Transects were distributed to represent a range of landslide ages and positions on the slides. The three categories of position include source areas (top of slide), transport areas (middle of slide), and deposition areas (bottom of slide). The source area is the upper portion of the landslide from which most of the soil mantel to bedrock or glacial till has been removed. The transitional area is the middle portion of the landslide where both the soil from the source area has passed or been deposited, and where variable amounts of the resident soil have been removed. The depositional area is the lower portion of the landslide that is dominated by soil deposition. A complete description of transects and results is included in the 2002 annual report. No additional landslide analysis was done in 2003.

Vegetation and Wildlife Habitat

Timber harvest records, 1976 timber type mapping, and aerial and on-the-ground surveys were used to determine the landscape pattern of plant communities and changes in serial stages in the watersheds. The amount harvested within the past 30 years for each watershed and the amount harvested along Class I and II streams was calculated. Information collected included the forested condition before harvest, amount of harvest, location and extent of blowdown, and regeneration success. This information was displayed in previous annual reports. The Tatitlek Native Corporation conducted regeneration surveys and reported that the regeneration of the harvest lands meets State Forest Practices Act. The National Wetlands Inventory database was used to quantify type of wetland present and identify where impacts may have occurred on wetlands.

Aerial surveys were used to determine where blowdown occurred. Information was then mapped and recorded in the District GIS database. In 2001 and 2002, monitoring blocks were installed in the areas clearcut harvested in the 1960's and 1950's that had no additional treatment. The six permanent blocks are 1/5 th acre in size and have nine smaller sub plots located within each. Initially the subplots were to be used to track changes in the understory and the larger blocks used to track changes in the overstory. However, due to the great number of trees in the stand, the subplots were also used to track changes in stand density and tree characteristics. All trees in the subplots were numbered and tagged. Tree species, height, diameter, age for each diameter class, and percent crown was collected. On the nine subplots, percent cover and height for each understory species were collected and canopy closure readings made.

RESULTS AND DISCUSSION

The Knowles Head Watershed Analysis Report completed in 1999 has detailed resource information about the area including summary tables for fisheries resources, soil conditions, vegetation, and wildlife. It is available at the Cordova Ranger District. The master GIS file set for the project is in the Cordova District electronic file system in J:/fsfiles/office/ 1900_planning /knowleshead/. It contains the coverages, shapefiles, documents, and text files for the project. The base maps used for the analysis are the 1996 digital orthophotos of the area. Themes that are being updated in Arcview are stored as shapefiles. The Arcview project file is called kh2003.apr. The soils information is currently in disc format available at the District office.

Themes were created that display the watershed boundaries, road and harvest unit location, streams, lakes, timber type, slope percent, aspect, land type, national wetlands inventory classification, anchorages, impact sites, landslide locations, high hazard slope and road locations, eagle nest tree locations, blowdown location, helicopter harvested areas, potential wildlife treatment areas, and permanent plot locations. Attribute tables associated with the fisheries data include ADF&G stream number, class of stream, species presence, and channel type. The impacts table includes site ID, fish species present, type of impact, and recommended action. The harvest attribute table displays unit number, acres, type and date of harvest. The blowdown attribute table displays year documented, type of damage, and acres.

Fisheries

In 1998 and 1999, crews completed 83 miles of the road surveys and inventory of 97 sites with associated impacts. In 1998, restoration work was done by hand at two sites on the Main Camp road, “MC SC7” and “MC SC7A”. In 1999, work included restoring 12 stream crossings, rehabilitating 600 feet of stream bank, and 4,400 sq. ft. of riparian area. This work improved approximately 5 miles of anadromous stream habitat. Two of the sites required major excavation of fill material and restructuring of the channel. Additional excavation and reworking of the instream structures was done at a 1998 restoration site that had failed. At the rest of the sites, crews removed minor amounts of fill. All were planted with seedlings and shrubs and seeded with grass. Three new waterbars were constructed through bedrock outcrops and six others were repaired to eliminate the input of road-derived sediments at those sites.

Restoration projects during the 2000 field season concentrated on degraded stream-crossings associated with stringer bridges, culverts, and waterbars. Using an excavator, a total of about 1,665 cubic yards of road fill material were removed from five stringer bridges, five box culverts, and two stream crossings. These sites are located along the Main Camp and Main Irish Cove Roads. Additionally, 27 waterbars were constructed or repaired and 18 culverts were removed. The culverts were replaced with water crossings similar to the natural stream channel that existed prior to road construction. A total of 10.5 acres of degraded logging road and 2.5 acres of abandoned sorting yard were seeded and fertilized along the Main Camp and Main Irish Creek Roads. The backhoe restoration work was completed by September 1. Due to the late completion date, the areas were not seeded until 2001. During the backhoe operations it was observed that the sod that had resulted from the early summer seeding had established a good root mass. Since the early season seeding efforts had such good results, crews waited to complete the seeding and revegetation efforts until July of 2001.

With the completion of the critical road-crossing work in 2000, the primary focus of the 2001 field season involved reseeding the restored road-crossing sites from the previous year and monitoring the stability of the work. Five stringer bridges, five box culverts, two stream crossings, 27 waterbars, and 18 removed culvert sites were visited, seeded with native grasses, and evaluated for the effectiveness of the previous restoration. A total of 34 lbs of grass seed and 566 lbs of fertilizer were used to cover approximately 1.35 acres. Two stringer bridge sites on the Main Camp Road had moderate erosion on the down-slope side of the road and one culvert removal site on the Main Camp Road had heavy erosion on the down-slope side of the road. All other sites appeared to be intact and functioning properly. Sitka alder was getting established on approximately 30% of the Main Camp and Main Irish Creek roads. Previous annual reports display where this work took place.

In 2002, road surveys indicated that revegetation of most roads was adequate. The survey of Main Camp Upper Spur Road (MCRIII) in the Hell’s Hole drainage indicated two minor and one major source of potential impact to streams. Minor potential impacts came from a failing water bar located approximately 400 yards above Main Camp Road.

Water was draining across road and loosening road surface for about 165 feet down to the next waterbar. The second minor potential source was a small creek or seep that was running across the road and saturating the road surface. During heavy rain, sheet flow across the road surface may transport fine sediment into nearby streams. Major potential for impacts were observed at a pulled culvert site located approximately 875 yards above the Main Camp Road. At this site, the streambed was approximately 20 feet below road surface. Parts of two old plastic culverts were still present. The road fill was not sloped back and extensive erosion was occurring on the steep sides. Road fill debris extended about 165 feet downstream of road and the stream subsides under this loosely sorted debris for about 66 feet downstream. In 2003, restoration strategies were developed for this site.

Surveys of the Main Camp spur road (MCRII) and Irish Creek spur roads did not indicate major potential for impacts to streams draining the upper slopes. Where roads crossed streams, steep banks had been left from the removal of old culverts. Often, buffers were not left along stream channels above the road. Below the road crossings crews observed small debris fans from road fill material, but below these streams typically regained a stable stream channel. Once streams entered a forested area any impacts appeared minimal.

Crews seeded 1 mile, or 3.6 acres, of the East Irish Creek Road roughly centered on the lowest Irish Creek stream crossing. Seeding efforts were concentrated in areas crossing muskeg meadows, along raw road cuts located immediately east of Irish Creek, and on berms and ditches created by the removal of culverts. Crews used 62.5 lbs of mixed native grass seed and 1043 lbs of fertilizer. In general, crews observed good natural regeneration of Sitka alder, spruce, and hemlock in the roadbed adjacent to forested areas.

Crews also seeded one mile, or 3.6 acres, of the Knowles Head Road roughly centered on Snug Corner Cove Creek. In this area the logging road was deeply down cut into the muskeg. The crew observed extensive raw road banks and deeply cut ditches along the logging road and concentrated reseeding efforts in these areas. Because the roads are down-cut in these sections, the sides of the road have been sloughing off into the drainage trenches that run parallel to the road. This created the potential for large amounts of sediment to be washed into nearby stream crossings and affect downstream habitat. However, it is uncertain how successful reseeding efforts will be on some of the steeper cutbanks. In some reaches of road, especially through forested areas, there was strong regeneration of alder, spruce and hemlock saplings.

In East Two Moon Bay Lake, 3 acres in size, three anglers fished for a total of 5.5 person-hours and caught 41 coastal cutthroat trout and 4 coho salmon parr. The average length of cutthroat trout was 6 inches and the largest was 11 inches. Juvenile coho salmon ranged from 4 to 6 inches long. Fish appeared to be in fair to good condition with most appearing robust and healthy, although some cutthroat trout were thin. Catch per unit effort, CPUE, was about 7.5 cutthroat trout per hour and 0.7 juvenile coho salmon per hour.

At West Two Moon Bay Lake, 8 acres in size, recent beaver activity had raised the lake level, flooding willow and spruce stands surrounding the shoreline. At this lake, two anglers fished for a total of 3 person-hours. During that time a total of 52 cutthroat trout and 25 coho salmon were captured. CPUE was approximately 17.3 cutthroat trout per hour and 8.3 juvenile coho salmon per hour. The average length of cutthroat trout captured was estimated at 6 inches and the largest was 10 inches. Juvenile coho salmon ranged from 4 to 6 inches with an average size of 5 inches. Qualitative observations of fish indicated that condition factors were high for both cutthroat and coho.

In 2003, 135 lbs of grass seed and 2,150 lbs of fertilizer were spread over 2.0 miles of road. A summary of the seeding efforts on individual road segment is shown on Table 1. The seeding information is also entered in the Knowles Head GIS Arcview project file kh2003.apr located in fsfiles\office\1900_planning\knowleshead\gis\.

Thickness (Distance/Fertilizer) was added as a relative measure of how thick the seed was spread. This variable may be useful in future effectiveness monitoring and seed applications. Thickness can be compared between segments so that the effectiveness of the seeding effort can be judged and a future desired thickness of spreading could be decided upon. The recommended coverage for past seed spreading is approximately equal to a thickness of 0.8. Visual inspection of the seeded road segment on Knowles Head Road (near Snug Corner Cove) indicated that this level of thickness might not be adequate.

Table 1. Summary of the seeding effort on 4 road segments on Knowles Head Peninsula.

Segment	UTM start	UTM end	Seed (lbs)	Fertilizer (lbs)	Distance (mi)	Thickness
1	06V 0523485 6729182	06V 0523362 6729972	30	500	0.63	1.2
2	06V0525996 6728960	06V 526896 6728784	60	950	0.81	0.84
3	06V0524405 6731100	06V0524627 6731262	30	450	0.3	0.67
4	06V0521570 6728933	06V0521819 6729083	15	250	0.2	0.8
Total			135	2150	1.94	0.88

A total of twenty-five miles of road was surveyed in 2003, located on the southwest end of the peninsula **(Figure 3)**. Most of the road segments were in good condition and did not pose threats to fisheries habitat in terms of erosion and sedimentation. Re-vegetation of the old roadbed was highly variable between segments. In some segments, the alder was over 6 feet tall and too dense to travel through. In others, the roadbed was sparsely vegetated with alder and grasses or not vegetated at all. These sparsely vegetated segments could be targeted for future application of grass seed. The data collected on general road condition for the surveyed road segments are in the Roads theme in the Arcview project file kh2003.apr under fsfiles\office \1900_planning\knowleshead\gis\.

Five impact sites were documented during the surveys. These sites had been previously identified and named in the Knowles Head Watershed Assessment (Cordova Ranger District internal document). Mike Furniss was present for the surveys at four of these sites: MC RI1, MC SI1, MC SCIII (upper spur road off Main Camp Road), and MIC SC4. These four sites were in the Hell's Hole drainage, a productive system for pink and coho salmon. The other site was ETM RI2 located near the outlet to Arrowhead Lake.

MC SCIII and MIC SC4 were typical of other stream crossing impacts surveyed on Knowles Head. The culvert was improperly pulled when the road was decommissioned, leaving steep banks and causing severe erosion at and downstream of the crossing. Figure 6 displays an example of this type of impact. Mike Furniss suggested that the major sediment transport had already occurred at these sites and that the exposed underlying "shot rock" was armoring the rest of the roadbed material and potential sediment source. This armoring would likely prevent further erosion and sedimentation.

MC SI1 was an impact caused by not retaining an uncut buffer strip adjacent to the stream. The stream has jumped out of the former channel and is braided across a clear-cut hillside. The current instability of this channel would make any restoration attempts difficult. This site should be left to re-establish a natural stream channel on its own.

MC RI1 was one of several major impacts caused by mid-slope road erosion and improperly pulled culverts (Figure 7). Impacts identified as MC RI2 through RI8 were also surveyed along this ¼ mile segment of road. At sites MC RI1 and MC RI2 culverts were pulled but road fill material was not pulled back resulting in steep slopes that are eroding into small intermittent gullies. The gullies are approximately 30 feet deep through the road fill material. This road segment is also on a steep mountainside. Sidecast material and log decks are slumping and eroding to the foothills of this steep mountainside. Several small streams exist at the foothills and are receiving sediment from these impacts. Mike Furniss suggested that placing log check dams in the gullies might reduce sediment transport. Aggressive seeding and fertilizer application in the gullies, roadbed, and surrounding erosive soils would further help to stabilize the area through the establishment of vegetation. A crew working out of a remote spike camp near the impact area will do this project in 2004.

Figure 6. Common impact on Knowles Head improperly pulled culvert during road decommissioning.

Impacts ETM RI1 and ETM RI2 consisted of two failed waterbars that caused major erosion of the roadbed and gullies along the edge of the road. Sediment is being transported to the outlet stream of Arrowhead Lake due to these impacts. A significant amount of roadbed material has already been transported at this site. A crew of two repaired the failure at site ETM RI2 by placing large boulders, cobbles and fill material at the upslope side of the waterbar, deepening the trench, and seeding the area. This repair work should prevent additional road surface runoff from traveling down to the waterbar at ETM RI1. Re-vegetation should stabilize the remaining road fill material and prevent future erosion.

Figure 7. Impact site MC R11 and the mid-slope road segment traversing this steep mountainside.

Impact site KH SC1 was visited during road surveys on June 18, 2003. It was one of the sites that crews rehabilitated during the 1999 field season. The work consisted of using sandbags and rock to rebuild the stream bank and narrow the stream channel. The effort appears to have produced positive results (Figure 8).

Figure 8. Photos taken at impact site KH SC1, looking downstream from just below the road. The bottom picture was taken in the summer of 1999 just after the re-habilitation work. The top picture was taken in June 2003.

Generally, the fish habitat in the Knowles Head area is in good condition. Crews have completed a majority of the road surveys and have now identified most of the impacts to fish habitat. Restoration work has been finished at the most adversely affected sites as well as other impacted sites. In the upcoming years efforts will be directed at monitoring the completed restoration work and checking the stream crossings to make sure no new problems have surfaced. It appears that most of the roads and streambanks are starting to revegetate naturally, so erosion problems should lessen over time. Landslides and blowdown will continue to be monitored.

Landslides

A landslide risk analysis for the study area concluded that there were four potential conditions that could generate a landslide regardless of ground disturbing activities. Ground disturbing activities would increase the potential for a landslide. Additional water, due to above normal precipitation or redirecting of surface or ground water, will increase the potential for a landslide in any of the above scenarios. The four conditions that could generate a landslide are:

- Middle side slopes with a slope gradient greater than 56%, that contain compact glacial till with poorly drained soils or lateral ground water from above, would likely produce a landslide after decay of the root strength of previously harvested trees.
- Roads with steep, high cut banks cut in loose soil or soil under-laid by compact till would continue to slough until the slope has regained its stable angle of repose.
- Road fill on steep slopes over about 72% will slough or settle until a stable angle of repose is obtained.
- Shallow soils on smooth bedrock on slopes over 72% will likely slide when the soils become wet enough.

Road related landslides have occurred on slopes greater than 56% with wet soils, where roads were constructed by cutting through bedrock or compact till covered with shallow mineral soil on slopes greater than 72%, or areas where road fill was sidecast on slopes greater than 72%. Approximately 9.1 miles of road were built on slopes between 56 - 72% and 2.5 miles were built on slopes over 72%. About 20.7 miles were constructed on slopes of 0 – 20% and 28.5 miles constructed on slopes of 21 – 35%.

Of the 40 slides recorded to date, seven slides were estimated to have occurred prior to road and harvest activity, 14 occurred from 1995 to 1996, 9 occurred from 1996 to1999, 8 occurred between 1999 and 2000, and 2 occurred between 2000 and 2001. The 8 new landslides recorded in August 2000 all began on slopes greater than 56 %. Two slides were related to roads, two were related to timber harvest sites, and four slides occurred in an undisturbed setting. No on-the-ground reconnaissance or restoration was necessary. The two new slides recorded in the summer of 2001 occurred on slopes over 72%. One occurred below a road and the other occurred in the upper reaches of a harvest unit. One slide is located just around the northeast point of Two Moon Bay on a northerly aspect. It began on an upper slope and appears to have started on bedrock. The slide is estimated to be about 75 feet wide and 400-500 feet long. The deposition ended on the lower slope and is not producing any sedimentation to streams in the vicinity. The other slide is located on the first headland northwest of the east arm of Two Moon Bay on a northerly aspect. It also started on the upper slope on bedrock. It is approximately 100 feet wide and about 200 to 300 feet long and extends about midway down the slope. No streams are below the slope and vegetation below the slide traps any sediment. No new slides were identified during aerial or field reconnaissance completed in August of 2002.

Ten landslides were sampled in 2002 to determine extent of the revegetation. The 2002 annual report gives detailed descriptions of the transects and amount of revegetation. To date, only preliminary analyses have taken place on the data. All analyses are based on the total cover of each species and ground cover feature on each transect (rather than the raw data for each point). A total of 73 species and 10 ground cover characteristics were observed among the 10 landslides (Table 2). The "importance value", the product of summed cover across all transects and the total number of occurrences across all transects, indicates that litter, gravel, wood, *Alnus crispa* ssp. *sinuata* (Sitka alder), soil, *Aruncus sylvester* (goatsbeard), *Equisetum arvense* (common horsetail), cobbles, *Carex mertensii* (Mertens' sedge), and unknown mosses were the top 10 most abundant species/ground cover classes encountered among the slides.

Vegetation and Wildlife Habitat

Approximately 91 miles of road were constructed and 6,015 acres were clear-cut harvested between 1989 and 1996. Of those acres, 104 were harvested by helicopter. An additional 729 acres were selective harvested using helicopters. Approximately 17% of the area, or 22% of the forested acres, was harvested in the 8 years. Previous harvest occurred in 1965 when 69 acres were harvested between Snug Corner Cove and Two Moon Bay and in 1950 when 199 acres were harvested in Irish Cove. Prior to 1955, scattered small select harvests occurred along the shoreline each removing less than 7 thousand board feet. Most of these earlier harvests were to supply lumber for the canneries, docks, mines, and fish traps.

In 2001 and 2002, monitoring blocks were installed and preliminary information was collected from the areas harvested in the 1950's and 1960's. Three were installed in the area harvested in the 1960's and three were installed in the area harvested in the 1950's. Photos were taken at photo points and tree, shrub, forb, herb, canopy closure, soils and topographic information was collected. The 2002 annual report summarizes the characteristics of the overstory and understory for the two stands. Average age was 48 – 50 yrs in the Irish Cove stand and 31 –37 years in the Two Moon area. Plots will be measured again in 5 years to establish trends.

Scattered blowdown continues to occur predominately along ridge tops and edges of the harvested areas. As of August 1999, approximately 660 acres, or 7 % of the remaining standing mature forest, had blown down. By August 2000, an additional 276 acres blew down, increasing the amount of mature forest that had blown down to 10%. Approximately 39.5 acres blew down within 100 feet of the ocean shoreline. By August 2001, an additional 66 acres blew down, increasing the amount of mature forest that has blowdown down to 11%. Approximately 8 more acres blew down within 100 feet of the ocean shoreline. Scattered windthrow of standing trees occurred on 211 acres in areas that had experienced blowdown in the past. The blowdown observed in 2002 and 2003 was scattered pockets in areas with existing blowdown or extensions of those areas. In 2003, 462 acres of a mix of old and new blowdown was mapped. The stands continued to ravel along the edges of harvested areas. GIS attribute tables for the project “khead.apr” contain detailed information on blowdown. Figures 11 through 14 display the areas of blowdown observed to date.

Regeneration of the harvested units is progressing satisfactorily. However, as discussed in previous reports, side cast and crib road failures on upper slopes will bury many acres of naturally regenerating trees and ground cover. Slash, debris, and log piles left at landings are decaying and becoming unstable and may ravel down steeper hillslopes (Figure 9).The road accessing the lower units along the Knowles Head facing Orca Bay, has piles of debris, slash and logs about 15 – 20 feet deep and 20 – 30 feet wide along the majority of its length on the beach side (Site A, figure 15). This is within a couple of hundred feet of the shore. The regeneration of this area will be delayed until this material decomposes and seedlings can become established. In some areas, a buffer only 2 to 3 trees wide was left along the shore and scattered blowdown is occurring.

Figure 9. Typical debris loading at landing, Knowles Head road Spur III (Site C on Figure 15).

Table 2. Potential thinning acres and year identified to date.

Year of potential thin	Total Acres	Size of trees as of 2003		Year harvested
		Hemlock	Spruce	
2008	78	16 - 18 ft tall	5 -10 ft tall (some planted)	1990
2010	135	12 -15 ft.	5-12 ft, 14 – 24” leader	1992-1994
2011	98	10 - 15 ft	10 – 15 ft	1991-1992
2012	25	8-10 ft	8 – 10 ft	1990-1992
2013	173	8 - 9 ft	3 - 4 ft	1992-1993
2014	94	5-12 ft	5-12 ft	1994
2015	107	8 – 9 ft, some 15 ft, 12 – 14” leader	5 – 8 ft, 30” leader (some)	1994-1995

2016	**12**	**5 ft**	**5 ft**	**1996**
2018	**114**	**5 ft**	**4 – 6 ft, 12 – 14” leader**	**1994-1996**

Figure 10. Example of growth of spruce planted in 1992 in windrowed area (Point H, figure 14).

Figures 11 through 15 display the areas reviewed and proposed treatment locations. Table 3 provides the information for each of the labeled sites (A through I) on figures 13 through 15**.**

Figure 11. Northeast Knowles Head review area for 2003.

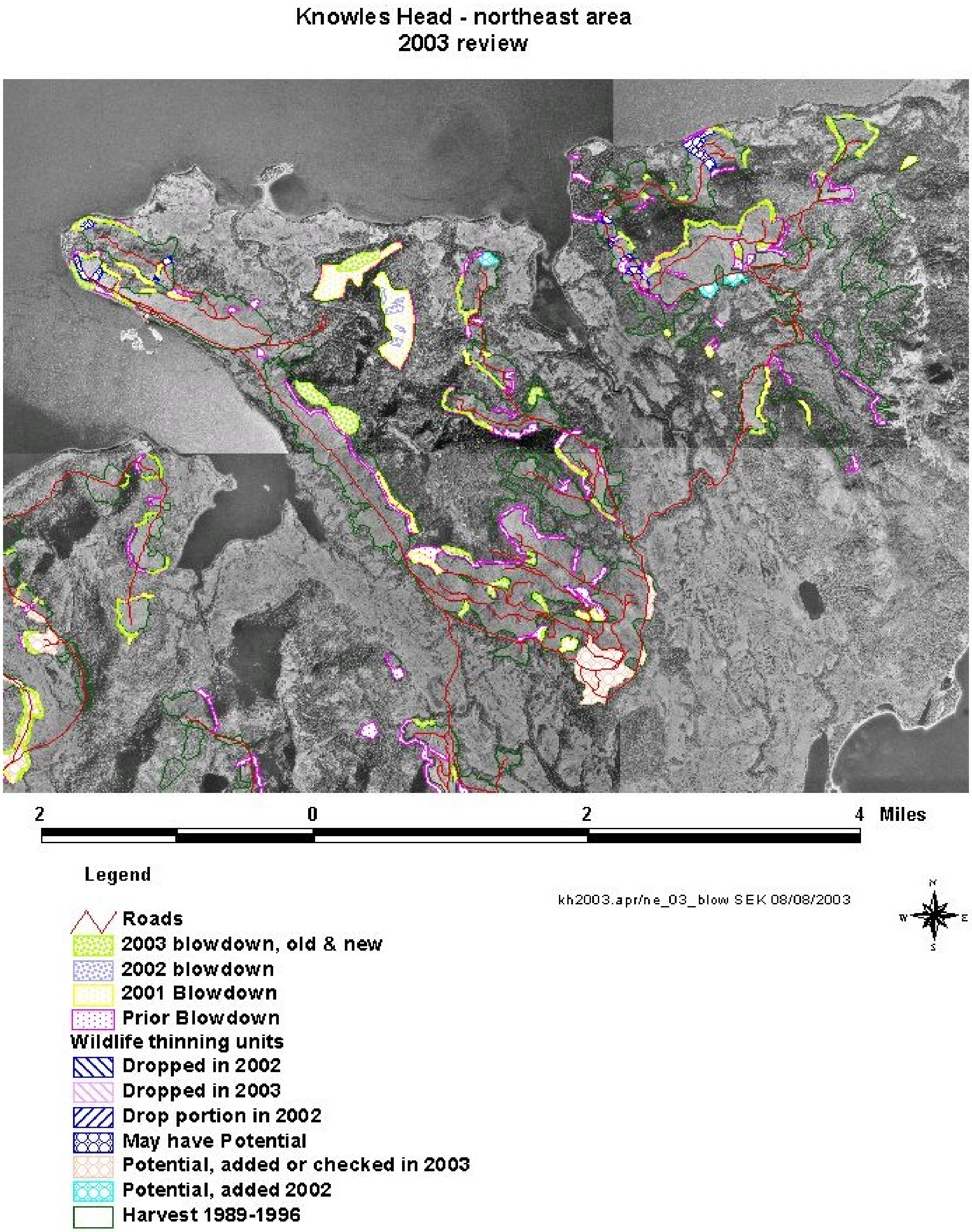


Figure 12. Northwest Knowles Head review area for 2003.

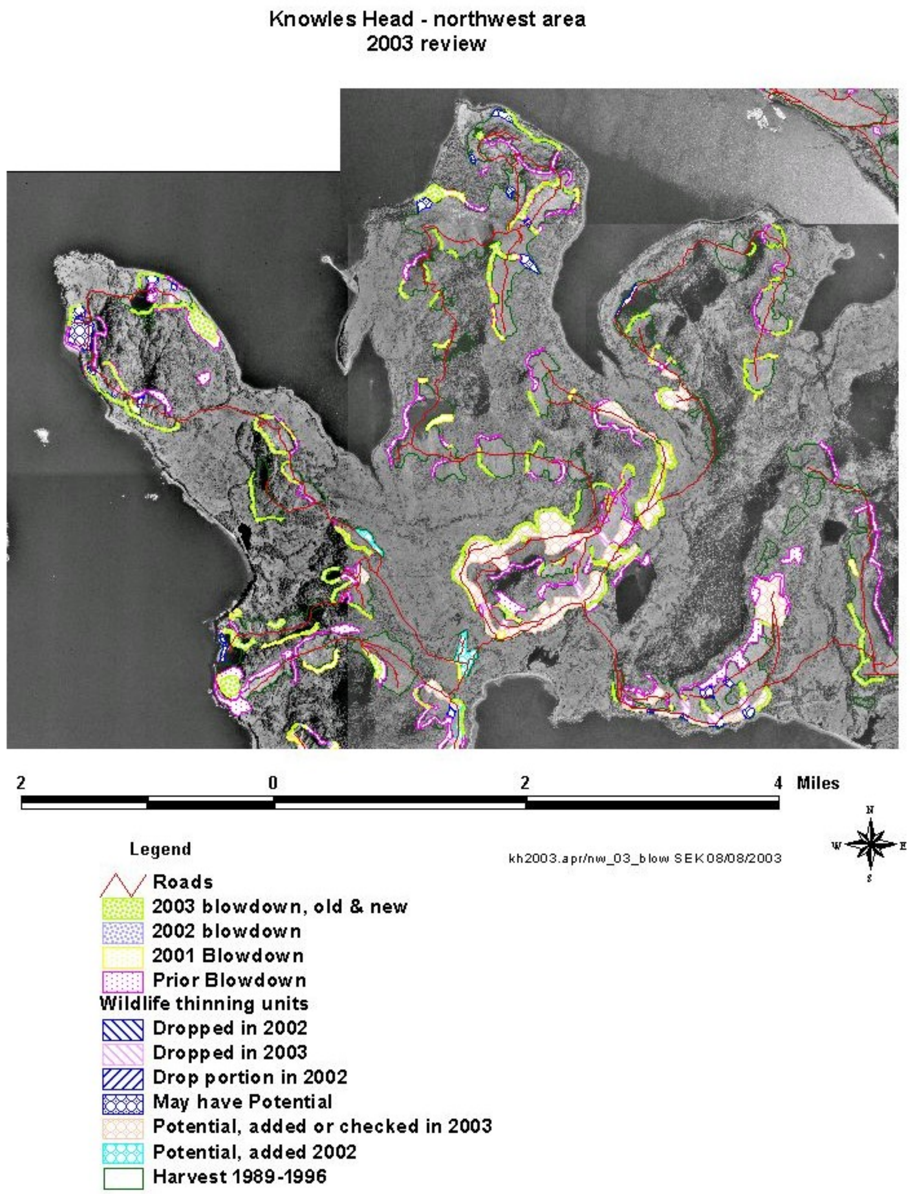


Figure 13. Southcentral Knowles Head review area for 2003.

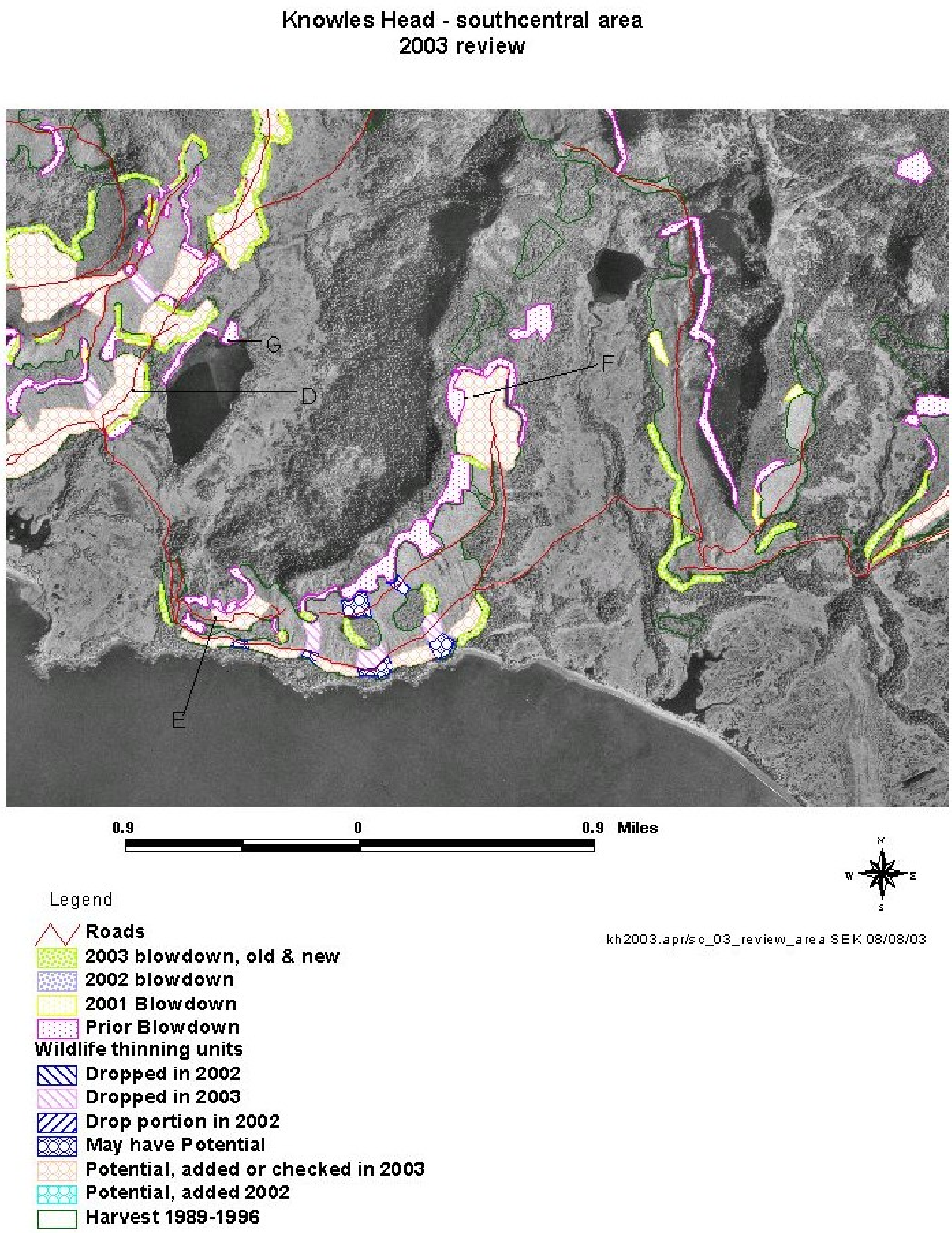


Figure 14. Southeast Knowles Head review area for 2003.

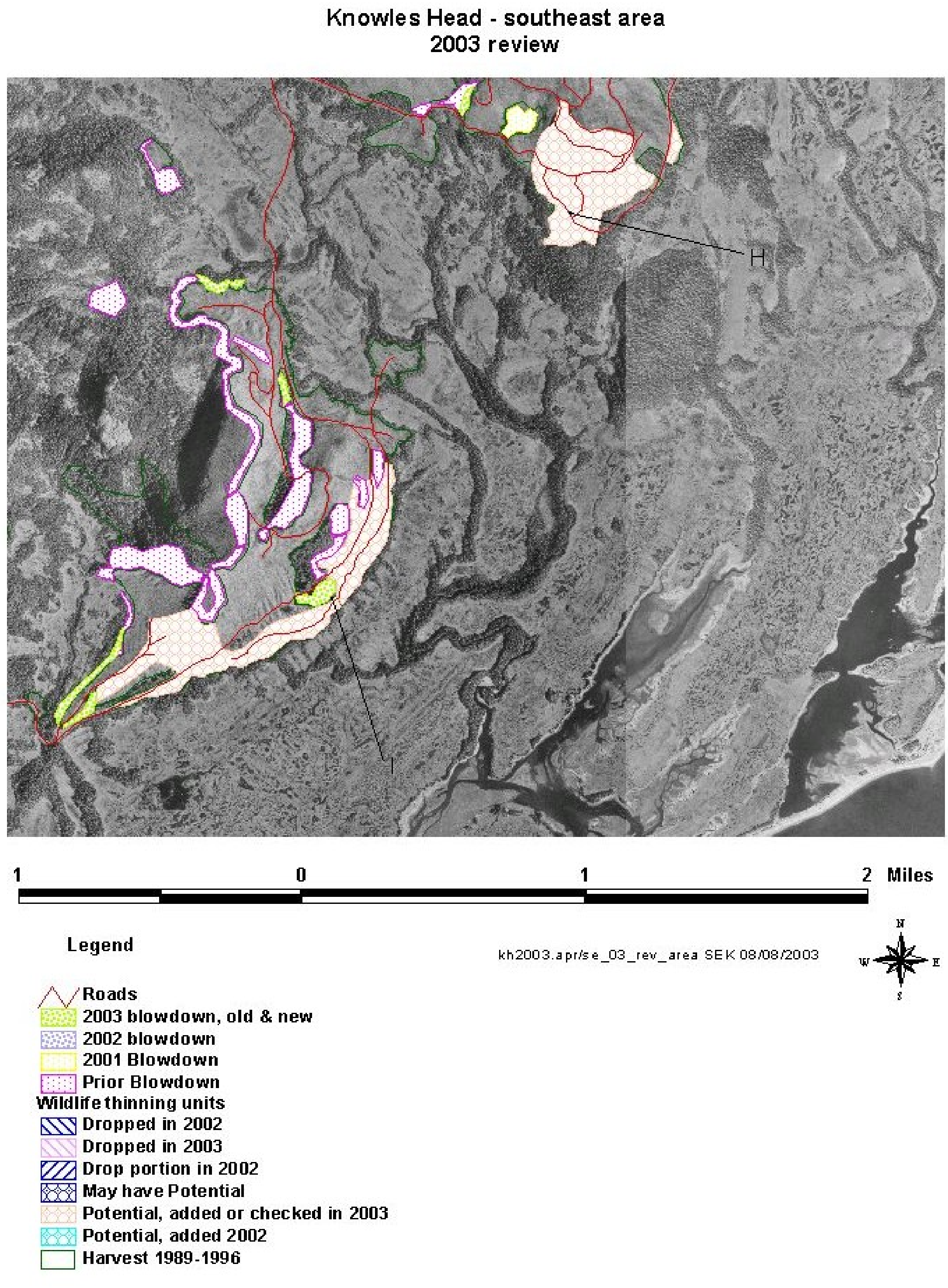


Figure 15. Southwest Knowles Head review area for 2003.

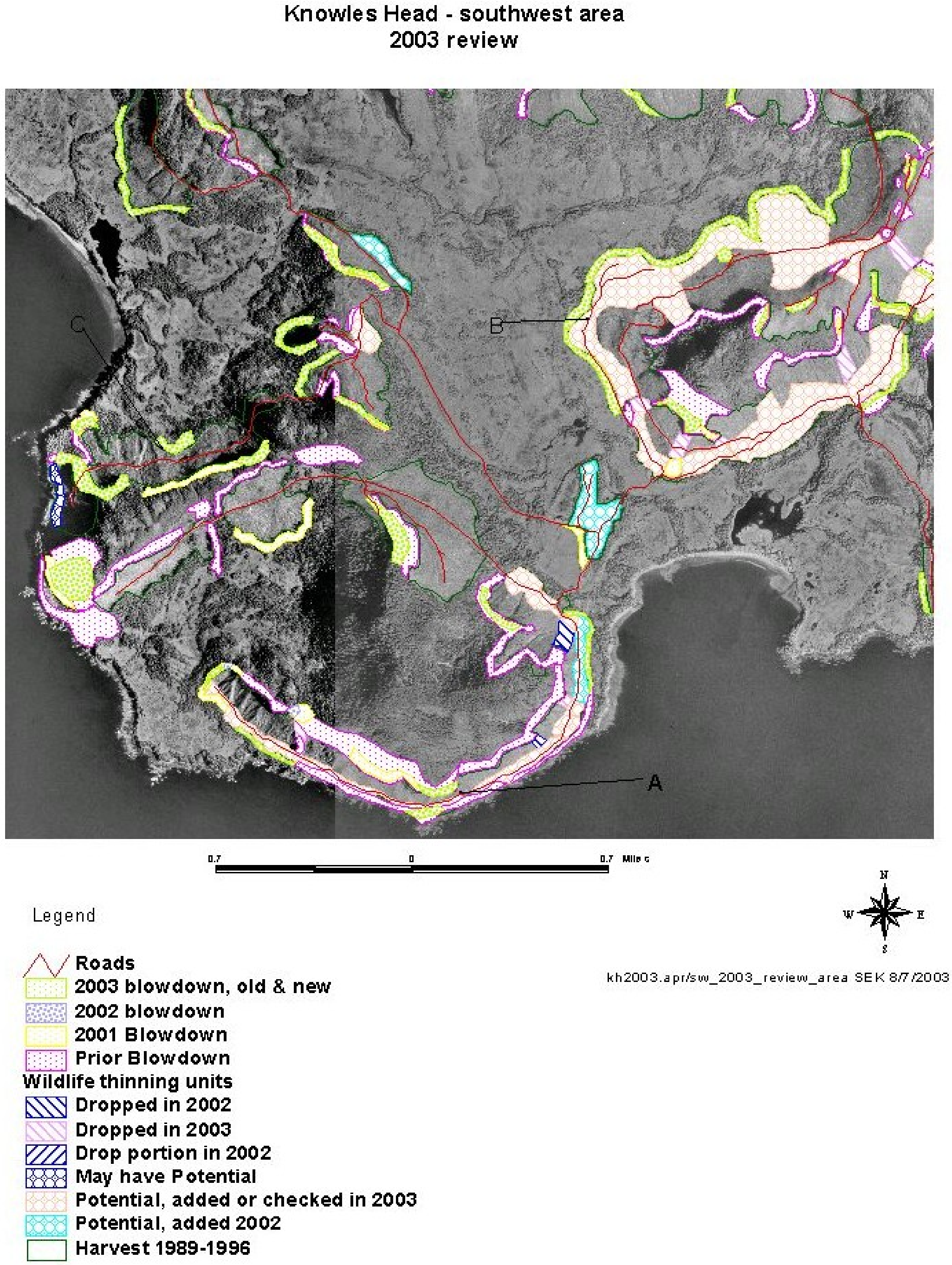


Table 3. Site information for Knowles Head Figures 12 - 15.

Site	Figure	Location	Notes
A	15	South Knowles Head road along shore	Log piles and slash 20 – 30 ft wide & 15 – 20 ft deep along road. Slash and logs will impede regeneration of beach fringe habitat. Only 1 – 2 trees left in some locations along beach fringe.
B	15	Lower Knowles Head road, spur I	Spur has >5 ft tall alder on north ½. OK to thin most of unit, gentle slopes. Thin lower half before upper slopes (thin soils)
C	15	Knowles Head rd Spur III (Photo – figure 9)	landings with a lot of slash, side cast road will unravel, blowdown along lower edge adjacent to muskegs
D	13	Road and unit just west of Arrowhead Lake	Road constructed by downcutting through unit. Over 5 foot tall walls on either side of road.
E	13	Up Main camp spur in unit cut in 92	Portions of road are very steep, 30% grade. Stream channels being redirected out of main draws. High water table in unit. Some hemlock 15 ft tall. Most 8 – 10 ft tall.

F	**13**	**Along upper edge of unit cut in 1992**	**Some beetle activity in blowdown along upper edge of unit.**
G	**13**	**Mature stand at north end of Arrowhead Lake**	**Beaver activity at mouth of lake, causing flooding/killing of trees at upper end. Blowdown and beetle activity present.**
H	**14**	**Along Main camp road in windrow area (photo - figure 10)**	**Site John Alden planted spruce from 45 different seed sources in 1992. Some 8 - 12 ft tall with 16-18" leader growth**
I	**14**	**Along main camp rd, area cut in 1991**	**New blowdown, fly over indicated good to thin below main road. Stand structure could be improved along the muskegs. (facing south)**

Figure 16. Photo taken at Site E in Figure 13, unit cut in 1992.

CONCLUSION

Fisheries

The inventory of impacts on streams and fish habitat is essentially complete. The fish distribution surveys, documentation of anadromous streams, and classification of stream channel types are also done. The main focus now is to monitor the restoration efforts to ensure they correct the erosion problems; monitor the stream crossings, slides, and blowdown areas to identify any new problems that may arise. Work in 2004 will include seeding and correcting impact sites identified in 2003. There is still a concern about the impact of sport fishing on the coho salmon population at West Hell's Hole. The Forest Service needs to quantify the habitat capability and work with outfitter-guides, flight services and ADF&G to assess the sport fishing harvest to determine whether it has a significant impact.

Landslides

The majority of the mountain slopes in the analysis area are prone to landslides. Most of the existing slides started on the Mountain Sideslope land type (31), which consists of convex to concave side slopes, greater than 1000 feet in length, with ground water originating in the alpine landtype. Steep cliffs or bedrock, slopes of 72 - 95%, and shallow mineral soil or an organic mat over impermeable soils or bedrock characterizes the upper third of the slope. The surface configuration is controlled by bedrock. The middle third of the slope is characterized by loose glacial till or shallow colluvial soil over a more compact glacial till that impedes the vertical flow of water. Slope gradient ranges from 56 - 72%. This compact till provides a surface on which groundwater will flow. The surface configuration may have shallow drainage channels depending on the depth of the unconsolidated soil. The lower third of the slope ranges from 35 -65%. It is characterized by deep soils consisting of non-compacted glacial till and or colluvium eroded from the upper slopes. Frequently, active water drainage from upslope will cut deep V-notches through this loose material.

The construction of a road creates a cut in the topography, loads a slope with fill material or concentrates water, all of which tend to decrease slope stability and increase the likelihood of a landslide relative to an undisturbed situation. All midslopes with a slope gradient greater than 56% with poorly drained soils underlain by compact glacial till or with lateral ground water from above will likely produce landslides once the original root strength has decayed in harvested areas. This usually occurs 5 to 9 years after harvest. Roads with steep, high cut banks in loose soils or soil underlain by compact till will continue to slough until the slope has regained its stable angle of repose. Road fill on slopes over 72% will slough or settle until a stable angle of repose is obtained.

Several of the upper slope roads were walked during regeneration surveys and as predicted, the roads, especially those with crib construction, located on steep slopes are starting to fail. Failure on these slopes will destroy any revegetation of the harvested units that has occurred to date. Old landings will likely cause the most damage as the material used as cribbing begins to fail.

With regards to the success of landslides naturally revegetating, cluster analysis of future measurement data from the landslide transects will be of value to determine if observed compositional changes are of a sufficient magnitude to result in a change in a transects classification. Such cluster analysis, coupled with ordination, would identify the magnitude of the relationship of position on a landslide and the rate and direction of vegetation succession. In general, the transects on source and transport positions on a slide group more closely together than they do with transects on deposition positions. This suggests greater compositional similarity of vegetation and ground cover in the source and transport areas of a slide and a difference between source/transport area composition and composition on the depositional surfaces. No statistically significant correlation was found between elevation and NMS (Non-metric multidimensional) scores. However, there are statistically significant correlations with percent slope.

Vegetation and Wildlife

The primary wildlife habitat enhancement opportunities for the Knowles Head area are related to maintaining of old-growth habitat types and thinning young stands to facilitate formation of a complex forest structure. Potential thinning enhancement sites in the analysis area described in the 1999 annual report have been modified. From preliminary data collected from the two areas harvested in the 1950's and 1960's, it appears that stand conditions can be enhanced with treatment if performed before age 30. Modifications to potential treatments made so far are to delay proposed treatments until at least 2008 and remove areas with very steep slopes from consideration. Additional areas will be surveyed in 2004. Changes in stand structure over time in untreated naturally regenerated stands will be monitored using the permanent plots installed in 2001 and 2002. The next measurement of these plots will be in 2006.

Wind will continue to play a role in shaping stand structure in the area. Orientation of the harvested areas has accelerated windthrow on southeast facing slopes. Stands will continue to ravel. To date, about 12% of the residual mature forest has been damaged by wind. No recommendations are included for treating any of the windthrown areas. Wind is a prevalent stand replacing disturbance event for Prince William Sound. Occurrence may have been minimized if the harvest pattern had been different, but it is unlikely any treatment now would have much effect. Small-scale wind damage can be expected to occur as stem snaps on protected north slopes and leeward sides of mountains. Wind throw will also continue to occur along south facing slopes, ridge tops, and along east and west flanks of harvest units and play a role in developing stand structure. It may also increase potential for insects and disease in area. Aerial surveys conducted by State and Private Forestry identified a black-headed budworm outbreak in 2001. No other outbreaks have been mapped in the area.

Additional modifications to the location of treatments of the young stands will be necessary to take into account blowdown as it occurs. Porcupines also appear to be playing a role in shaping stand structure. Porcupines have hit the area harvested in the 1960’s quite heavily and as a result may swing the stand to a more hemlock dominated type.

General guidelines for treating second growth stands resulting from harvest are outlined in the 1999 annual report. Also the Forest Service Pacific Northwest Research Station has recently published a pamphlet called ”Promoting Habitat Complexity in Second Growth Forests” that is very useful (Carey 2003). It describes the benefits of variable density thinning which include helping generate complex forest structure by promoting tree growth at different rates, encouraging understory development, improving forest health by increasing resistance to disturbance, and improving the ability of the stand to recover after disturbance. Biological diversity is increased which allows ecosystems to function well through climatic variation (Carey 2003). It also describes cavity tree creation, coarse woody debris augmentation, conservation of biological legacies, extended harvest rotations, key structuring processes, and processes influencing species composition. However, thinning is costly (over $300/acre in Southeast Alaska) so it is imperative to prioritize areas for treatment.

MONITORING PLAN AND PROGRAM OF WORK

A monitoring plan developed to address the key management concerns and a detailed program of work outlining when and how restoration work will be completed was described in the 1999 annual report. Table 4 displays the program of work for the next few years.

Table 4. Program of work.

Year	Work Group	Task	Restoration Funding	Task
2003		**Total Funding**	**$65,000**	As described in this report.
2004	Fisheries	Planning	$2,000	NEPA & project coordination & prep
		Restoration & enhancement	$9,000	complete projects identified in 2003 survey
		Monitoring & evaluation	$5,000	Impacts, restoration Cutthroat and coho monitoring
	Silviculture	Team Leader /Planning /GIS	$10,000	Annual reports, GIS update
		Monitoring & Evaluation	$8,000	Survey thinning potential & prepare prescriptions
	Soils	Monitoring	$3,000	Midslope roads & slides, ID restoration projects
	Wildlife	Monitoring & Evaluation	$6,000	Potential treatment projects, blowdown in beach fringe, dive survey of log transfer site ($2500 NFS funds)
2004		**Total Funding**	**$43,000**	
2005 - 2011	Silviculture	Planning/ evaluation	$7,000	Each year survey areas for potential thinning
Fm		Enhancement / restoration	$10,000	Layout & prepare contracts or force acct work
		Enhancement / restoration	$30,000	Recommend max 50 acre contracts to avoid defaults
		Monitoring	$8,000	Contract administration
	Fisheries	Monitoring	$7,000	Field projects, blowdown, fish pop., reports
	Soils	Monitoring	$2,000	Slides, midslope roads
	Wildlife	Evaluation/ Monitoring	$6,500	Previous thinned areas every 5 yrs, potential treatment areas.
	Recreation/ lands	Monitoring	$500	Recreation use, determine public info sign needs for access points to NF lands.
2005 - 2011	**Funding to come from NF sources**	**Yearly funding**	**$71,000**	**Reflects only projects identified by 10/03. Costs are prorated to reflect frequency of surveys /work.**

ACKNOWLEDGEMENTS

This annual report would not have been possible without the help of Dirk Lang and Deyna Kuntzsch, Fisheries Biologists, Sam Greenwood and Chris Ashinhurst, Fisheries technicians, Mike Furniss, PNW Hydrologist, and Dan Logan, Wildlife Biologist.

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Certification

I have reviewed the annual Forest Monitoring and Evaluation Report for Fiscal Year 2003 for the Chugach National Forest that was prepared by the Forest resource specialists. Current National Forest Management Act regulations (36 CFR 219.10(g) require that ordinarily a forest plan be revised on the 10-year cycle or at least every 15 years, or whenever the Regional Forester determines that conditions or demands have changed. This is the first year of the new Revised Land and Resource Management Plan. I am satisfied that the new revised plan is sufficient to guide management of the Forest. This report is approved.

/s/ Rebecca S. Nourse (for)

JOE L. MEADE
Forest Supervisor