Kenai Peninsula Brown Bear Studies:

Report of the Interagency Brown Bear Study Team, 1984

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SUMMARY

This report summarizes existing information on brown bears (Ursus arctos) from the Kenai Peninsula, Alaska. Much of the data presented here was collected from extensive stream surveys and personal interviews. In addition, there is a review of harvest statistics, and known sightings of brown bears from the Kenai Peninsula. A literature review on brown bear food habits as it relates to available foods from the Kenai is presented. Salmon spawning areas from the entire area are classified according to their fish runs, known or suspected use by brown bears, and extent of human use of each area. Current land use catagories are discussed and potential conflicts with human use as they relate to brown bears reported. Results of a user survey from the Russian River/Resurrection River are presented. Recommendations for continued work are included.

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Preface

This is the first report of the Kenai Peninsula Interagency Brown Bear study team (IBBST). The IBBST was formed in 1984 following joint meetings between the U.S. Forest Service,(USFS), U.S. Fish and Wildlife Service (FWS), and the Alaska Department of Fish and Game (ADF&G). The group was established to coordinate efforts in collection of scientific information relative to brown bears on the Kenai Peninsula. The major goal of the group is to establish a data base that will aid land managers in meeting the primary goal of maintaining a viable brown bear population on the Kenai Peninsula.

This report contains some of that data base. It was prepared by the interagency group, although the majority of the text was written by John Bevins, field technician, who was assigned to the project in 1984. We are grateful to John for his efforts. Stream survey information was collected by John Bevins and Greg Risdahl. Additional information was provided by biologists from USFS, FWS, and ADF&G. They've improved the quality of this report. We thank USFWS pilots Bill Larned, Bob Richey and Bob Delaney for their hours of early morning and evening flying that was conducted in addition to their regular duty. We also thank Ted Spraker for his critical review of the text, Gino Del Frate for drafting the figures, and Siri Strong for typing the many revisions and final report.

Charles C. Schwartz
Chairman, IBBST

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I. INTRODUCTION

Impacts on local brown/grizzly bear (Ursus arctos) populations and the increased occurrence of human/bear conflicts resulting from accelerated human activities on the bear's range are well documented (Herrero 1970, Craighead and Craighead 1971, Elkmork 1978, Martinka 1982). The Kenai Peninsula is undergoing rapid land use changes, resulting in increased use of it's resources by humans. The United States Fish and Wildlife Service (USFWS) proposed a study on the Kenai National Wildlife Refuge (KNWR) in 1983 to gather baseline information on this brown bear population. Information collected would be used to make management recommendations on activities with potential negative impacts to bears, and reduce bear/human conflicts on the Peninsula.

On January 6, 1984, representatives of the USFWS, U.S. Forest Service (USFS), and the Alaska Department of Fish and Game (ADF&G) met at the KNWR headquarters in Soldotna to discuss this proposal. At this meeting, it was agreed that there was a mutual need to obtain information on brown bears and that the best approach would be through an interagency effort. An interagency brown bear study team (IBBST), composed of Ed Bangs (USFWS), Kurt Nelson (USFS), and Chuck Schwartz (ADF&G), was formed.

During subsequent meetings, the IBBST determined information needs and discussed logistics and timeframes required for studies of various intensties. The team developed a step-down plan (Appendix 1) which outlined information needs, and strategies necessary to collect this information. The group decided that a limited effort to locate and radiocollar bears would be conducted during the summer and fall of 1984. This initial effort could then help to determine the feasibility of developing a more intensive study the following year. They also decided that an extensive survey should be conducted by technicians to gather background information pertaining to Kenai Peninsula brown bears through literature searches, interviews, and aerial and ground surveys of known and suspected brown bear high use areas. Field efforts would be concentrated along salmon spawning areas. Technicians would be funded by the USFS and USFWS. A memorandum of understanding was endorsed by the three agencies in July, 1984.

This report summarizes the work conducted from April to October, 1984 and includes recommendations for continued field efforts and for management concerning brown bears. The goals of this year's efforts were:

1) To establish a file of pertinent brown bear literature and to review this literature for information applicable to the Kenai Peninsula Brown Bear Step-Down Plan.

2) To interview biologists and local residents to obtain information pertaining to the Kenai Peninsula Brown Bear Step-Down Plan.

3) To conduct aerial surveys of alpine areas on a portion of the Kenai Peninsula to identify possible brown bear use areas.

4) To conduct ground surveys on the Kenai Peninsula of known or suspected important brown bear use areas, and to document brown bear use in these areas.

5) To review and centralize information on historic and present brown bear distribution, salmon abundance and distribution, and present land status on the Kenai Peninsula.

6) To monitor human use and human/bear encounters within a recreation area on the Kenai Peninsula (the Russian River/Resurrection River trail system) receiving heavy use by both humans and bears.

7) To test the feasibility of capturing brown bears on a portion of the Kenai Peninsula for subsequent radiotelemetry studies.

II. MATERIALS AND METHODS

A. Literature Review

A file containing brown/grizzly bear research papers and related information was established at the USFS District Office in Seward. We obtained a microfiche copy of the 1982 Brown Bear Bibliography (Tracy et. al. 1982), which contains a listing, in bibliographical form, of over 4000 references (scientific publications, unpublished technical reports, popular publications) concerning brown/grizzly bears. We obtained copies of several applicable papers through a library search conducted by the USFS Forest Sciences Laboratory in Juneau, and from biologists' personal files. A literature review was conducted on brown/grizzly bear food habits (Risdahl 1984).

B. Interviews

Information concerning salmon and bear use of various streams on the Kenai was obtained from several agency fishery biologists. Biologists who have conducted brown bear research in other regions were contacted to obtain their advice regarding our techniques. Interviews were conducted with a few residents on the Kenai who are knowledgeable about brown bears. Names of persons contacted are listed in Appendix 2.

C. Aerial Surveys

Aerial searches for brown bears were conducted using a Piper Cub on May 2 and May 30 and in a Cessna 206 on June 25. Efforts were concentrated on alpine areas where suspected spring/early summer feeding activity might occur. USFWS and ADF&G biologists conducted 19 intensive aerial searches of salmon spawning areas and alpine areas within portions of the KNWR and Chugach National Forest (CNF) from early July to late October.

D. Ground Surveys

Ground surveys were conducted on four areas believed, by agency biologists, to be important brown bear areas. These areas included the Upper Russian-Resurrection River drainages; Johnson Pass trail; Lost Lake - upper Boulder Creek area; and Twin Lakes - Benjamin Creek area (Figure 1). These areas are evaluated based on the presence of brown bear sign and abundance of known and suspected bear foods, using a system similar to Herrero et.al. (1983). Surveys were conducted during June and July.

Areas were accessed by trail or float plane. Each area was surveyed 4-5 days, using man-made or game trails where possible. All habitats were searched, with emphasis placed on types where brown bears should most likely occur. Open areas were glassed with binoculars and a 20x spotting scope. Each survey was divided into several segments, based on vegetative and topographic features. Each segment was assigned a letter. Survey routes, brown bear observations, and bear sign located were marked on 1:63,360 scale USGS quad maps. Prior to the

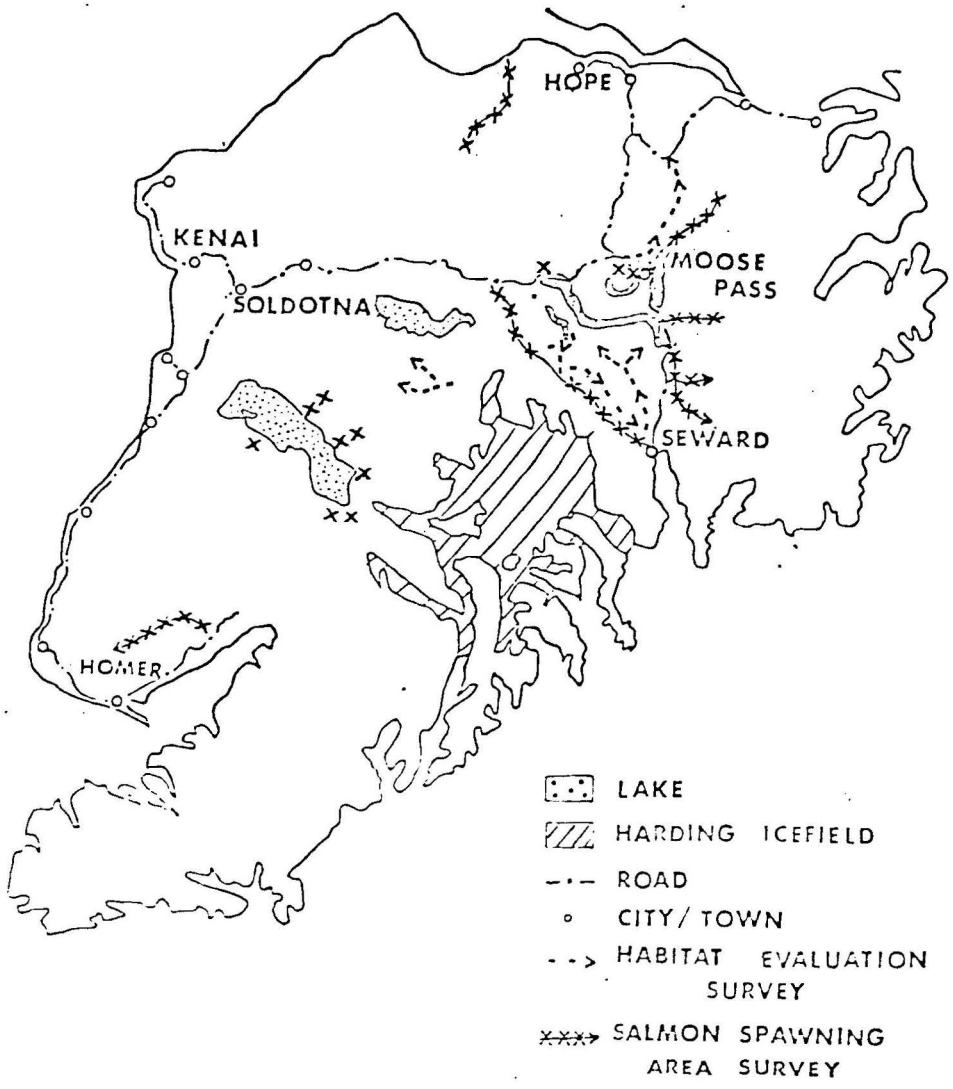


Figure 1 Location of ground surveys conducted on the Kenai Peninsula, 1984.

final two trips (Lost Lake, Twin Lakes), a field form was developed on which to record the relative densities (high, medium, low, trace) of each potential food species. A write-up of each survey, with an accompanying map is included in Appendix 3.

Major emphasis was placed on surveying salmon spawning areas in the 1984 field season. A total of 23 individual streams and rivers, ranging from a quarter mile to over 20 miles in length were surveyed. Surveys were conducted from mid-July to mid-October and each spawning area was visited once (except the South Fork of Snow River, which was surveyed twice). Most trips were made when salmon numbers were at a peak or past peak, when bear sign was greatest.

Access to spawning areas was by foot via trail (n=8), boat (n=9), or floatplane (n=6). The entire length of most spawning areas were walked, while only portions of five of the larger drainages were walked.

Surveys were not systematic since techniques were affected by physical characteristics of the stream and adjacent terrain. During each survey, we walked along banks of the stream/river when possible and walked directly in the water when vegetation was heavy or terrain too steep. The Chickaloon River was surveyed by canoe. Visual estimates were made of the total number of live salmon, carcasses fed on by bears (termed bear-kills) and untouched carcasses. Accuracy of live salmon counts decreased with increased fish densities, but estimates are probably within $\pm$20 percent. Most carcass counts were low estimates due to the heavy vegetation cover on stream banks. Several carcasses were found over fifty meters from the banks. Tracks were used to determine if black or brown bears were using the area, and, in some cases, to give us an indication of how many bears had been visiting the stream recently. Generally, substrates were poor for tracks. Other information which was noted was the presence of brown bear or black bear hair on branches overhanging the stream or trail, and the abundance of rubbed and marked trees, scats, trails, and beds. The extent to which vegetation had been beaten down, the condition of the trails, and the age of the sign were all noted. Few direct observations were made of either brown or black bears. Individual trip write-ups and maps are included in Appendix 4.

E. Mapping

A composite map was constructed of the Kenai Peninsula, using 1:250,000 scale USGS quad maps. Brown bear observation and mortality locations, land status categories, salmon spawning areas, bear high-use areas and survey route locations were drawn on acetate overlays.

Observations were obtained through ground and aerial searches, surveys conducted by biologists on the peninsula, sightings reported to agency biologists from other sources, and sightings recorded on bear observation cards at the Russian River/Cooper Lake/Resurrection River trailheads. Different symbols were used for each of these

categories due to the obvious biases of each. Observations were documented on observation cards (Appendix 6), which contained location and descriptive information.

Brown bear harvest data from 1961-83 for Game Management Units 7 and 15 was obtained from ADF&G files. Locations of many of the reports were too general to map. Some kills with general location descriptions (e.g. Caribou Hills) were mapped on a small scale map so that regional comparisons could be made.

Land status information is tenative because state and native selections are pending and the status of some lands is undetermined. Present land ownerships and areas with special status's on state and federally owned lands were mapped.

F. Russian/Resurrection River Trail Survey

A system was initiated to monitor human use and human/bear encounters on the Russian River/Resurrection River trail system. This area receives high human use and also has a high amount of bear use, resulting in a relatively high incidence of reported bear/human encounters (Johnson and Apgar, unpub. report, 1981). We placed trail counters and established visitor survey stations containing maps and observations cards at several locations within the system. Exact methods and results of this survey are reported in Appendix 5.

G. Bear Tagging Efforts

Brown bears were tagged using standard procedures (Schwartz et al. 1983). Captured individuals were fitted with Telonics radiocollars equipped with an inverse mortality mode set to change pulse rate after 10 minutes. Bears were radio-tracked using fixed-wing aircraft.

III. RESULTS AND DISCUSSION

A. Population Characteristics and Bear Observations

The size of the Kenai Peninsula brown bear population is unknown, but it is probably lower than other coastal areas of Alaska. ADF&G biologists believe that the brown bear population has remained stable over the past 2 decades, based on observations made by department personnel and historical harvest data. (Ted Spraker pers. comm.)

Brown bears are distributed throughout the peninsula, highest densities occuring along western slopes of the Kenai Mountains (Tustumena Benchlands, Chickaloon River) , in the Caribou Hills and associated drainages (Anchor River, Deep Creek), and in the larger, roadless intermountain valleys (Russian River, Trail Creek).

1. Harvest Statistics

Figure 2 shows the distribution of reported brown bear kills on the Kenai from 1961 to 1983. These include animals harvested for sport, defense of life and property (DLP) kills and known illegal kills. Several kills are not mapped, due to the vague description of their locations, but total numbers of brown bears killed within the various sections of the Peninsula are reported. Data was obtained from ADF&G files; since 1961, the Department has required that hides and skulls of all brown bears killed be sealed by ADF&G personnel. Harvest was greatest for the Tustamena Lake, Caribou Hills and Russian River areas, accounting for approximately 13.5, 11 and 9 percent respectively, of the total kill. Other important areas include the Anchor River, Deep Creek and Skilak Lake areas. Data probably reflects relative human use. Moose hunters are concentrated in the Caribou Hills and associated drainages, and several of those bears were probably taken incidentally, since 75% were killed during September. Skilak and Tustumena Lake provide relatively easy access to the backcountry.

In an analysis of GMU 15 brown bear harvest data, ADF&G game biologist, Dave Holderman, found that 34 defense of life and property (DLP) brown bear kills have occurred from 1970 to 1983; 11 DLP kills occurred in the last 4 years. Statistical analysis of the data provided no conclusive trends because of a small sample size. However, he noted that several trends are suggested. Female brown bears occur more frequently in the DLP kills (76%) than in the sport harvest (45%). DLP kills are most common in July and August (42%) and at least 50% of the bears killed during these months were at salmon spawning areas (Holderman 1984).

2. Aerial Surveys

During 3 spring/early summer aerial surveys (Figure 3), we flew a total of seven hours and observed 2 brown bears. On May 2, lower and midelevation slopes on all but north aspects were

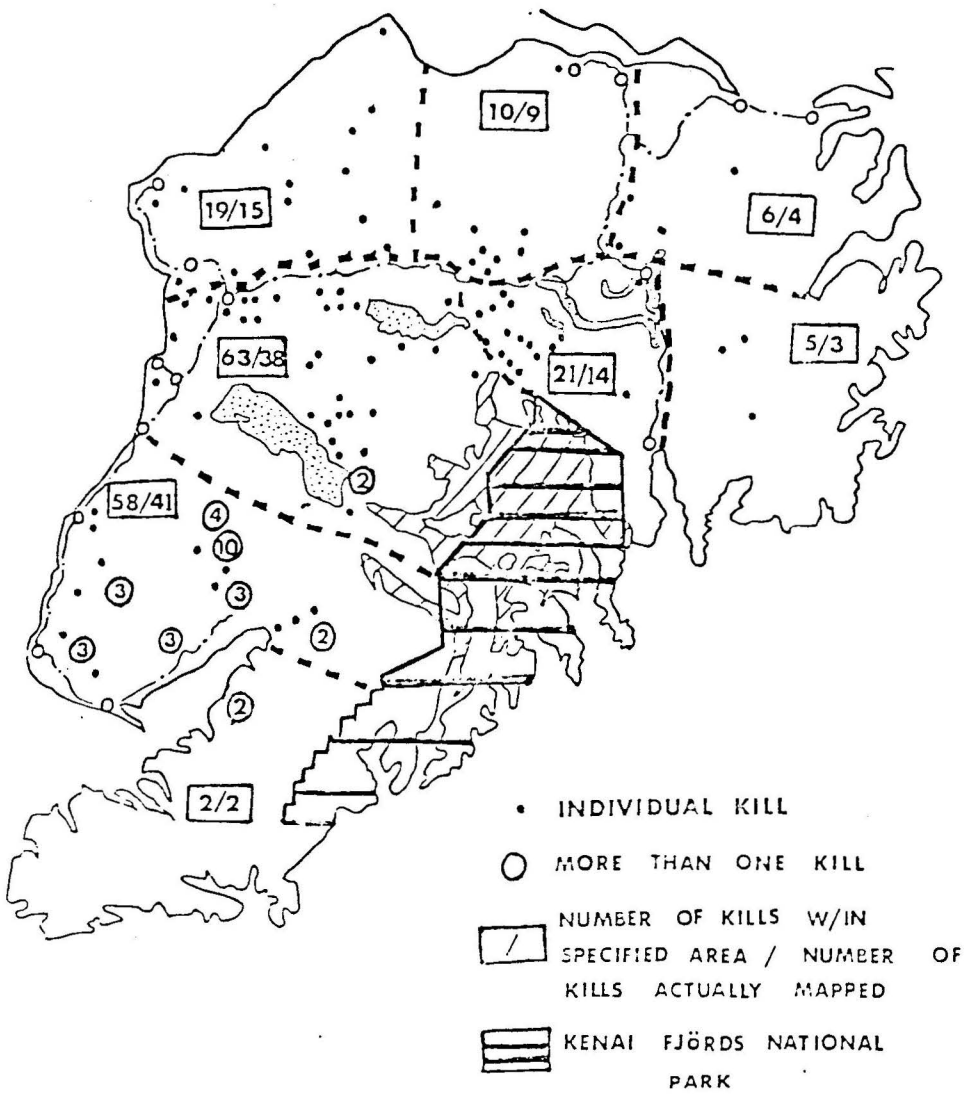


Figure 2 Brown bear harvest distribution on the Kenai Peninsula, 1962-1933.

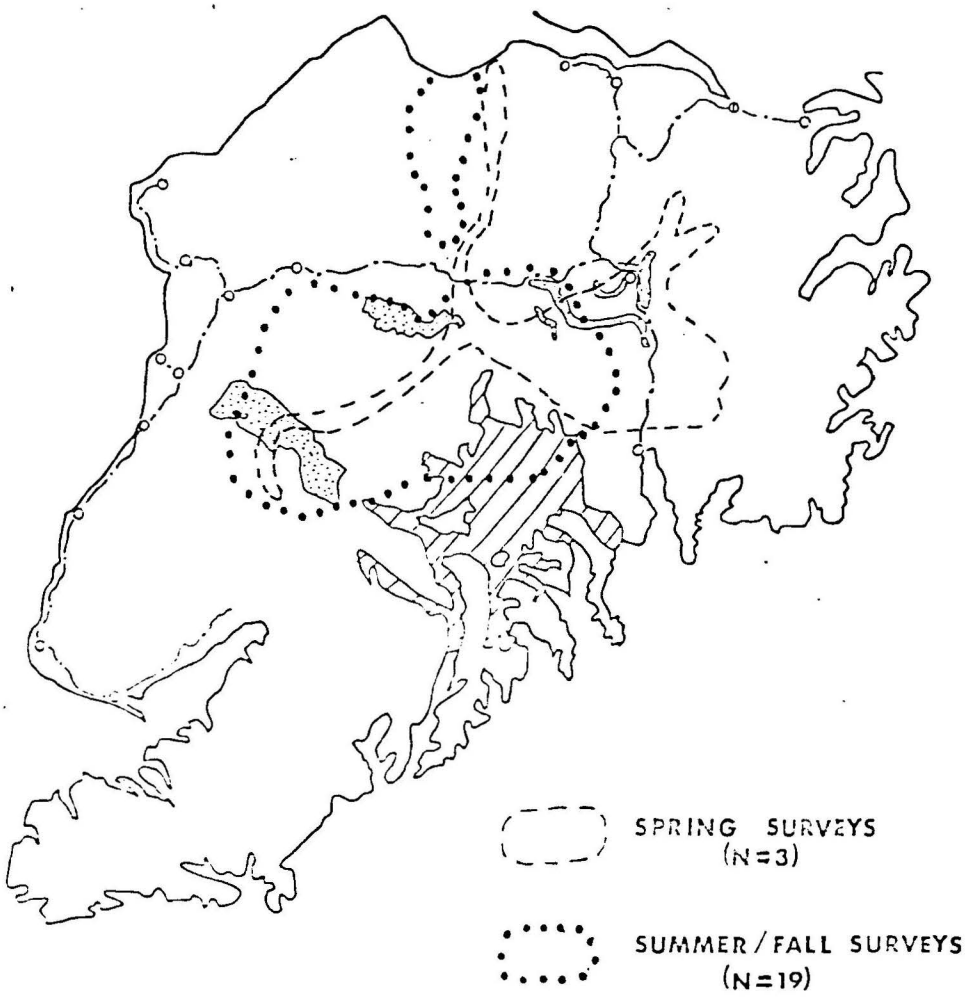


Figure 3 Areas surveyed aerially for brown bears, May-October, 1934.

generally snow-free and vegetation was just emerging. Higher elevations, including alpine meadows of the Lost Lake/Upper Boulder Creek area were snow-covered. Fourteen black bears were observed on open, snowfree areas, but no brown bears. Several sets of brown bear tracks were observed in the snow-covered area at the head of Upper Russian Lake. On May 25, several areas still remained snow-covered, but higher elevation meadows were greening up at this time. A brown bear sow and yearling were observed at mid-slope on a snow-covered bench above Johnson Creek (Figure 4). Black bears were frequently seen in open hillsides and valleys. On June 25, all areas surveyed were snow-free. No brown bears were observed.

KNWR and ADF&G biologists conducted 19 aerial searches for brown bears from July 6 to October 26, in 48 hours of flight time. Efforts were concentrated on salmon spawning areas from the Russian River, west to Nikolai Creek, and adjacent alpine areas. A few surveys included alpine areas east of the Russian River, the Resurrection River drainage and the Chickaloon River System. Forty-nine brown bears were observed, including 8 sows with 13 offspring (Table 1). A maximum of 44 individual bears were observed, but this estimate is probably high, because sightings were made repeatedly in the same areas. The majority of bears utilizing salmon spawning areas were observed in the Killey River, Funny River, and Russian River systems, while a few were observed in Nikolai and Bear Creeks. Heavy cover along all or part of some major spawning streams precluded good sightability on these areas for the surveys. Only eight brown bears were observed in the alpine. Black bears were commonly seen in the alpine throughout the survey period.

Five surveys were conducted during July, totaling 8.8 hours of search time. Nineteen brown bears, including 3 sows with 4 offspring, were observed. Eight individual bears or bear family groups were seen along salmon spawning area, while 3 were observed in the alpine. Red salmon were seen in small numbers at several tributaries (Moose Creek, Nikolai Creek, and Upper Russian Creek) during two flights in early July, but only one brown bear was observed feeding on salmon. Large concentrations of king and red salmon were first noticed in Benjamin Creek and Upper Russian Creek, respectively, on July 18. On July 20, eight brown bears were sighted along a 10-15 mile stretch of the Funny River, although no salmon were observed. Three individual bears were spotted at the confluence of Benjamin Creek and the Killey River on July 25.

Seven surveys were conducted during August, totaling 21.6 hours of flight time. Twenty six brown bears, including 5 sows with 9 offspring, were observed. On August 3, a young female was radiocollored on the upper Funny River, and a sow, accompanied by 2 cubs, was lost in heavy cover after being darted on Benjamin Creek. By August 7, few salmon were in Benjamin Creek, but the Killey River/Benjamin Creek area continued to be an important area of concentration for brown bears; from the 7th to the 9th, a sow with 2 cubs (same bear as darted on August 3) and 6 other individual bears were observed there.

Table 1 Summary of brown bear observations made by KNWR and ADF&G biologists during aerial surveys, July-October, 1984.

Date	Time	Total Survey Time(Hrs.)	Craft	# of Brown Bears Observed	# Sows	# Offspring
7/6	0715	2.9	cub	3	-	-
7/13	1500	1.0	206	0	-	-
7/18	1400	1.5	206	2	1	1
7/20	1515	1.0	206	8	2	3
7/25	1535	2.4	cub	6	-	-
Subtotal		8.8		19	3	4
8/3	1540	4.3	206	0	-	-
8/3	1600	3.3	cub	4	1	2
8/7	0600	2.0	-	3	-	-
8/8	0530	3.0	cub	3	1	2
8/9	0550	3.9	cub	6	-	-
8/20	-	2.3	cub	6	2	3
8/22	0725	2.8	cub	3	1	2
Subtotal		21.6		25	5	9
9/10	1630	3.5	206	0	-	-
9/22	1630	2.5	cub	1	-	-
9/24	1700	4.0	cub	0	-	-
9/25	1545	2.5	206	0	-	-
10/16	1545	2.2	206	3	-	-
10/17	1600	1.5	cub	1	-	-
10/26	-	1.7	cub	0	-	-
Total		17.9		5	-	-
Year Total		48.3		49	8	13

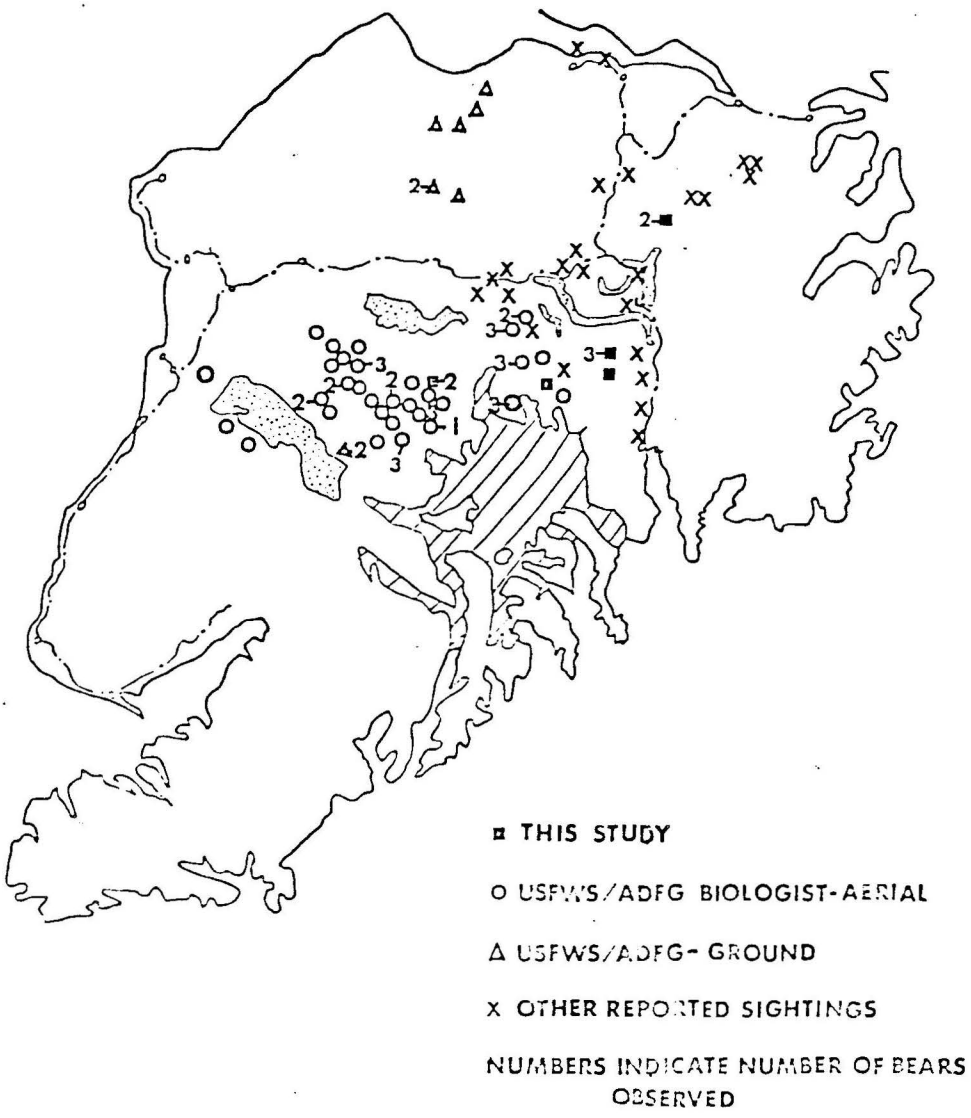


Figure 4 1984 brown bear observations on the Kenai Peninsula.

Salmon continued to be abundant in Upper Russian Creek and Bear Creek throughout August, and a sow with cubs and an individual bear were spotted at each of these creeks. A sow with 2 cubs was observed on the Russian River two days prior to the sighting of the family group seen at Upper Russian Creek. A lone bear was also observed at Nikolai Creek. No bears were seen in the alpine during August.

Seven surveys were made from September 10 to October 26, totalling 18 hours of search time. Only 3 individual bears were sighted. A large boar was radiocollared at the head of the Funny River on September 22. On October 16, both radioed bears were seen on the Killey River, as was a large bear, which was on a freshly killed moose. Silver salmon were abundant in the Killey River in mid-October.

3. Ground Surveys

Seventeen days were spent conducting ground surveys on four suspected high brown bear use areas (Appendix 3). Seven brown bears were observed from the ground, including a sow with 2 cubs. Four bears were observed in alpine meadows, two in salmon streams and one at the base of an avalanche chute. Evidence of brown bear use was found in all four areas. Positively identifiable brown bear sign, such as tracks and hair, were typically found along natural travel corridors (creekbottoms, saddles), man-made trails and salmon spawning areas. No established travel corridors were found in alpine areas; identifiable sign in this habitat was limited to scats, which were numerous, and excavations (2 were observed in alpine). Brown bear scats could not be distinguished from black bear scats, except when accompanied by identifiable sign. Numerous scats were briefly examined in the field. Green vegetation (mostly graminoids and horsetail) formed the bulk of most scats. Evidence of digging for rodents or roots was found on three occassions; extensive excavations were only found in a series of seasonally moist meadows south of Upper Russian Lake.

Habitat evaluations (Appendix 3) are highly speculative due to the paucity of observed brown bear sign, shortness of the surveys and the lack of area specific food habit and habitat preference information. Areas of potential use during various seasons were identified in each area surveyed. The Benjamin Creek and Upper Russian/Resurrection River drainages showed the greatest evidence of use. Alpine areas, especially the Lost Lake/Upper Boulder Creek area showed good potential for summer/fall use.

4. Incidental Observations

An unusually high number of brown bear sightings were reported from late June to early July this year. Fourteen observations were made by individuals at campgrounds, or along the Seward and Sterling Highways; these included 9 subadults, a sow with cubs

and 5 bears of unknown sex and age class. Subadults were observed twice on the Turnagain Arm mudflats near Hope, twice on the Sterling Highway between Tern Lake and Cooper Landing, 4 times between miles 3.5 and 18 of the Seward Highway, and once at Trail River campground, near Crown Point. A young bear was observed by fishermen several times near the Russian River campground. A small brown bear was also observed in Moose Pass in early August (Figure 4).

B. Bear Tagging Effort

Four brown bears were darted in the 1984 season. On 3 August, an adult female with two cubs was darted at Benjamin Creek. She escaped into dense vegetation prior to the dry effort and was subsequently lost. She and both cubs were seen five days later in the same area, but no additional attempts were made to dart her. A young female (#001) was darted and processed on the Funny River the same day. On 9 August, a 2.5 year old male was immobilized, processed but not radiocollared. A large adult male was collared on 22 September. Because of drug complications, he was too taxic to remove a tooth for aging or lip tattoo. The radiocollared male was located 7 times before apparently shedding his collar along the Killey River after October 16. The female was located 15 times, the last location on November 21. Since then, this bear has not been located, despite several searches. This bear utilized an area of approximately 400 km sq. between Tustumena and Skilak Lakes.

The amount of aerial survey and helicopter time required to locate and capture bears was high. This was because: 1) initially, we tried to capture only sows or sows with cubs; 2) brown bear were uncommon in alpine area despite repeated searches in excellent habitat; and 3) thick vegetation particulary along streams greatly reduced bear visibility. This was supported by the fact that radiocollared bears were only seen on 4 of 22 aerial locations (18%). Furthermore, it appeared that some bears that were observed during surveys apparently went into cover after being disturbed by aircraft.

Success of capture operations scheduled for 1985 can be improved by concentrating effort along salmon streams before August, attempting to capture any adult bears encountered, and by searching salmon streams with relatively open habitats such as the middle Funny River. In addition, if brown bear are located in open habitats during other types of surveys or radio telemetry studies, attempts at capture should be made based upon a case by case basis.

C. Seasonal Habitat and Food Preference

Habitat selection of grizzly bears in the northwestern United States and Canada is well documented (Craighead et.al. 1982, Mealey 1975, Martinka 1972, Pearson 1975, Herrero et.al. 1983), however little information is available for Alaskan brown bears. Ongoing radiotelemetry studies in Denali National Park, Admiralty Island and Kodiak Island are addressing this subject. From literature search

and field observations, we can hypothesize about habitat selection of Kenai Peninsula brown bears. A complete understanding of this can only be obtained through a more intensive field study.

The temporal availabilty and distribution of preferred food items dictates bear movements throughout the active season (Pearson 1975, Amstrup and Beechum 1976). Although browns/grizzlies may consume a wide variety of food items, the bulk of their diet is composed of a few high energy food sources, which vary in energy value and availabilty between seasons (Craighead et.al. 1982). Bears selectively use habitats containing usable quantities of those foods. Following is a brief description of potential food sources available to brown bears on the Kenai Peninsula, documentation of their importance in other areas and evidence of use on the Kenai.

1. Ungulates

Ungulates, especially moose (Alces alces), are highly preferred food item of some brown bears in Alaska (Spraker et.al. 1981, Murie 1944). Chatelin (1955) believed that Kenai bears are carnivorous as much as possible and that "they will lose no opportunities to eat meat whenever they can, although they were not designed to capture live animals readily." Moose are consumed at all seasons, but are most available in early spring (April, early May), when dead and weakened animals can be found on their winter range; during calving season (late May - early July), when young calves are preyed upon; and during hunting season (September), when visceral remains are available. KNWR biologists reported finding 3 adult moose (including 2 radiocollared animals) killed by brown bears this year. Franzmann et.al. (1980) found that brown bears killed 6% of radiocollared moose calves on their study area in the north western Kenai.

2. Salmon

Salmon (Oncorhynchus sp.) is a preferred food source which is high in energy and easily obtained during late summer and fall (Clark 1957, Stonorov and Stokes 1970, Russell 1974, Glenn and Miller 1977, Egbert 1978). Salmon streams are a particularly critical habitat at this time, as bears congregate at these relatively small areas. Bears will also search lakeshores and stream banks in the spring, for carcasses buried by wave action the previous fall. Our field observations confirm that salmon is an important food source for Kenai Peninsula brown bears (see Section 3).

3. Green Vegetation

Grasses, sedges and horsetail (Equisetum sp.) are major foods of brown/grizzly bears in late spring and early summer (Mundy and Flook 1973, Russell 1974, Lloyd and Fleck 1978, Singer 1978, Craighead et.al. 1982). Many researchers reported that bears shifted to more preferred food items in mid-summer (Clark 1957,

Russell 1974, Egbert 1978), while others found that green vegetation was an important supplementary food surce throughout the summer (Mundy and Flook 1973, Pearson 1975, Valkenburg 1976, Herrero et.al. 1983). Scats containing these food items indicated that they are probably important to Kenai brown bears (see Appendix 3,4). These plants are widespread on the Kenai, are most abundant in lowland wet meadows, river bottoms and bases of avalanche chutes in the spring and become available in subalpine and alpine meadows in early summer.

4. Berries

Berries are important late summer and fall food surces to brown/grizzly bears throughout the bear's range (Clark 1957, Mundy and Flook 1973, Pearson 1975, Glenn and Miller 1977, Egbert 1978, Craighead et.al. 1982, Herrero et.al. 1983). Berries become available on the Kenai Peninsula in mid-July and, along with salmon, probably form the bulk of the bears diet during summer and fall. Most berries desicate by mid-October, but a few species [crowberry (Empetrum nigrum), lowbush cranberry (Vaccinium vitis-idaea)] are persistent. They are probably utilized until bears den and may be important food sources in the spring. Berries used most heavily by brown bears should include lowbush cranberry, highbush cranberry (Viburnum edule), crowberry, blueberry (Vaccinium sp.), devils'club (Oplopanax horridus) and salmonberry (Rubus spectabilis. Samples of each were found in late summer/fall scats (Appendix 4). Highbush cranberries are especially abundant along creek bottoms and along edges between timber and meadows. Blueberries and crowberries are most widespread and productive in lower alpine habitat, but good crops are produced in certain open-timbered areas. Lowbush cranberry is most productive in certain open-timbered areas. Devils'club is a common understory component of timbered stands along creek bottoms and on other moist sites. Salmonberries do well in open areas near timberline.

5. Other Foods

In other parts of Alaska and Canada, roots and corms are nutritious food sources highly sought after by brown bears throughout the active season (Pearson 1975, Reynolds 1980, Stelmock 1981, Herrero et.al. 1983). These are mainly found along river floodplains and in alpine meadows. Although we searched these areas, we found very little evidence of digging for this food source (Appendix 3,4).

Rodents are preferred foods which are taken opportunistically. Occasionally, bears will dig for rodents, but the amount of effort exerted to procure them is seemingly too great to make them an economical food source (Murie 1944, Pearson 1975). We found only 2 excavations for rodents during extensive searches in alpine meadows and other habitats (Appendix 3).

Bears also forage for insects, especially larvae (Clark 1957, Husby et.al. 1977, Stelmock 1981, Craighead et.al. 1982). They commonly tear apart logs and dig up nests in search of this delicacy, but gain little energy value from it (Clark 1957, Husby et.al. 1977, Stelmock 1981, Craighead et.al. 1982). We commonly found evidence of bears searching for insects during our ground surveys.

Other food items reported in the literature are more area-specific or of minor importance. A list of potential food items on the Kenai is presented in Appendix 4.

D. Brown Bear Use of Salmon Spawning Areas

All five species of Pacific salmon utilize the watersheds of the Kenai Peninsula for spawning. Run timing, salmon abundance and species composition varies dramatically between drainages, resulting in differential use of spawning areas by brown bears in different portions of the Peninsula.

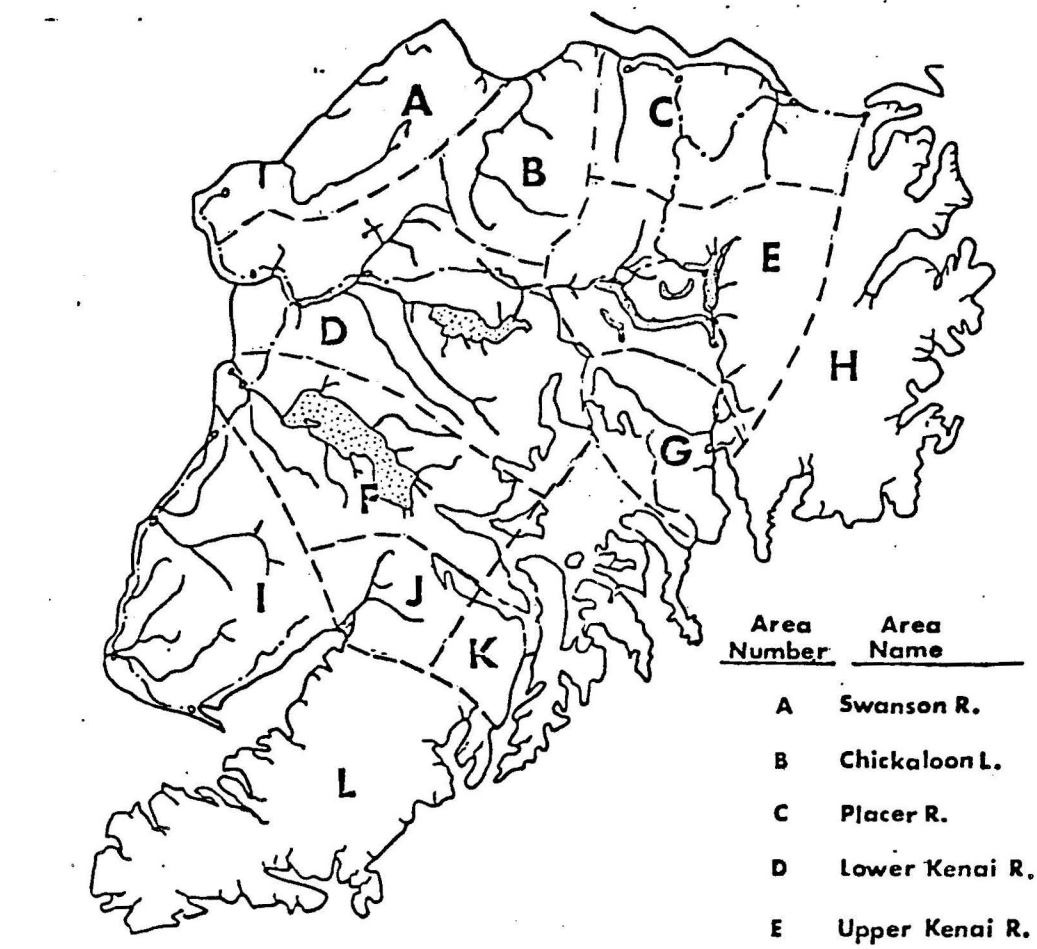
To simplify a discussion of brown bear use of salmon spawning sites, the Peninsula was divided into 12 areas, using geographic features separating watersheds as boundaries (Figure 5). Areas A, B, F, G and J include a major drainage (river) which flows directly into saltwater (Swanson, Chickaloon, Kasilof, Resurrection, and Fox Rivers, respectively). The Kenai River system was divided into 2 areas (D and E). Areas C, H, I, K and L contain several smaller systems draining into coastal waters. Brown bears are wide-ranging and may include the drainages of several areas within their home ranges. Information available on salmon spawning areas and brown bear use varied between areas.

1. Swanson River (Area A)

Area A includes the Swanson River system and several smaller drainages flowing into the Gompertz Channel and Chickaloon Bay of upper Cook Inlet. Salmon distribution is shown in Figure 6.

The Swanson River system includes over 50 miles of streams and lakes. An estimated 6000 silver salmon spawn throughout this system from late August through early October, with larger concentrations occurring above the Swanson River Road. Reds, which are present in July, number less than 3000 and also spawn throughout the system. A few pinks spawn in the lower few miles during August.

Bishop Creek, located 3 miles west of Swanson River, receives a run of between 5,000 and 10,000 reds. These are mainly lake spawners. An undetermined number of silvers and a few pinks also spawn in Bishop Creek. Run timings are similar to those of the Swanson River. Silvers also spawn in Otter Creek, Seven Egg Creek and Pincher Creek. These creeks are not surveyed, so numbers are unknown. No other creeks in this area are listed as spawning habitat for salmon in the anadromous fish catalog.



Area Number	Area Name
A	Swanson R.
B	Chickaloon L.
C	Placer R.
D	Lower Kenai R.
E	Upper Kenai R.
F	Tustumena L.
G	Resurrection R.
H	Nellie Juan
I	Anchor R.
J	Fox R.
K	Fjords
L	Seldovia

Figure 5 Geographic Breakdown of Kenai Peninsula.

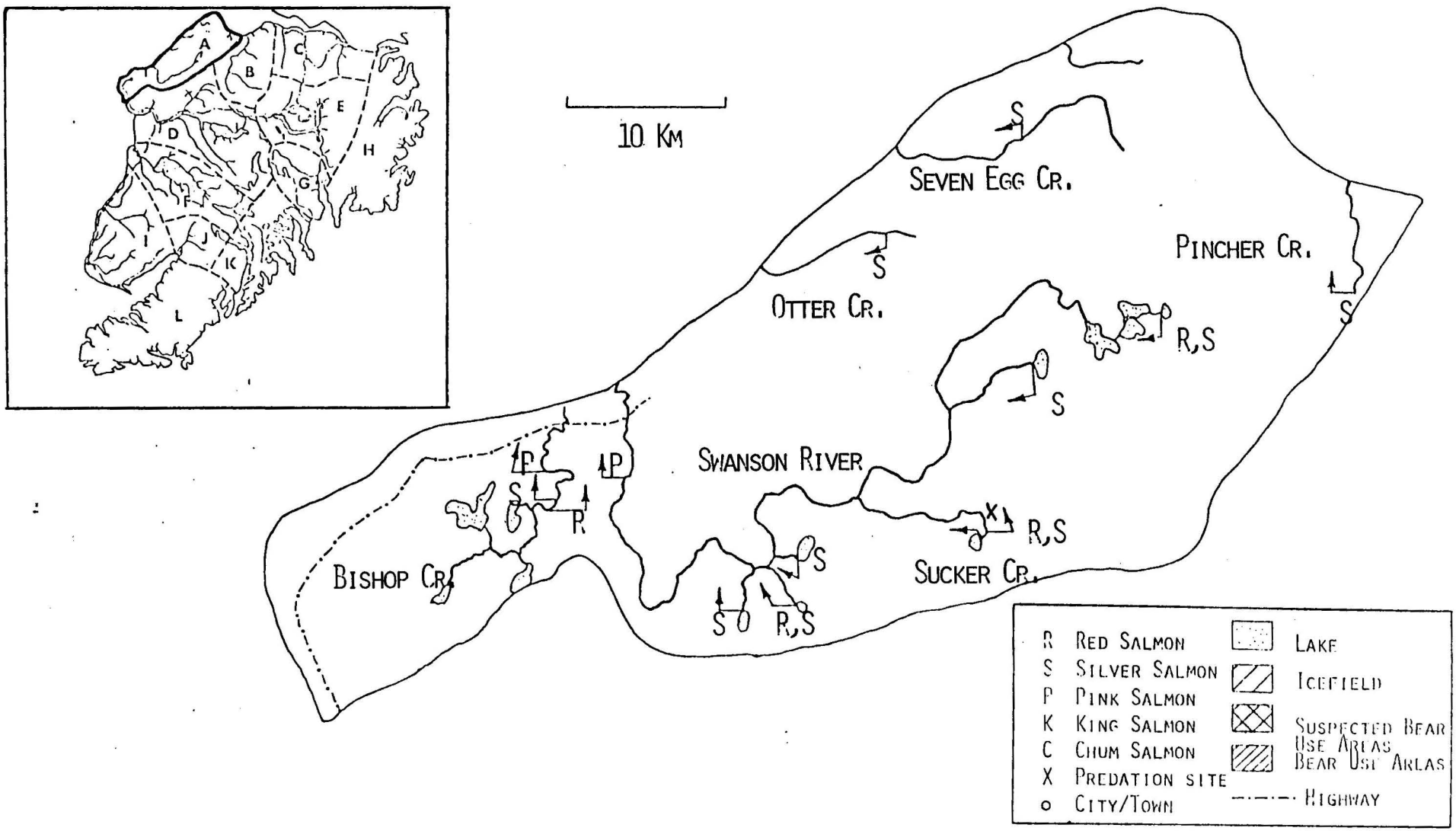


FIGURE 6 SALMON DISTRIBUTION IN AREA A (SWANSON RIVER).

We did not do any survey work within Area A and know of only one location where bears feed on salmon. This is a small portion of Sucker Creek (Figure 6), a tributary of the Swanson River, where ADF&G biologists have observed brown bear sign every year since 1977 (year survey began). The number of bears using Sucker Creek probably does not exceed 5 bears (Chuck Schwartz, Pers. Comm.). Salmon appear to be spread fairly thin within the Swanson River drainage, but additional brown bear use within this system probably does occur; especially in the unroaded upper portion. The other drainages within Area A are probably used to a limited extent also. We did not hear of any recent sightings in this area, but records show that at least 12 brown bears have been shot in Area A between 1961 and 1981. All but one of these bears were taken in the fall.

2. Chickaloon River (Area B)

The Chickaloon River watershed contains over 80 kilometers of spawning habitat for four species of salmon (Fig. 7). It's remoteness insures that it receives relatively little use by humans. Consequently, it may provide ideal summer habitat for brown bears. Little information was available concerning salmon use of the Chickaloon system prior to 1984. The USFWS initiated a salmon habitat survey this summer and fisheries biologist Jack Dean provided us with information on salmon distribution within the system. There are apparently three spawning populations of red salmon in the Chickaloon River system. Although spawning occurs throughout the drainages, concentrations are limited to a few areas. The best red salmon spawning habitat is on Mystery Creek. The upper and lower limits of the spawning grounds are not known, but there is a 13 kilometer stretch of excellent habitat. This area includes 3 kilometers below the pipeline road and 10 kilometers above the road. An estimated 6-7000 reds spawn here. Reds arrive on these spawning grounds on June 28 and peak activity occurs in early July. A second concentration of around 2000 fish occurs on a 13+ kilometer stretch of the Chickaloon River near the pipeline road. A population of unknown size spawns in the upper end of the Chickaloon and in Swan Lake.

Kings first appear in the Chickaloon in mid-June and there are four concentrations in this system. The largest concentration occurs along a 13 kilometer stretch of the Chickaloon River, which is bisected by the pipeline road. An estimated 2000 kings spawn there beginning in late June. Peak numbers occur in mid-July. Approximately 1000 kings spawn on a 13+ kilometer stretch of Mystery Creek. Timing is similar to that of the Chickaloon. An estimated 600 kings spawn between river miles 8 and 17 of the Chickaloon. Peak numbers occur in mid-July. A small population of kings spawn in the North Fork, between river mile 11 of the Chickaloon and the pipeline road.

Pink salmon move into the river in early August and are on their spawning grounds between river miles 9 and 19 of the Chickaloon

by mid-August. Numbers were estimated at over 50,000 this year. Pinks are typically an every other year spawner and numbers are expected to be low next year.

Silver salmon enter the Chickaloon River in mid-August. Numbers and distribution are unknown but they probably spawn throughout the system. Their spawning season lasts about 2 1/2 months.

Jack Dean reported heavy brown bear use on a 2.5 kilometer stretch of the Chickaloon River above the pipeline road. He observed a large bear and a pair of young bears, and heard a fourth bear on this stretch of the river on July 18. Predation on salmon was heavy. He noted that predation was less intense along a 1.6 kilometer stretch of Mystery Creek above the pipeline. Here, he observed three different sets of bear tracks of unknown species on July 17. He also observed tracks of a sow and 2 cub brown bears on Mystery Creek below the pipeline road on September 11. Jack's fisheries crew observed brown bears between river miles 8 and 24 of the Chickaloon on five different occasions during July and August.

During our three-day survey of the Chickaloon, in late August, we observed heavy brown bear activity along the river between river miles 7 and 19. Most of the predation on this section was on pink salmon.

The anadromous fish catalog shows pinks and silvers spawning in a short stretch of Little Indian Creek and pinks, kings and silvers spawning in Big Indian Creek. These creeks climb in elevation quickly above the intertidal zone. We are not familiar with salmon numbers or bear use for these two creeks.

3. Placer River (Area C)

Area C includes the watersheds flowing into Turnagain Arm between and including Resurrection Creek and Portage Creek (Fig. 8). We did not survey these drainages for bear activity this year.

Kings enter Resurrection Creek in June and spawn in the river and it's tributaries as far as Fox Creek, approximately 22 kilometers up the drainage. Escapement is estimated at around 500 salmon, most of which spawn in the upper end of the river. A run of from 20,000 to 50,000 pinks spawn in the first 8 kilometers of the river during late July and early August on even years. Approximately 200 to 300 silvers enter in August and have a distribution similar to kings.

Human activities in the lower section of the river (homesites, roads, mining claims, recreation) restrict bear use of the large concentrations of salmon which occur there. However, occasional brown bear sightings are made. The upper portion of the king and silver spawning areas receive considerably less human use. Salmon are spread throughout several miles of habitat and brown bear use of this stretch is probably light.

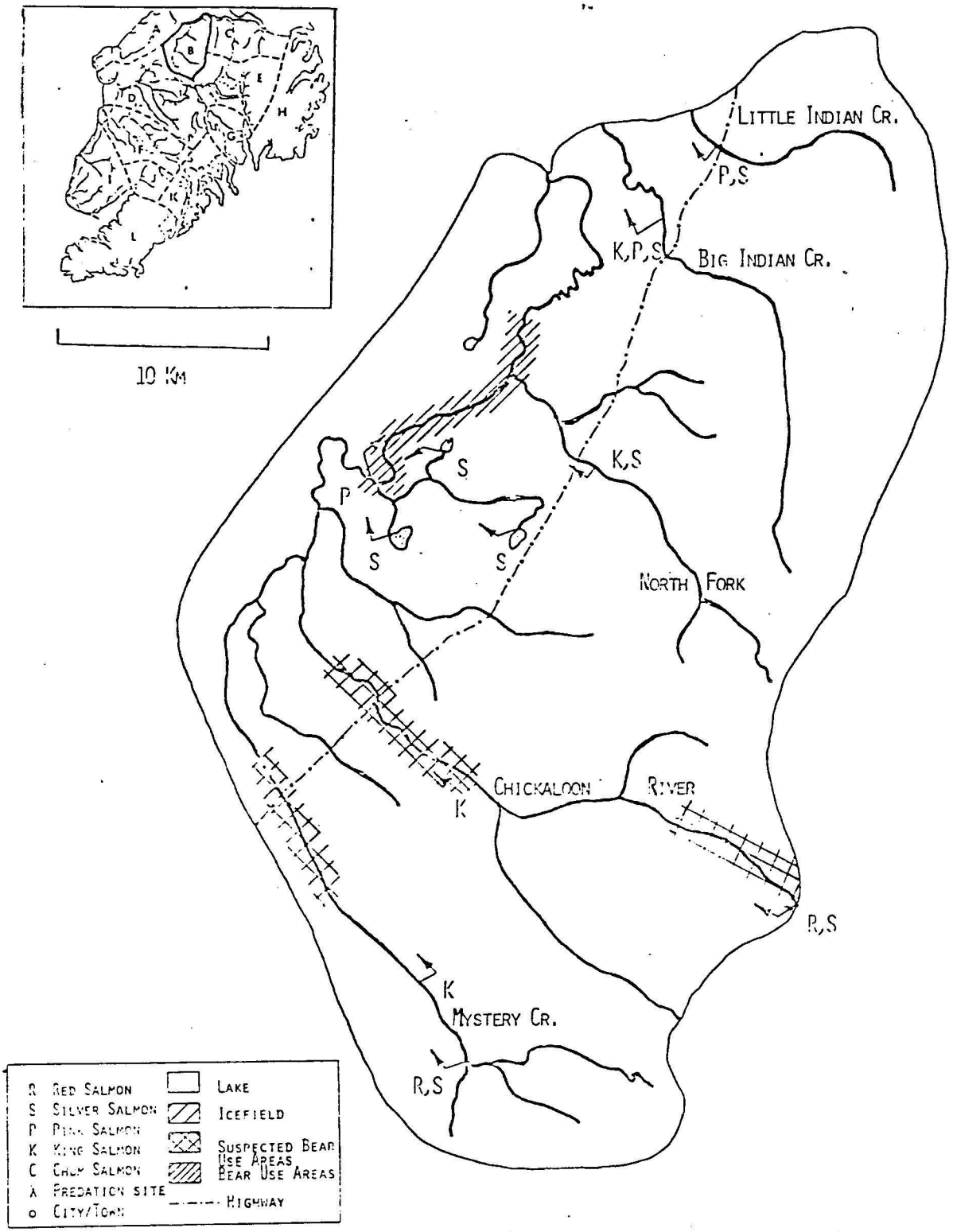


FIGURE 7 SALMON DISTRIBUTION AND BROWN BEAR USE OF SPAWNING AREAS IN AREA B.

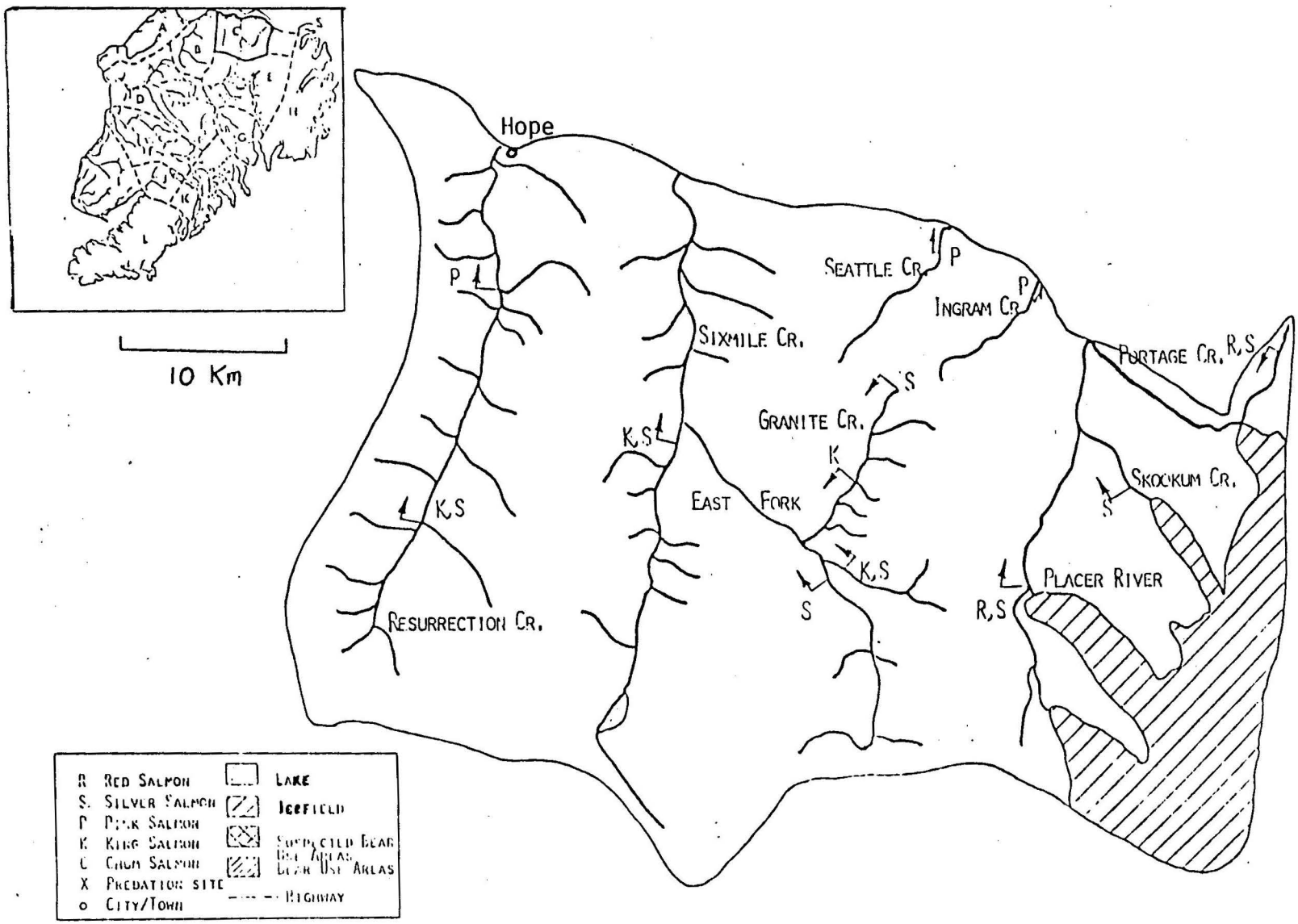


Figure 3 Salmon distribution in Area C (Placer River).

The Sixmile Creek watershed receives a June run of kings which move as far up as Granite Creek to spawn. The majority of spawning occurs in the East Fork. The silver run extends to Turnagain Pass, with most spawning occurring in Granite Creek. Silvers enter the system in early August and peak numbers occur in mid-September. Chums and pinks spawn in the first few miles of Sixmile Creek in August.

Some bear predation probably occurs throughout the Sixmile watershed, but relatively low salmon numbers and high human activity limit bear use. The Seward Highway and Hope road closely parallel the spawning area. Forest Service fishery technicians reported seeing brown bear feeding activity while conducting escapement counts of king salmon along the East Fork this year.

Seattle Creek and Ingram Creek receive small pink runs in August. These fish are restricted to within a short distance of the outlet and bear predation is probably minimal.

The Placer River receives a small run of red salmon which spawn in mid-July and August. The main stem of the river is heavily glaciated and the fish spawn in clearwater tributaries throughout the valley. Silvers enter the system in August and are present through the first of November. Silver escapement is estimated at 500. This species spawns in the main river channels, which become clear in October. Although salmon numbers are relatively small in this drainage, brown bear use is believed high. The large valley contains no roads, limiting human access. The Alaska Railroad passes through this valley and railroad employees have made numerous brown bear sightings.

Portage Creek is utilized by an estimated 2500 reds and 500 silvers, as well as by pinks and chums. Run timings are similar to the other creeks. Most of the spawning occurs in clearwater tributaries. Bear Valley, above Portage Lake, receives much spawning activity. The Portage area is highly visited by people during the summer months, and brown bear activity on the stream is probably limited until September. At least one brown bear is known to feed on silvers near the Forest Service Work Center late in the year. Bear Valley is more remote and probably receives more bear use.

4. Lower Kenai River (Area D)

Area D encompasses the tributary rivers and streams of the Kenai River below, and including the Russian River. This area includes several locations of concentrated brown bear use (Figure 9).

Two distinct runs of red salmon enter the Russian River beginning in mid-June and mid-July, respectively. The yearly escapement count exceeds 60,000 fish. Spawning areas include four small tributary creeks of Upper Russian Lake and the upper

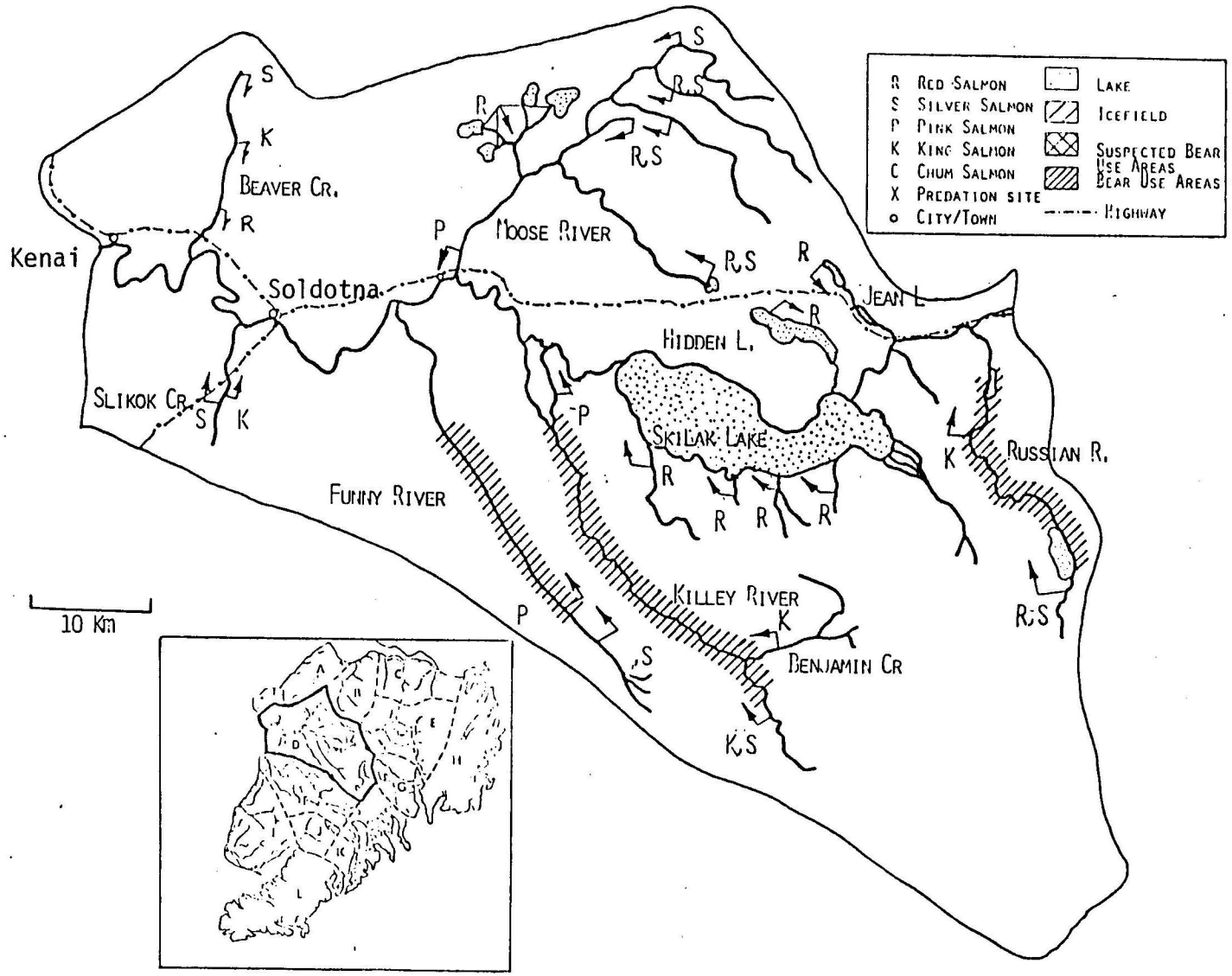


Figure 9 Salmon distribution and brown bear use of salmon spawning areas in Area D (Lower Kenai River).

4 kilometers of the river. Spawning begins in one tributary creek in late July, while the other creeks are used in September. Salmon are vulnerable to bears throughout the river, but heavy human use below Lower Russian Lake limits bear predation there. Heavy brown bear activity occurs along the tributary creeks and along portions of the river above Lower Russian Lake; numerous brown bear sightings have been made throughout this drainage. Reds are present at the tributary creeks through October. A run of about 2500 silvers enter the system from August to October and spawn through November. Spawning probably occurs in the outlet of Upper Russian Lake and in the lake's tributaries. A small number of kings spawn in the lower portion of this river.

Red salmon escapements at Hidden Lake were 10,600 and 27,000 for 1983 and 1984, respectively. Reds enter from mid-July to mid-August. A small number of silvers also spawn in Hidden Creek in September. USFWS fisheries biologists observed sign of brown bear feeding activity here. We expect that predation is not as heavy as in more remote areas.

Peak red escapement counts in Jean Creek have varied tremendously, from 129 to 27,000, in the past several years. The 1983 escapement was 3,000, with most fish entering the creek prior to July 1. Reports indicate that reds are present until early October. This creek is paralleled by the Sterling Highway and most of the reds spawn in Jean Lake, so brown bear predation is probably minimal.

Small numbers of red salmon spawn in tributary creeks on the south side of Skilak Lake in August. Spawning areas are restricted to within short distances of the mouths of these creeks. Escapement in Pipe Creek has been as high as 500 fish, which is a concentration significant enough to attract bears. Brown bear use of these tributaries is unknown, but suspected.

King salmon enter the Killey River in mid-July. Escapement is estimated at 8000; an estimated 600 fish spawn in a half mile stretch of Benjamin Creek, while the rest of the population spawn in the upper stretch of the river. Silvers spawn in the drainage from August to November. Aerial surveys conducted by KNWR biologists have revealed that brown bears feed on salmon in this drainage throughout the spawning season. At least eight individually recognized brown bears used the upper 16-19 km of spawning habitat this season. The lower 1 km of Benjamin Creek also receives heavy use.

The Moose River is a large, branched system containing several small lakes. Little is known about salmon numbers and distribution. A small number of kings enter in mid-July and spawn in the lower portion of the river. Red numbers were suspected to be low, but USFWS fisheries biologists counted over 500 fish in one small lake surveyed this summer; KNWR proposes to study the system further next year. Silvers spawn throughout the system. We suspect that brown bear predation occurs on this river, but intensity of use is dependent on salmon availability.

The Funny River receives a small runs of kings and pinks in mid-July and August, respectively. An unknown number of silvers also spawn in this river beginning in mid-August. ADF&G fisheries biologist Loren Flagg observed 3 brown bears on the banks of the Funny in July, 1983. During an aerial survey on July 20 this year, USFWS biologist Ed Bangs observed a sow with two offspring, a sow and yearling, and three other individual brown bears, all within a 19 km stretch of the river above Horsetrail Lake. Other flights revealed that brown bears use this river through late September.

Portions of the lower Kenai River are known to be used by brown bears. Chuck Schwartz (pers. comm) has observed late fall and early spring use near the mouth of the Killey River. He has also observed brown bear tracks in a few locations along the lower portion of the river, below Slikok Creek. Brown bears and their sign have been observed periodically along a three mile stretch of the river below Skilak Lake by local residents and USFWS biologists. The bears feed on silvers during the late fall and early spring (Ted Bailey pers. comm.).

5. Upper Kenai River (Area E)

Area E includes all of the Kenai River watershed east of (above) the Russian River (Figure 10).

Juneau Creek receives a run of 60-90 kings and a few reds in late July to mid-August. Although salmon were vulnerable on this stream, we found that no bear predation had occurred previous to our July 31 survey.

From 4000 to 6000 reds spawn in Moose Creek during August. This creek is paralleled by the Seward Highway and we counted a small number of bear-killed carcasses during our survey. Most of the activity occurred where the stream was separated from the highway by a wide strip of heavy cover. Although most of the activity appeared to be that of black bears, we did find some brown bear sign.

Trail Creek receives a strong run of red salmon during late July and August. Reds spawn in the clearwater tributaries of this heavily glaciated creek. During mid-August, we counted over 3500 red salmon in four tributaries, including Railroad and Johnson Creeks, most of which had been fed on by bears. Tracks and hair indicated that brown bears were utilizing all of these tributaries. Silvers enter Trail Creek in late August and September. At this time, glacier melt slows down and this species spawns in the main creek, as well as its tributaries. Silver distribution and numbers are not known. Moose Pass resident, Ken Condit, reported seeing 4 different browns using a tributary creek near Hunter several years ago. Alaska Railroad employee, John Gaule, has observed brown bears within the drainage on several occasions and identified 7 individual bears in 1983.

Grant Creek receives a run from 30 to 50 kings in August and early September. A small number of silvers also spawn in the creek during September and October.Although we did not survey this creek, we expect that some bear predation does occur there.

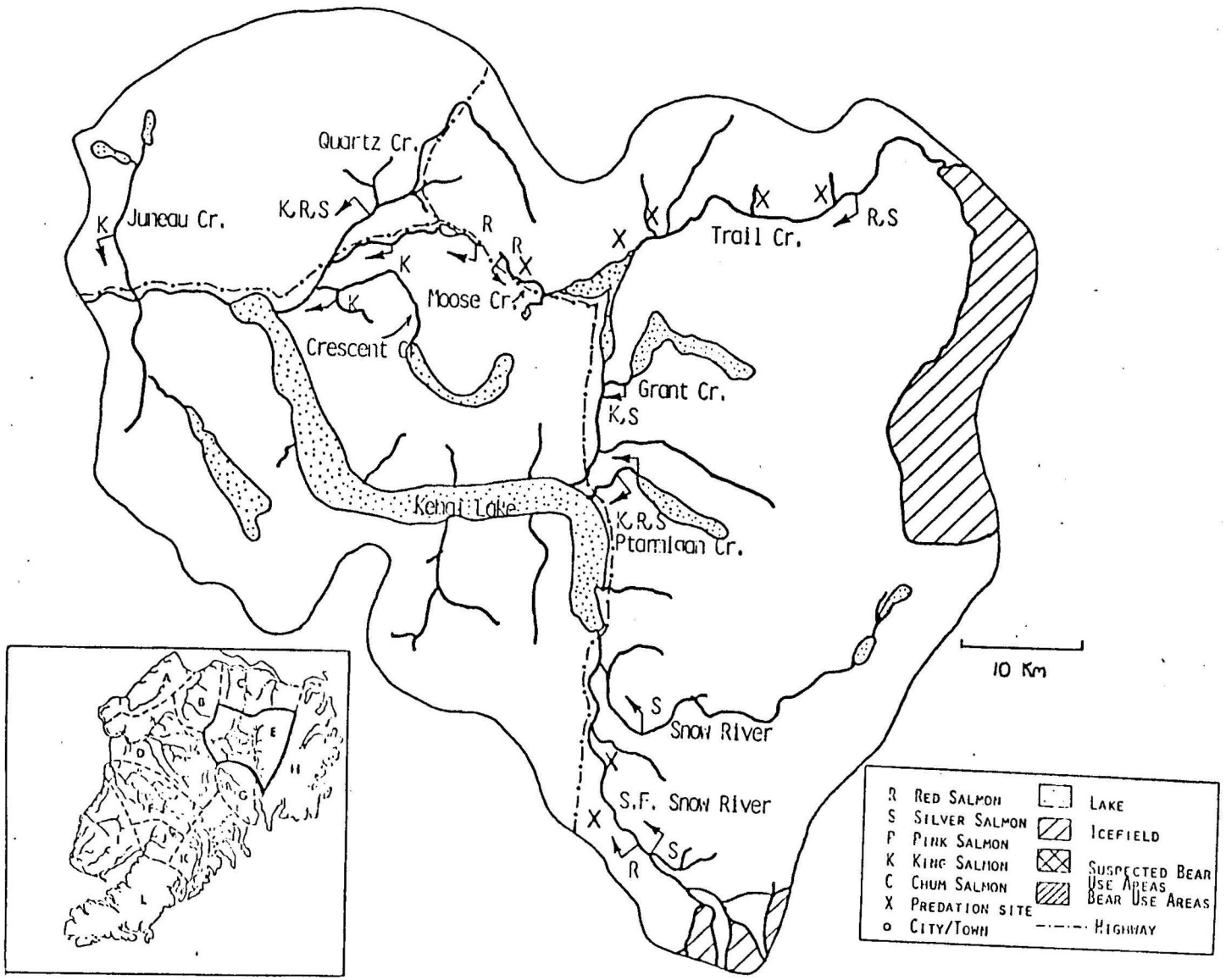


Figure 10 Salmon distribution and brown bear use of salmon spawning areas in Area E (Upper Kenai River).

Ptarmigan Creek has a strong run of reds which enters from mid-August to early September. Escapement numbers have varied tremendously from year to year over the past few decades, but have risen sharply in the last few years. Forest Service fisheries technicians estimated peak escapement to be around 18,000 in late August, while we estimated over 50,000 reds in the creek in mid-September. About 50 kings also spawn in the creek. We found very little bear use of this creek, near the upper end of the spawning habitat. We observed only black bear sign, but a Forest Service employee reported seeing a brown bear on the creek in early September.

The South Fork of Snow River receives small runs of reds and silvers in late August and late September, respectively. Although salmon numbers are small, we found that heavy predation occurred on the tributary creeks where each species concentrated. Brown bear tracks were numerous throughout the river bottom and at least four different brown bears were utilizing the drainage.

6. Tustumena Lake (Area F)

Area F encompasses the Tustumena Lake-Kasilof River watershed (Figure 11). Tustumena Lake has 11 tributary creeks which are utilized by spawning salmon; nine are used by red salmon and at least six receive silver runs. A small number of pinks and chums also use these tributaries.

Crooked Creek, which enters the river 2 km downstream of the Sterling Highway, is presently regulated by ADF&G for king salmon production. Crooked Creek king escapements for the past few years have averaged just over 3000 fish. This species enters Crooked Creek from early June to early August, with peak numbers occurring in late July. Approximately 200 silvers spawn in Crooked Creek during the first two weeks of September. We do not know salmon distribution or bear use of this creek.

An early run of reds begin entering Tustamena Lake tributaries, Nikolai Creek and Clear Creek in late May, but the majority of this species enter their spawning grounds beginning in mid-July. Escapement into Tustumena Lake has averaged 200,000 reds for the past few years. The average red escapements for each of seven creeks over the past two years were: Bear Creek - 58,000, Moose Creek - 17,000, Nikolai Creek - 12,500, Glacier Creek - 55,000, Seepage Creek - 4,600, Crystal Creek - 900, Clear Creek - 1,700. Silvers begin reaching their spawning grounds in August and are present through the end of October.

We found evidence of brown bear use on five of the seven tributaries which we surveyed in early August. Of these, a 4 km stretch of Moose Creek showed the most intense predation by brown bears. Reds were plentiful and easily obtained in the shallow water and carcasses littered the banks. ADF&G fisheries technicians were chased by a brown bear sow accompanied by her

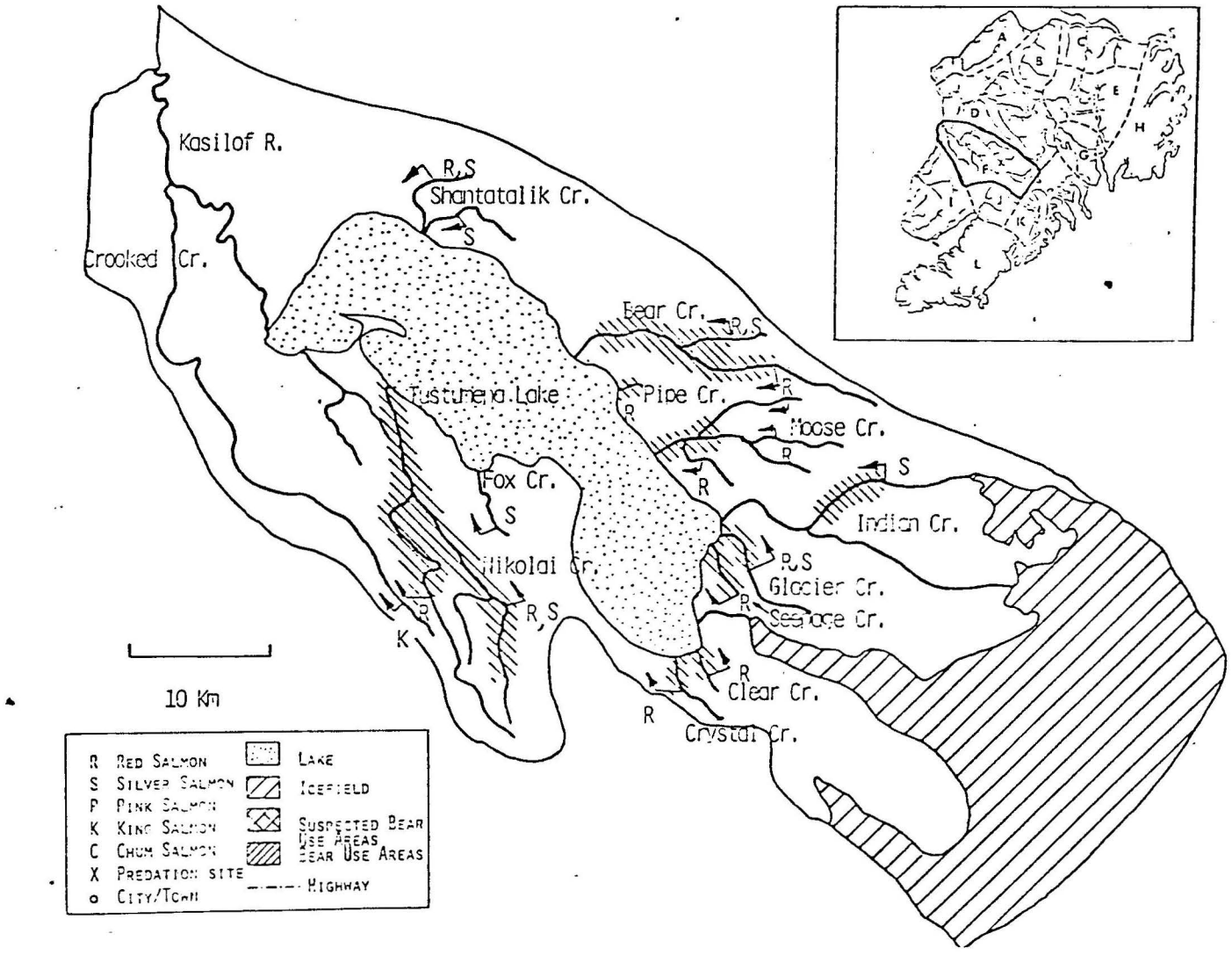


Figure 11 Salmon distribution and brown bear use areas in Area F.

cub, while surveying Moose Creek in late August. We noted heavy bear activity on Glacier, Crystal, and Seepage Creeks, and on a 3.2 km portion of Bear Creek. Salmon were abundant on the 4 km stretch of Nikolai Creek that we surveyed, but there was very little sign of bear predation there. Clear Creek contained very few salmon and, consequently recieved little use. We did not survey Pipe Creek, but ADF&G fisheries personnel counted just under 1,000 carcasses showing evidence of bear predation, during their late August survey. Most of this predation occurred within a 1 km stretch of this tributary.

Red salmon spawn throughout a 32 km stretch of Nikolai Creek and over 24 km on Bear Creek, and brown bears use occurs along the upper portions of both these streams. Joe Blackwell, who resides near the mouth of Bear Creek, and George Pollard, a guide living in Kasilof, have both observed brown bears in the upper stretches of Bear Creek. Blackwell has observed several brown bear beds above the creekbottom, 5-6 km from the creek's mouth. KNWR biologists have observed brown bears on Bear Creek and Nikolai Creek while conducting aerial surveys during July and August.

The ADF&G fisheries division does not conduct surveys of silver salmon in this area, but they know that there are strong silver runs in Nikolai and Indian Creeks, and suspect that good runs also occur in Bear Creek and Glacier Creek. George Pollard has observed brown bear activity along Indian Creek and Bear Creek during mid-October.

7. Resurrection River (Area G)

Area G encompasses the Resurrection River and its tributaries, including Salmon Creek, which parallels the Seward Highway and enters the river approximately one mile north of Resurrection Bay (Figure 12). A few small streams enter the bay immediately east of the river and along the west side of the bay.

In the past, very little has been done to identify spawning habitat in the Resurrection River above Salmon Creek. The Alaska anadromous fish catalog indicates that kings, pinks, and silvers spawn there, but only silvers are believed to utilize the system in great numbers. ADF&G biologist Ted McHenry (pers. comm.) predicts that about 34,000 silvers spawn above Salmon Creek from late September to November. During a survey which we conducted above Boulder Creek in mid-October, we found between 300 and 400 fish in the river and three of its tributary creeks. Brown bears were feeding on the salmon in these areas, but predation was not extensive.

The Salmon Creek drainage is utilized by red, silvers, and pinks. Areas utilized by bears include three tributary creeks of Bear Lake and the portion of Grouse Creek above Grouse Lake. Approximately 500 and 150 reds use these spawning areas, respectively, from the end of July through August. Pinks are

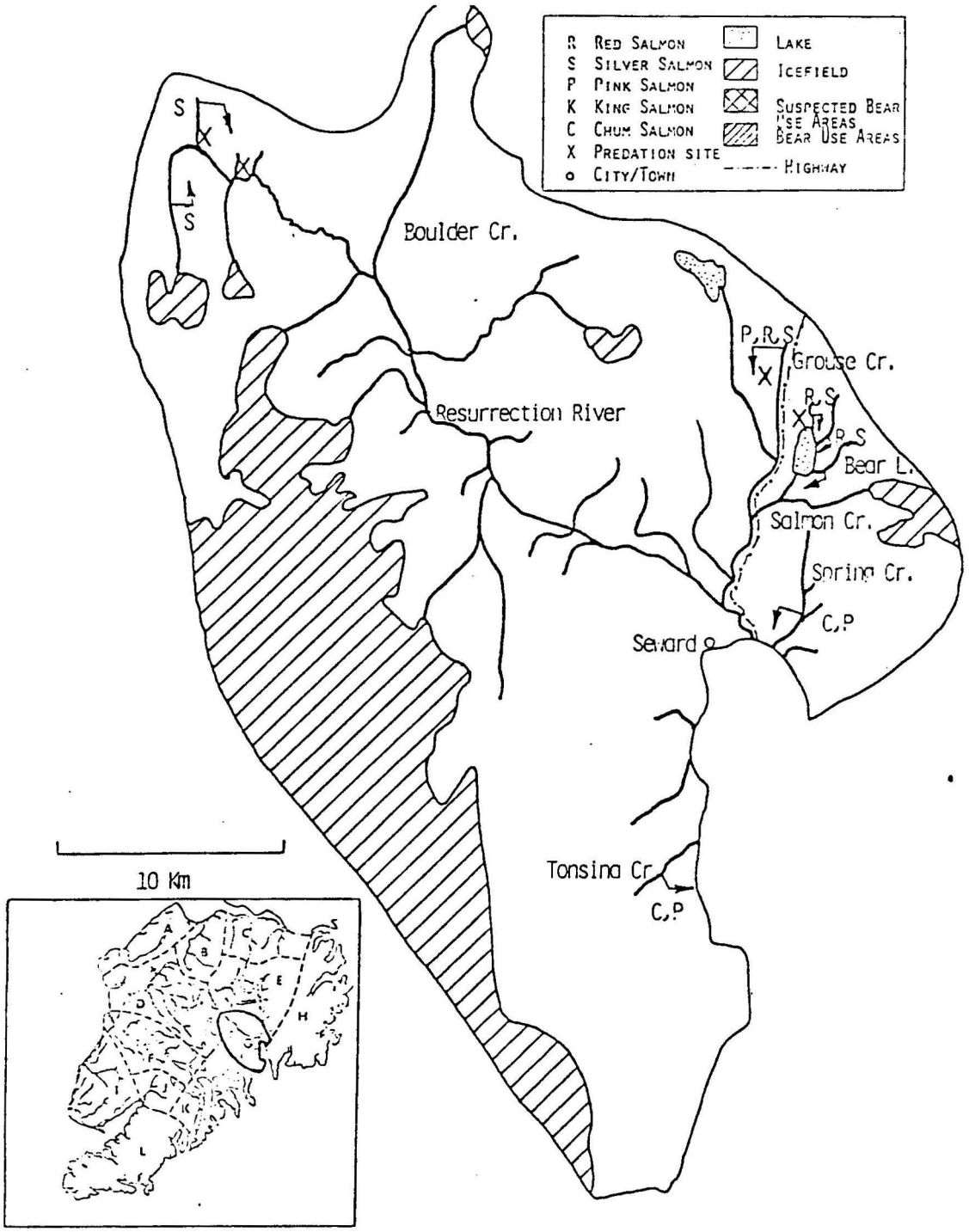


Figure 12 Salmon distribution and brown bear use of salmon spawning areas in Area G (Resurrection River).

present in Grouse Creek in large numbers in even years. Silvers, averaging 3500 in Bear Lake and 500 in Grouse Creek, become available to bears in late October and November. Individual brown bears have been observed feeding on salmon at these locations a few times in the past two years. We observed brown bear tracks and freshly killed carcasses in one tributary creek of Bear Lake in late October. The salmon are also picked up along the lakeshore as they die.

Two small creeks flowing directly into Resurrection Bay in area G receive salmon runs. Pinks and chums enter Spring Creek and Tonsina Creek from mid-July to the end of August. Peak escapement counts for Spring Creek include 300 pinks and 500 chums, while Tonsina Creek receives a run of about 4000 of each species. Brown bear use of these two creeks is probably minimal, although verification is needed.

8. Nellie Juan (Area H)

Salmon spawning sites are abundant throughout the coastal fjords and islands of area H (Fig. 13). These are remote sites for the most part, separated from the rest of the Peninsula by large icefields and glaciers. We have no information on brown bear use, but it is probably minimal. Interior peninsula brown bears could access a portion of the coast via the Nellie Juan drainage and Kings Bay.

9. Anchor River (Area I)

King salmon enter the Ninilchik River, Deep Creek, Stariski Creek and Anchor River systems from early May until early July and reach their spawning grounds by mid-July. Aerial counts conducted by ADF&G fisheries biologists on the Anchor River and Deep Creek indicate that an average of 2300 and 1000 kings spawn in these two systems respectively. The 1983 count on Deep Creek was estimated at 3200 fish. The salmon migrate over 50 km up both systems and are spread out fairly evenly throughout both drainages (see Fig. 14). The other systems are not surveyed, but similar numbers and distributions are predicted.

Silvers enter these same systems in August and September and are on their spawning grounds from early September through November. Numbers are unknown and distribution is similar to that of kings.

These systems offer several miles of narrow, shallow spawning habitat, where bears can easily capture salmon. Human activity near the lower portions limits bear use. We noted heavy brown bear use of the upper half of the Anchor River during our survey in August. ADF&G biologist Dave Holderman believes that the other systems are equally important. Bear use of salmon on these spawning creeks extends from mid-July through November.

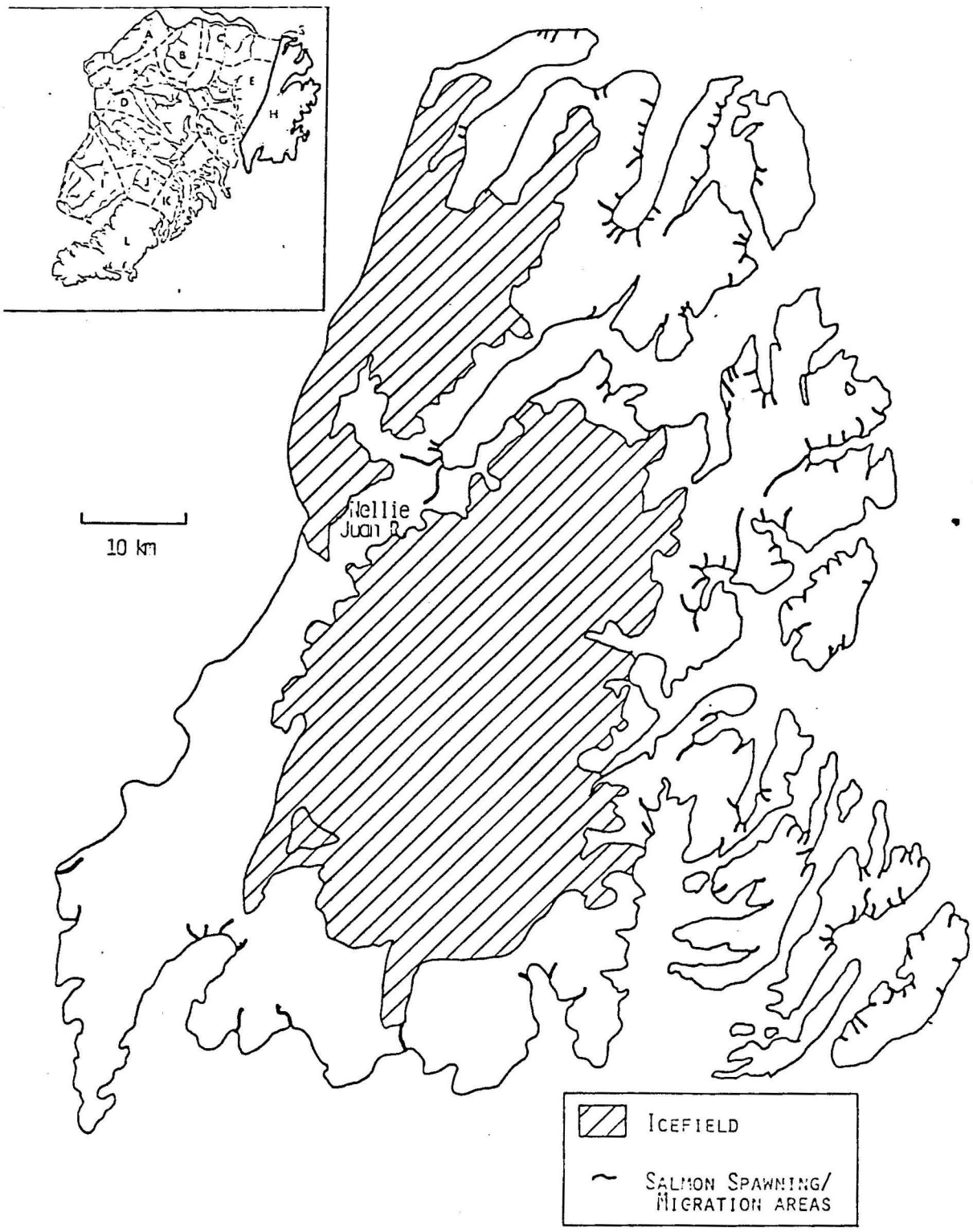


Figure 13 Distribution of spawning salmon in Area H (Nellie Juan).

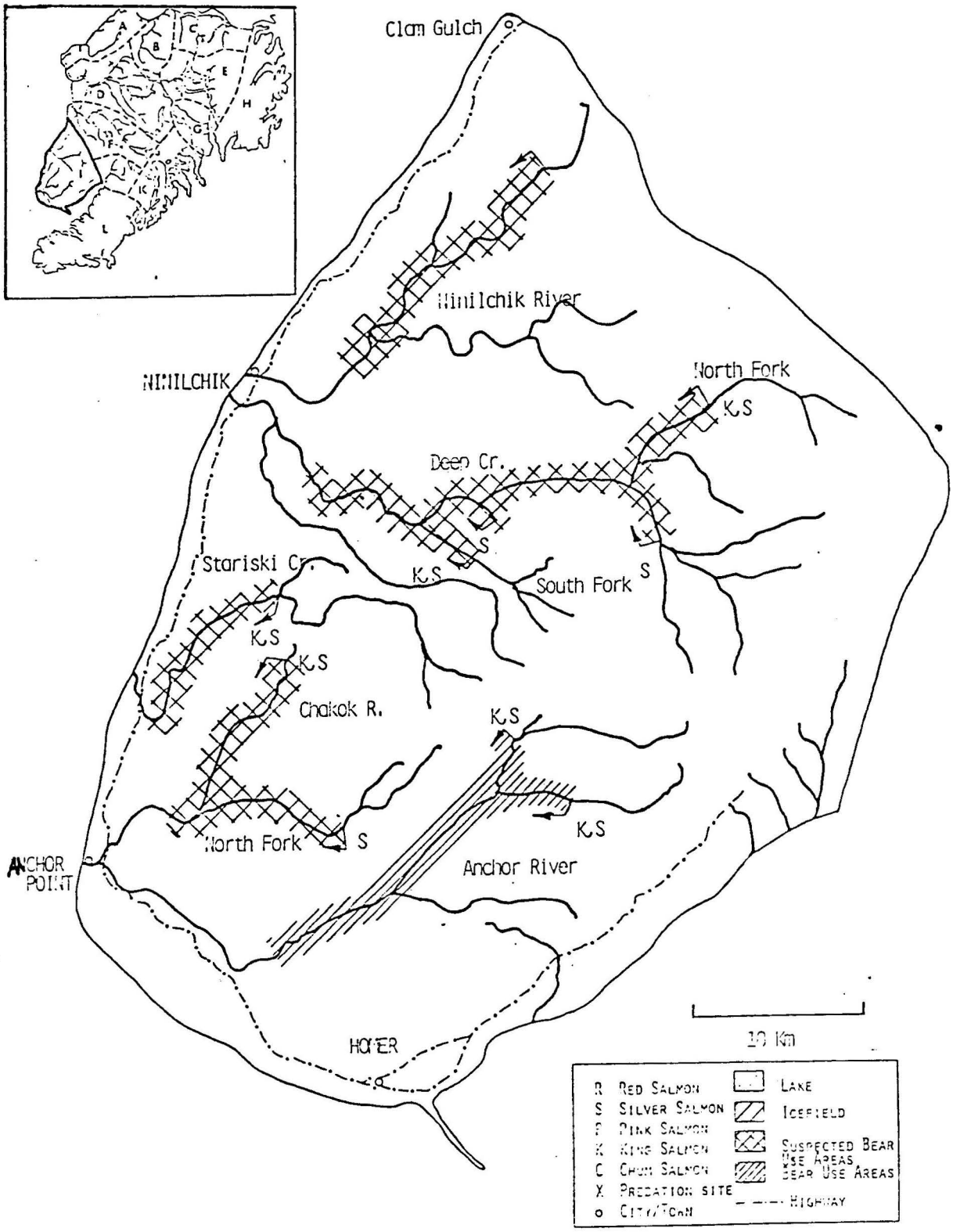


Figure 14 Salmon distribution and brown bear use of salmon spawning areas in Area I (Anchor River).

10. Fox River (Area J)

Area J includes the Fox River, Sheep Creek and their tributaries (Fig. 15). Up to 900 red salmon enter the Fox River in late June. The majority of these fish migrate to the mouth of Clearwater Slough, where they hold over before moving to clearwater tributaries further upriver to spawn. A few groups of reds spawn in Clearwater Slough about a mile above it's mouth, and in the clearwater tributaries of Sheep Creek. Spawning begins in mid July. From 700-1300 silvers reach Clearwater Slough in late July and most of these also move into other clearwater tributaries to spawn. A few silvers also spawn in Clearwater Slough and in tributaries of Sheep Creek. Silvers are present through October.

Extensive human use of parts of the Fox River may limit brown bear activity in that area. There are three settlements and several homesteads in the lower portion of the river. Subsistance fishermen access fishing sites as far as Clearwater Slough by ATV's and airboats. There is less human activity in the upper portion of the river and in Sheep Creek. ADF&G fisheries biologist Tom Schrader has not seen brown bears during his aerial survey for salmon on the Fox River for the past 7 years; previous to that, he would commonly see a few brown bears. However, wildife consultant, Patsy Martin, reported seeing 5 brown bears on the river between Sheep Creek and Clearwater Slough during one day in October, 1984.

11. Fjords (Area K)

Figure 16 shows the locations of salmon spawning areas within Area K reported in the Alaskan anadromous fish catalog. These areas are remote and separated from the peninsula's interior by large icefields and steep rocky shorelines. Brown bear activity on these streams is believed minimal.

12. Seldovia (Area L)

Area L includes the remote lower finger of the Peninsula lying south of Kachemak Bay (Fig. 17). We have little information on brown bear use of this area. The few sightings and sign observed by ADF&G biologist are shown on the accompanying map.

13. Summary of Brown Bear Use of Spawning Areas

A summary of salmon availability and bear use for 23 spawning areas surveyed from July to October is presented in Table 2. Ratings are based on our subjective interpretations of the amount of sign observed in each area. The 'bear use' rating does not distinguish between black and brown bear because sign was often found from both and it was impossible to determine how much sign was made by each species. In areas such as Benjamin Creek and Chickaloon River, brown bear sign was so abundant that we had little doubt that these were important areas to this

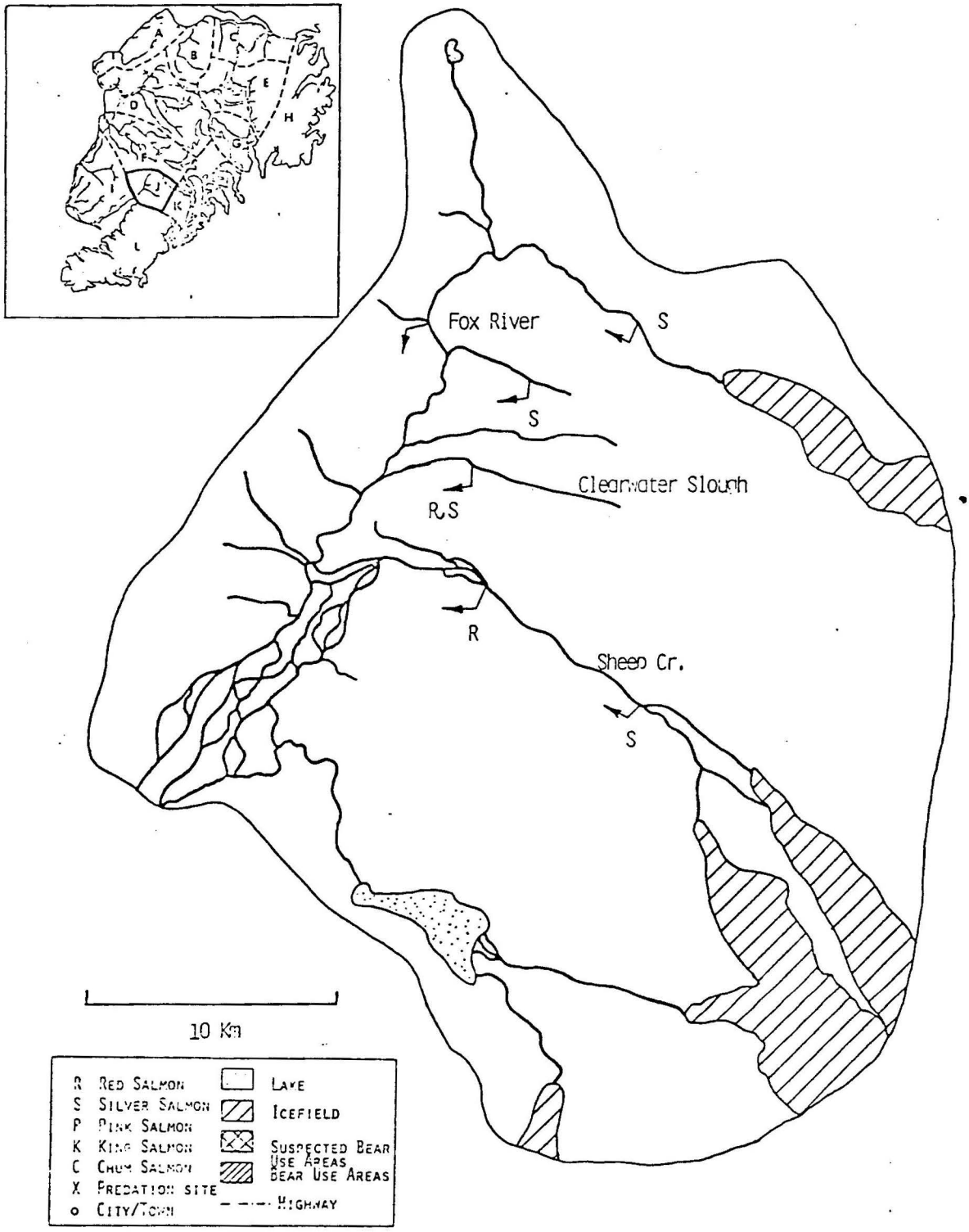


Figure 15 Salmon distribution in Area J (Fox River).

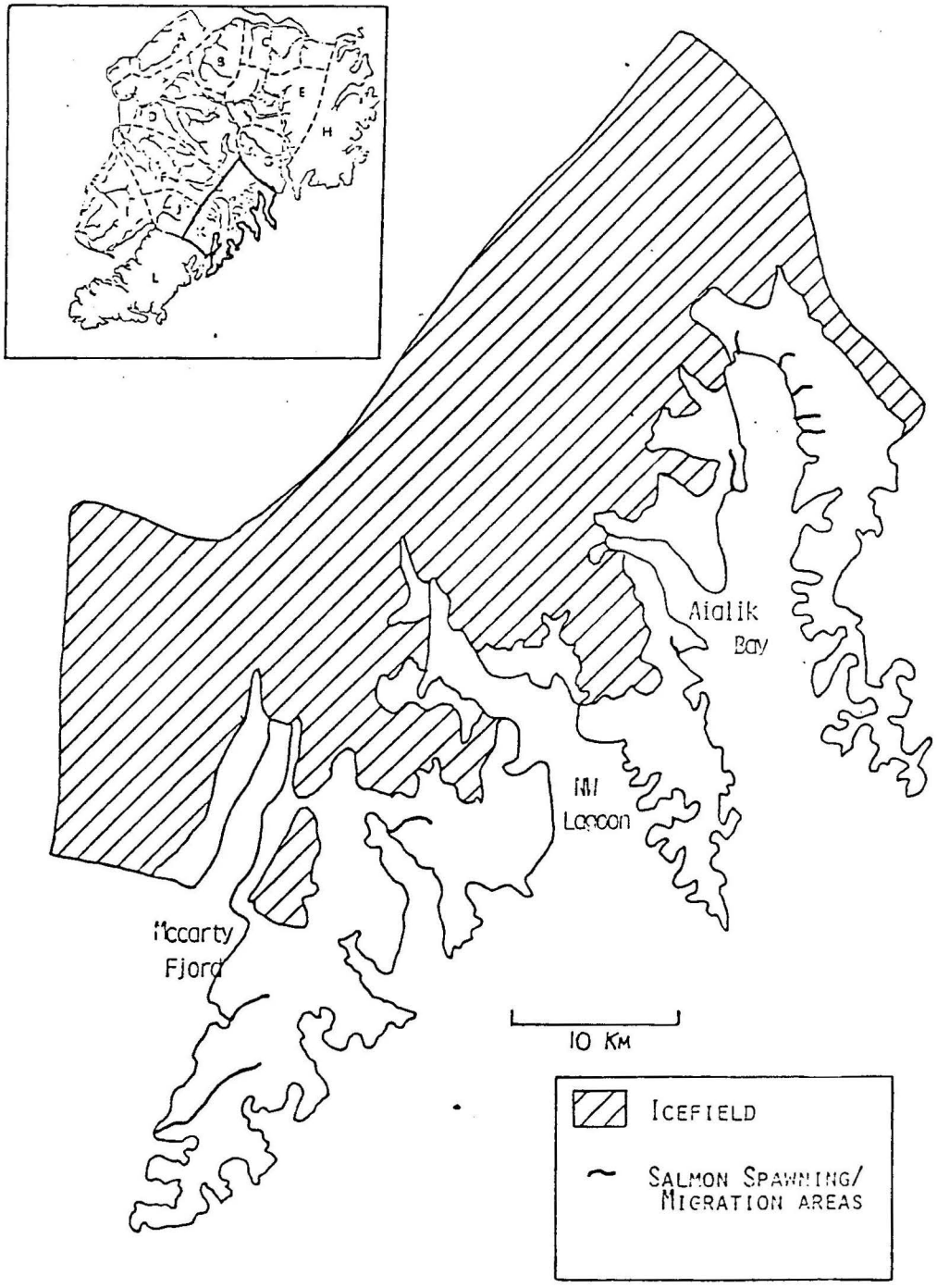


Figure 16 Salmon distribution in Area K (Fjords).

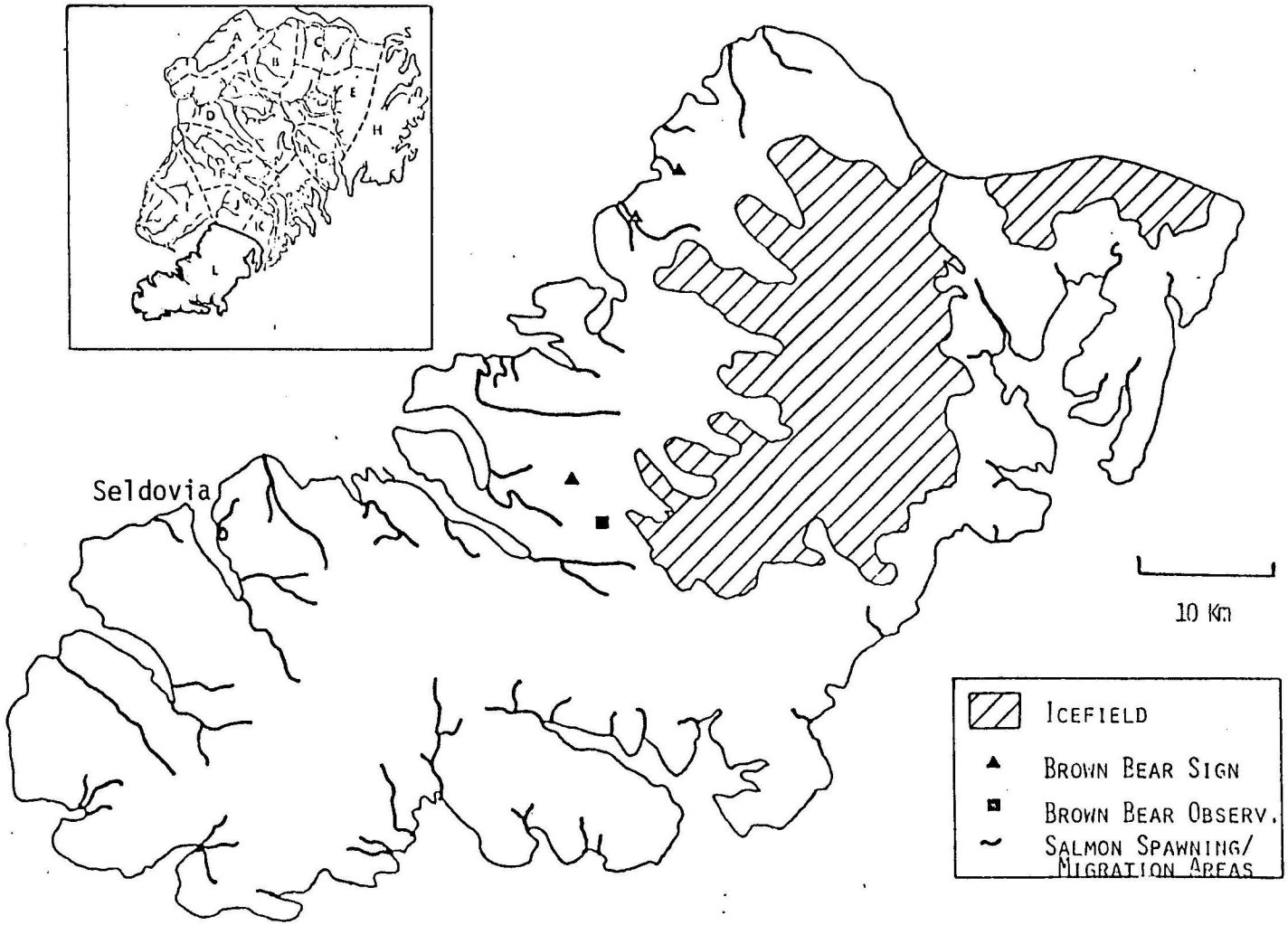


Figure 17 Salmon distribution and observed brown bear use of Area L (Seldovia).

species. Typically, substrates were poor for seeing tracks and it was not possible to determine how many bears were using a particular stretch of stream. In a few areas, such as the Anchor and Snow Rivers, sandy and muddy substrates were common and we could identify the tracks of several individual bears.

Generally, streams receiving high brown bear use on the Kenai have an abundant, easily obtained food source and are in areas receiving little human impact. In addition to the high use areas which we identified on Table 2, it appears that the upper tributaries of the Funny and Killey Rivers and upper portions of Deep, Nikolai and Bear Creeks are of importance to brown bears. Areas where brown bear use is unknown, but may be significant include the upper end of the Chickaloon River, portions of the Chakok, Ninilchik, Fox, Moose, Resurrection and Placer Rivers, Crooked Creek and tributaries entering the south side of Skilak Lake. Little is known about the importance of the various silver runs to brown bears during October and November. Without a better understanding of the distribution, seasonal requirements and movements of this brown bear population, it is difficult to assess the significance of individual spawning areas.

E. Bear/Human Conflicts

At present, the Kenai Peninsula appears to have sufficient undisturbed habitat to support a viable brown bear population. ADF&G biologists believe that the population has remained stable for the past 20 years (D. Holderman pers. comm.). Hunting pressure is relatively light on the Kenai bears, although an increase in reported bear mortalities has occurred in the last decade, resulting from the opening of a spring brown bear season in 1980 and a higher incident of Defensive of Life and Property (DLP) kills. Longterm resident and guide George Pollard believes that few persons seriously hunt brown bears on the Kenai because of the great time and effort required to locate a bear. He feels that most brown bear sportkills occur incidentally during hunts for other game species. Harvest statistics from 1961 to 1983 indicate an annual harvest ranging from 4.8 to 13.3, with a general upward trend (Table 3).

Rapid increases in the human population and tourism in southcentral Alaska will place greater demands on the Peninsula for development and recreational use. These demands will place greater stress on the brown bear population and could eliminate the species from parts of it's presently occupied range.

1. Potential Conflicts Reported in the Literature

The brown bear is vulnerable to high levels of human activities on it's range because of the species' large spatial needs, low reproductive potential and aggressive nature (Knight 1980). Brown bears can be negatively affected through increased human/bear confrontations resulting in bear mortalities, or

Table 2 RESULTS OF 'BEAR USE' SURVEYS CONDUCTED ON SALMON SPAWNING AREAS ON THE KENAI PENINSULA, 1984.

DA OF SURVEY	DRAINAGE	SPAWNING AREA[1]	LENGTH OF AREA SURVEYED KM (miles)	STAGE OF RUN	SALMON COUNTS (SPECIES) (LIVE/DEAD/BEAR KILL)[2]	BEAR USE[3]
	Benjamin Cr.	D	.8 (.5)	rising to peak	100/0/8 (K)	*Intense
7/31	Juneau Cr.	E	1.1 (.7)	past peak	75/3/0 (K)	+Low
8/1-3	Anchor R.	I	32 (20.0)	past peak	400/600 (K)	*!Heavy
8/6	Moose Cr.	F	4.0 (2.5)	peak	4000/577 (S)	*Intense
8/7	Bear Cr.	F	4.0 (2.5)	peak	4000/150 (S)	+Heavy
8/8	Crystal Cr.	F	1.6 (1.0)	starting	70/0/3 (S)	Low
8/8	Clear Cr.	F	0.8 (0.5)	start of 2nd run	397/26/38 (S)	+Heavy
8/8	Glacier Cr.	F	3.2 (2.0)	peak	17000/?/300 (S)	!Heavy
8/9	Seepage Cr.	F	1.6 (1.0)	peak	1657/0/84 (S)	+Moderate
8/9	Nikolai Cr.	F	4.0 (2.5)	past peak	1229/250/21 (S)	+Low
8/14	Moose Cr.	E	6.4 (4.0)	peak	1900/2670/140 (S)	+Moderate
8/15	Johnson	E	1.3 (0.8)	past peak	221/220/440 (S)	*!Heavy
8/15	Railroad	E	1.6 (1.0)	past peak	276/450/1350 (S)	*Intense
8/22-4	Trail Cr.	E	11.2 (7.0)	past peak	33/450 (S)	*!Heavy
8/28-30	Chickaoon R.	B	40.0 (25.0)	past peak	12/50000 (P)	*!Intense
9/10-12	SF Snow R.	E	19.2 (12.0)	past peak	12/425 (S)	+Moderate
9/13	Snow R. (above Jct)	E	6.4 (4.0)	-----	-----	Low
9/13	Ptarmigan	E	4.8 (3.0)	past peak	35000/15000/20 (S)	Low
9/18	Snow R. (below Jct)	E	8.0 (5.0)	-----	-----	Low
9/25-6	Russian R.	D	16.0 (10.0)	past peak	1000/200 (S)	*!Lo/Heavy
9/24	Bear Cr.	D	0.4 (0.25)	peak	3-5000/500 (S)	*Intense
9/24	Beaver Cr.	D	0.4 (0.25)	peak	20/55 (S)	+Moderate
9/24	Canyon Cr.	D	0.4 (0.25)	peak	1000/200+ (S)	+Heavy

1. Spawning areas according to Fig. 5.

2. Many of these are estimates, good for general comparisons. Many of the bear kill numbers are low estimates. Where two numbers appear, one is the live salmon count, the other is the dead salmon count, with no distiction made between bear kills and untouched carcasses.
   S = Sockeye K = King P = Pink

3. this rating is subjective and many variables must be considered (timing, ease of locating sign, behavior differences in bears, yearly differences in salmon numbers and bear use) before a more accurate assessent can be made. Certain creeks showing low/moderate use are known to receive heavier brown bear use on stretches which we didn't survey (eg - Bear Cr., Nikolai Cr.)

* Based on our evidence, these stretches appear to be major brown bear feeding areas.

\+ We also found evidence of brown bear use at these locations.

! Only portions of these spawning areas received heavy or intense use

Table 3 Brown Bear Harvest Statistics for the Kenai Peninsula, 1961-1983

Years	(# of Years)	Number of Bear Kills Unit 7	Unit 15	Total	Avg. # Bears/Year	Range
61-65	(5)	3	21	24	4.8	2-6
66-70	(5)	7	35	42	8.4	4-12
71-75	(5)	6	32	38	7.6	4-10
76-80	(5)	10	38	48	9.6	6-14
81-84	(4)	8	39	47	11.7	7-17

through habitat loss. Human activities which may result in habitat loss include development of rural subdivisions and other settlements, road construction (Elkmork 1978, Zager 1980), oil, gas and mineral development (Schallenberger 1980), certain timber harvest practices (Mealey 1977, Zager 1980), and livestock grazing (Schallenberger and Jonkel 1980).A brown bear's response to human activities is often one of avoidence; however, at least some bears use areas close to development. Bears making frequent use of developed sites, especially within close proximity of human settlements, are vulnerable to human-caused death.

The effect of mining and timber harvest activities on brown bears is dependent upon the amount of human activity at the sites and the longevity of the project. Avoidence will occur during periods of operation, which is generally short-term. Negative impact may continue if public access is allowed to these sites. Bear use may also decrease if important food sources or cover decline as a result of the operation. Certain timber harvest techniques can stimulate growth of bear foods, resulting in habitat improvement (Zager 1980).

Brown bears and livestock may use the same food sources where their ranges overlap, particularly during spring and early summer. In riparian areas, livestock often overgraze and trample succulent vegetation preferred by bears. Bear predation on livestock may also develop, especially when livestock carcass dumps are improperly located (Zager and Jonkel 1983).

Although recreational activities such as fishing, hunting and camping can be compatible with maintaining a brown bear population, increased human use of the backcountry in other regions has resulted in more frequent bear/human interactions in which a bear has become aggressive. In most of these situations, the bear is responding to natural instincts to protect it's young, defend a food source, or defend itself when surprised at close range. Bears' bluff charges are often misinterpreted as attacks. Human injury and bear mortality are frequent outcomes of such encounters. Sites of particular concern include salmon spawning areas during the spawning season, sites near carrion from ungulates killed during winter and near ungulate viscera remains during the hunting season. Improper food storage and disposal at backcountry cabins or campsites may also result in bear/human confrontations.

2. Potential Conflicts within Land Status Categories

Portions of the Kenai Peninsula are controlled by three federal agencies (NPS, USFWS, USFS), various state agencies, native corporations (Chugach Natives, Inc., Cook Inlet Region, Inc.), the Kenai Borough and private landowners (Figure 18). The map is generalized and subject to change pending the outcome of various land status decisions (acceptance of the KNWR Management Plan, land swaps, state and native land selections). Future

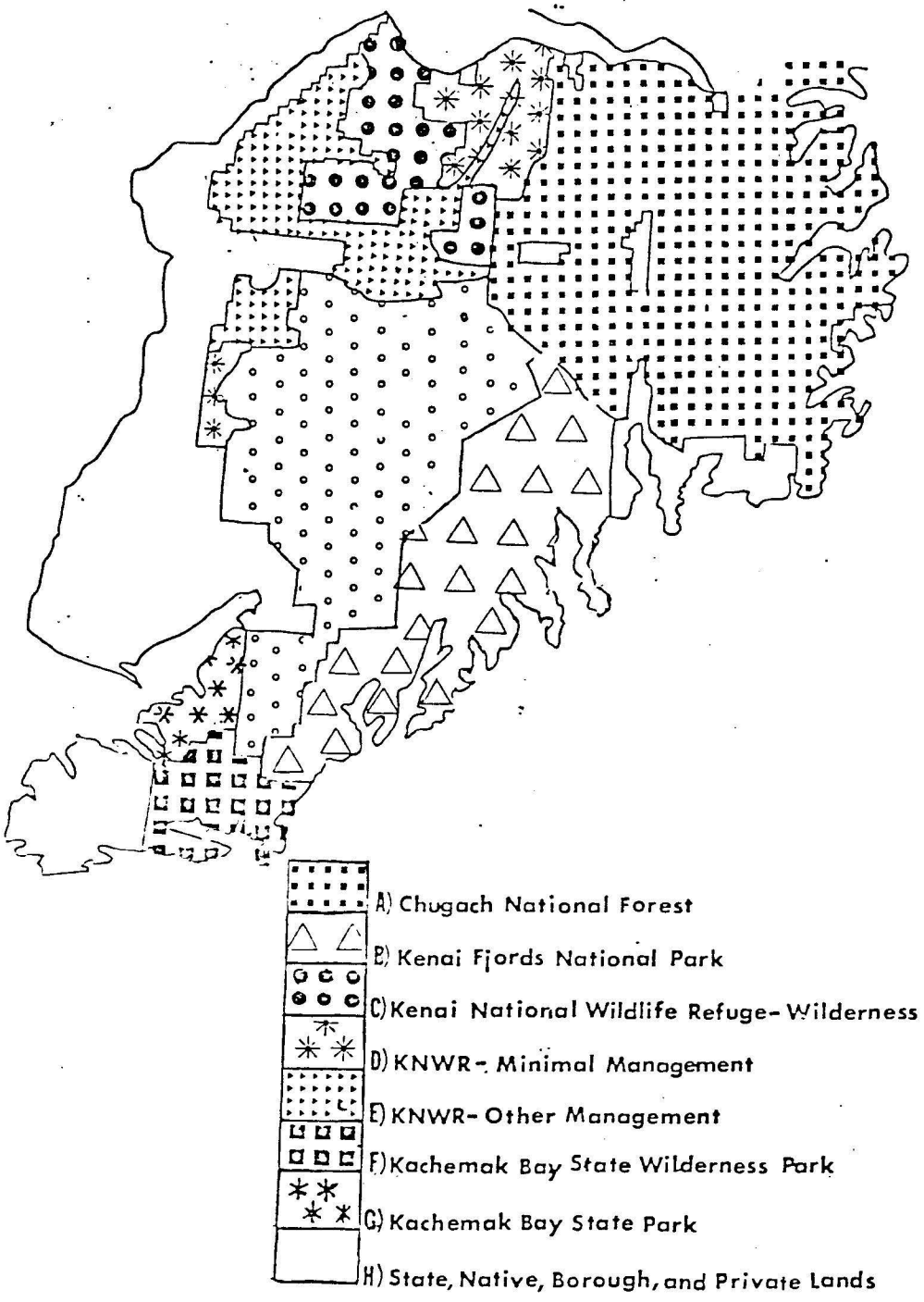


Figure 13 Land status types on the Kenai Peninsula, 1984 (boundaries approximate).

management practices within each category will effect the brown bear population differently. The purpose of this section is to discuss human activities within each category which could have impacts on brown bears.

2a. Chugach National Forest

The Chugach National Forest (CNF) is located within the mountainous east side of the peninsula. The USFS maintains a multiple use philosophy, stressing management for people and the use of all resources, including minerals, timber, fish and wildlife. Presently, the majority of development activities occur along the Seward and Sterling Highways.

Large parcels of land owned by the state, native corporations or private individuals parallel the highway near the city of Seward and the townsites of Moose Pass, Hope and Cooper Landing. Much of this area is slated for development to accomodate the expected growth of these communities. Brown bears will be displaced from good spring and early summer habitat and salmon spawning areas occurring on these areas.

Increased automobile traffic along roads may result in greater avoidence of these areas by brown bears. We noted that high salmon concentration areas close to roads and human activities, such as Ptarmigan Creek, Moose Creek and Juneau Creek received relatively little brown bear use. More remote areas with equal or smaller runs (the South Fork of Snow River, Trail Creek tributaries) recieved heavier brown bear use.

Several brown bears were reported near townsites and in campgrounds within the CNF this spring. However, the bears' stays were short and no bear mortalities occurred. A bear mortality occurred at the Russian River, when a young brown bear spent considerable time near humans and displayed no fear. The bear was accidently overdosed during tranquilization for relocation.

Mining and timber harvest occurs in several areas within the CNF. The level of disturbance these operations pose to bears must be evaluated on a site by site basis.

A goal of the USFS is to increase recreational opportunities on the CNF. The Forest Service actively maintains numerous trails and a series of visitor cabins in the backcountry. Bear/human confrontations have occurred on these trails and a few have resulted in the bear's death (Johnson and Apgar, unpub. rep., 1981). A particularly high encounter rate has occurred in the Russian River drainage. Brown bear predation on salmon occurs throughout this river system. We are currently monitoring visitor use levels and bear/human confrontations on this system (see Appendix 5). Confrontations will likely increase with the

construction of more trails in bear habitat and increased visitor use of existing trails.

2b. Kenai Fjords National Park (KFNP)

The majority of the KFNP is composed of extensive icefields and glaciers, or rugged coast seperated from the peninsula's interior. Areas used by brown bears within the park are restricted to a portion of the Resurrection River drainage and possibly a small, remote area north of Nuka Island. A trail paralleling the Resurrection River on the CNF side and a USFS visitor cabin south of Boulder Creek pose potential bear/human confrontation problems. The drainage offers spawning habitat for a large number of silver salmon, but spawning site locations need to be identified. At this time, the drainage offers a good refuge for bears from heavy human impacts, but this status could change.

2c. Kenai National Wildlife Refuge (KNWR)- Wilderness

The KNWR wilderness units include 1.35 million acres of habitat. The management emphasis of these areas is to maintain them in primitive conditions by eliminating the use of mechanized equipment and vehicles and permanent structures in all but a few areas (limited motorized access is allowed in "accessible wilderness" areas). These areas, especially the Andrew Simmons Wilderness Unit, will be core refuges for the brown bear population in the future.

Wilderness areas are not free from potential negative impacts on brown bears. Bear/human conflicts have occurred in these areas, notably along salmon spawning sites. Motorboat access is allowed to the entire Tustumena Lake shore. Several salmon spawning areas utilized by brown bears occur along tributaries of this lake.

Other recreational opportunities in the wilderness units have less impacts on the brown bear population. Several small lakes within the Andrew Simmons Wilderness Unit are accessible by small aircraft. The Swanson River and Swan Lake canoe routes within the Lowland Wilderness Unit are managed for nonmotorized wildland recreation. A limited trail system occurs within the wilderness areas. Potential threats are greatest along the wilderness area fringes, where greater human access may occur.

2d. KNWR-Minimal Management

These areas correspond to areas selected under the minimal management category in the prefered alternative management plan described in the KNWR Environmental Impact Statrement (1984). Minimal management areas offer protection to brown bears similar to that of wilderness areas. The entire

Chickaloon River system and adjacent mountains, which are believed to be key brown bear areas, lie within this and wilderness managenent categories. A road corridor through this area will allow vehicle access. The entire Tustumena Lake shore is similarly protected under minimal and wilderness management. Permanent facilities present in this land classification may include public safety cabins and fly-in tent camps.

2e. KNWR-Other Management

This classification includes refuge lands selected to be managed under three objectives (traditional, moderate and intensive management) under the preferred alternative management plan described in the KNWR Environmental Impact Statement (1984), and lands conveyed to several native associations. Some form of development and habitat manipulation may occur on all lands within this category, with levels of these activities differing between management classifications. The potential negative impacts to brown bears are considered greater on these lands than on other refuge properties.

2f. Kachemak Bay State Park (KBSP)

The coastal bays and coves of KBSP are seasonally fished by sport and commercial fishermen. ADF&G maintains a hatchery at Tutka Bay and several native inholdings occur along coastal areas. Interior portions of the park are relatively undisturbed and there is no road access. Brown bear sign has been observed in a few locations in the park by park and ADF&G employees. Future management will include maintaining a trail system and developing campgrounds. Brown bear movements between the KBSP and the interior wilderness areas is dependant on land management decisions within other state, native and private lands, as they provide a link between the two areas. Some local interest has been expressed in extending the East End Road across the Fox River and to the park boundary, but there are no plans for this in the near future.

2g. Kachemak Bay State Wilderness Park (KBSWP)

The KBSWP provides protection similar to that of refuge wilderness areas. The importance of this remote area to brown bears is unknown, but ADF&G biologists have made one observation there. This area is bordered to the north by several large glaciers. Future brown bear movements between the KBSWP and the peninsula's interior wilderness areas is dependant on land management decisions within other state, native and private lands, as they provide a link between these two areas.

2h. Other Areas

This category includes various state, native, borough and private lands. These areas will be subject to human activities which will have the greatest negative impacts to brown bears.

The areas surrounding the lower Kenai River and to the north will be subject to increased human settlement, eliminating brown bear use. State and native lands around existing townsites within the CNF (these are discussed in section A) will recieve similar pressures.

The large land area north of Kachemak Bay, to Clam Gulch, is of particular importance. This area includes good year-round brown bear habitat and several key salmon spawning areas. Coastal areas near the Sterling Highway and East End Road include a patchwork of several land ownerships, and are subject to increased human settlement. Further inland, including the headwaters of Deep Creek and the Anchor River, and adjacent alpine areas, lands are owned by either the state or native corporations. These lands are presently roadless, but are accessible by ATV's. Decisions on future land management practices are not final, but potential impacts include the construction of a power corridor and road across the upper ends of the drainages, and cattle grazing. ADF&G biologists are presently working on a management plan to protect upper portions of the Anchor River for wildlife habitat, particularly for it's value as moose winter range.

Land located on the tip of the Seldovia Arm south of Kachemak Bay, is owned by native corpoprations and private individuals, and is subject to development. We do not know it's importance to brown bears, however, observations in this part of the Kenai Peninsula are rare (Ted Spraker, pers. comm.)

IV. CONCLUSIONS AND RECOMMENDATIONS

Increased human activities will put greater stresses on the Kenai Peninsula brown bear population. Due to the large amounts of protected remote habitat available to bears, it may be possible to maintain a viable population. The Andrew Simmons Wilderness Unit could serve as a core area for this species, with fringe areas providing less secure habitat. Several areas presently important to brown bears may serve as smaller refuges, as land adjacent to them becomes increasingly developed. These areas may include the large, presently unroaded intermountain drainages to the east (Snow River, Russian River/Resurrection River, Placer River/Trail Creek), the Chickaloon River system and adjacent wilderness, and portions of the headwaters of the Anchor River and Deep Creek. Corridors of habitat between these areas would be necessary to assure that smaller subpopulations don't become isolated.

At this time however, we lack information on the brown bear population's size, seasonal habitat use and movements to make sound recommendations for maintaining habitat integrity. This information can be obtained through an ongoing interagency study. Information needs are outlined in the IBBST's step-down plan, with emphasis placed on capturing and radiocollaring bears and subsequently relocating them from the air and ground (Appendix 1).

A. Stream Surveys

Information obtained from stream surveys is limited because of difficulties in distinguishing black and brown bear sign, inability to correlate amount of sign with numbers of bears, and limited survey efforts. However, the surveys do provide documentation of what areas are available to bears as feeding sites and which areas were used in 1984 by brown bears. In addition, areas regularly visited by brown bears contained abundant sign, thus were easily identified.

Salmon spawning areas of greatest concern include a three mile stretch of the Kenai River immediately below Skilak Lake, tributary creeks of Upper Russian Lake, Trail Creek, and the South Fork of Snow River on the CNF, and portions of the Chickaloon River and several tributary creeks of Tustumena Lake on the KNWR. Each are within close proximity of trails, roads, or boating areas.

Other areas which are of equal importance but have more remote locations include the Upper Killey River/Benjamin Creek, upper Funny River, the Anchor River above Beaver Creek and the upper ends of Bear and Nikolai Creeks. The Anchor River is of more immediate concern, due to its close proximity to the Homer community and its susceptibility to greater human impacts.

There are several spawning areas on the peninsula where brown bear predation is suspected but the amount of use is unknown. Areas which should be investigated include the upper stretches of Deep Creek, the upper Chickaloon below Swan Lake, Crooked Creek, Skilak Lake tributaries, and portions of the Fox, Moose, and Placer Rivers.

Little is known about brown bear use of silver salmon spawning areas because fisheries biologists usually do not conduct surveys of this

late run species. We found that some bears continue to feed on salmon through October and expect that the more remote silver spawning areas receive concentrated use. Most spawning areas coincide with those reported for other species, although silvers tend to be more widespread and may move further up some drainages. Bear predation on silver salmon should be better quantified. The Resurrection River receives a large run of silvers and minimal use by other species. Spawning areas should be identified and investigated in this drainage.

B. Ground Surveys

Habitat evaluations made during ground surveys are tentative because of the lack of area specific information concerning brown bear habitat preference on the Kenai. Important food sources such as green vegetation and berries are widespread and found in several habitats. Preference for specific food items and habitats is unknown. Salmon spawning areas were the only important habitats easily confirmed. Detectable brown bear sign is limited to hair and tracks, typically found along travel corridors (streams, man-made trails, in saddles), and feeding sites indicative of the species (excavations), which were rarely found. Observations were also infrequent.

Increased demands for human use of bear habitat require that we rely on our presently limited knowledge concerning brown bear habitat preference to make recommendations. Ground surveys should be conducted through areas where increased human use may occur. Information is especially important where human influence will be long-term (eg: permanent habitat alteration, roads, trails, cabin sites). Ground surveys are useful in identifying areas which could be avoided or buffered, to mitigate against potential negative impacts to bears or reduce the likelihood of bear/human encounters. Such areas include salmon spawning streams, travel corridors, productive berry patches, possible spring foraging areas and bedding sites. Several days may be required for the preparation, field survey and subsequent writeup of each evaluation.

C. Aerial Surveys

Aerial surveys proved ineffective for providing brown bear density and distribution information. During 54 hours of flight time under good viewing conditions, from May to October, only 6 brown bears were observed in alpine, while 45 were observed along salmon spawning areas. It appears that low densities and heavy cover precludes this as a viable survey method. Aerial surveys of salmon spawning areas would be useful in identifying specific areas of salmon concentration. These should be followed up by ground searches to confirm brown bear use.

D. Bear Tagging Efforts/Radiotelemetry

Success of capture operations scheduled for 1985 can be improved by concentrating effort along salmon streams before August, attempting

to capture any adult bears encountered, and by searching salmon streams with relatively open habitats such as the middle Funny River. In addition, if brown bear are located in open habitats during other types of surveys or radio telemetry studies, attempts at capture should be made based upon a case by case basis. Radiotelemetry is the most reliable technique for obtaining needed information on the Kenai brown bear population. By employing both aerial and ground radiotracking, data can be obtained on population size, demography, movements and habitat use.

E. Interviews

The few interviews conducted with various Kenai Peninsula residents proved helpful in obtaining information concerning bear distribution and human activities within specific areas. Interviews should be conducted wherever time permits. Interviews are time consuming, especially when persons live far from the interviewer's worksight. Scheduling is also a problem, since persons must often be reached during non-working hours.

F. Bear/Human Conflicts in the Backcountry

Use by people can occur in brown bear habitat without deleterious effects to the bear population. However, examples have shown that as human use increases, so does the likelihood of bear/human confrontations. Several confrontations on the Russian River have resulted from humans approaching bears too closely, knowingly or not. Similar situations may be avoided in the future by educating trail users. Information signs could be posted at trailheads and backcountry cabins in high bear use areas. Pertinent information would include suggested hiking and camping techniques, proper food storage techniques, and facts about bear behavior.

Information gathered on human use and bear/human encounters on the Russian/Cooper/Resurrection trail system will help to identify problem areas and gauge bear tolerance (see Appendix 5). Collecting information from trail counters and backcountry use stations could be less expensive and time-consuming with proper coordination with other activities. The USFS should continue these efforts. In addition, bear encounters reported in the Cross Kenai Trail Report (Johnson and Apgar, unpub. rep., 1981) should be investigated and more thoroughly documented.

G. Information Updating

Maps and files should be continually updated as current information on land status, bear harvest and spawning areas become available. Literature on current research should be obtained as it becomes available. A file of brown bear observations should be maintained by agency representatives of the IBBST and other biologists should be encouraged to report observations. We should continue to monitor DLP kills, particularly with regard to trends, location relative to changes in human activity lie.

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APPENDIX I

KENAI PENINSULA BROWN BEAR STEP-DOWN PLAN

1) Maintain a viable brown bear population on the Kenai Peninsula
   2) Maintain an adequate habitat base to support the brown bear population at the current level.
      3) Protect a contiguous land mass(es) of suitable brown bear habitat from direct loss due to human development.
         4) Determine optimum land mass size necessary to support the population.
            5) Estimate home-range sizes for various classes of brown bear.
               6) Literature review.
               6) Extesive field study.1
            5) Determine seasonal distribution of various age/sex classes of bears.
               6) Literature review.
               6) Intensive field study.1
            5) Determine seasonal habitat preferences of various age/sex classes of bear.
               6) Identify known concentration areas on seasonal basis.
                  7) Literature review.
                  7) Relate known salmon spawning areas to brown bear use.3
               6) Indentify other critical habitat areas on a seasonal basis.
                  7) Literature review.
                  7) Interviews with long-term residents.
                  7) Intensive field study.4
      3) Protect a contiguous land mass of suitable brown bear habitat from indirect human activities that alter habitat quality.
         4) Determine kind and level of acceptable human activity.
            5) Literature review.
            5) Interviews with long-term residents.5
            5) Field studies.
         4) Determine kind and level of acceptable human activity.
            5) Literature review.
            5) Interviews with long-term residents.
            5) Field studies.5
   2) Understand the demograpic processes that effect the current brown bear population.
      3) Estimate the annual reproduction and recruitment rates of the current population.
         4) Review of literature.
         4) Field study.6
      3) Estimate the current population size.
         4) Literature review.
         4) Field study.7
      3) Estimate mortality and dispersal rates within the current population.

4) Estimate natural mortality causes.
    5) Review of literature.
    5) Field study.8
4) Determine extent and nature of man-caused mortalities.
    5) Annual hunter harvest.
    5) Defense of life and property kills.
    5) Other unreported losses.8
4) Estimate dispersal rates and distances as it relates to geographic distribution of habitat.

1 1) Minimum home-range polygons of marked bears.
2) Estimate overlap of home-range areas of individual bears.
3) Compare home-range areas to geographically secure land base.

2 1) Location of marked bears by season.
2) Aerial surveys.

3 1) Stream surveys - ground checks.
2) Stream surveys - aerial verification.
3) Stream surveys - fisheries crews.
4) Stream surveys - locations of marked bears.

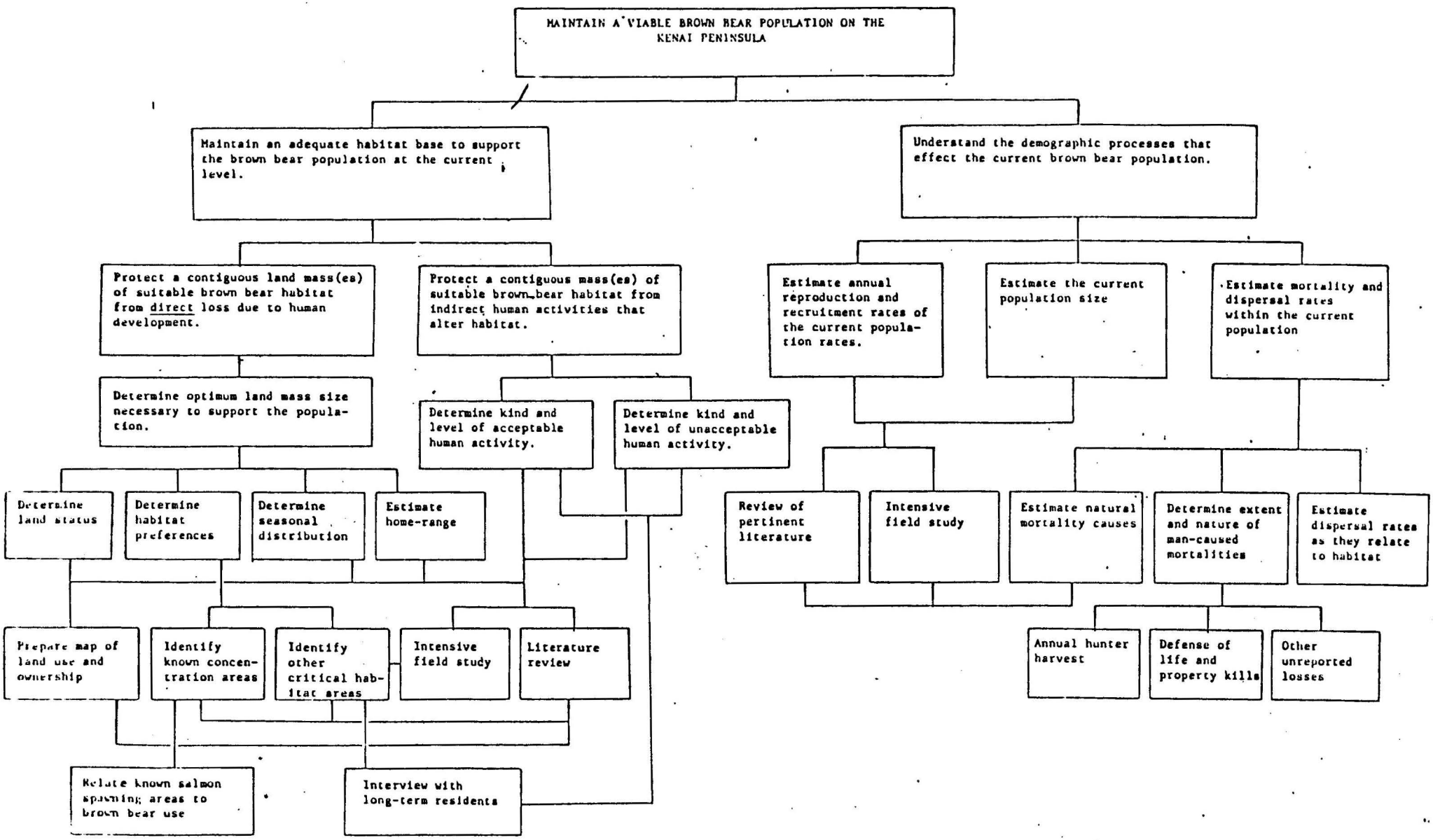
4 1) Location of marked bears.
2) Food habits study to evaluate food resources associated with habitat areas.
3) Compare abundance of habitat areas to geographic land base and minimum home-range polygon.
4) Evaluate potential migration-travel corridors relative to critical habitats.

5 1) Interview long-term residents, hunting guides, homesteaders as to historical distribution of brown bears and compare to current distribution to evaluate indirect or direct effects of habitat change on brown bears.
2) Document long-term bear-human conflicts as they relate to human activity by season via hiker questionaire and trail counters.
3) Test the feasibility of transect evaluation to rate brown bear habitat use to minimize potential human conflicts as discussed by Herrera et.al. (1983).

6 1) Document reproductive rate of adult females via radio-telementry.
2) Determine age of first breeding.
3) Determine cub/yearling/2 yr. old survival.

7 1) Accurate determination is probably not feasible, estimates can be made via:
   a) Relate home-range size and overlap to total available habitat.
   b) Estimate numbers of marked vs. unmarked individual associations during the breeding season.

8 1) Estimate mortality rates of cub/yearling/2 yr. olds associated with radio-collared females.
2) Long-term monitoring of marked individuals.


MAINTAIN A VIABLE BROWN BEAR POPULATION ON THE KENAI PENINSULA
Maintain an adequate habitat base to support the brown bear population at the current level.
Understand the demographic processes that effect the current brown bear population.
Protect a contiguous land mass(es) of suitable brown bear habitat from direct loss due to human development.
Protect a contiguous mass(es) of suitable brown bear habitat from indirect human activities that alter habitat.
Estimate annual reproduction and recruitment rates of the current population rates.
Estimate the current population size
Estimate mortality and dispersal rates within the current population
Determine optimum land mass size necessary to support the population.
Determine kind and level of acceptable human activity.
Determine kind and level of unacceptable human activity.
Determine land status
Determine habitat preferences
Determine seasonal distribution
Estimate home-range
Review of pertinent literature
Intensive field study
Estimate natural mortality causes
Determine extent and nature of man-caused mortalities
Estimate dispersal rates as they relate to habitat
Prepare map of land use and ownership
Identify known concentration areas
Identify other critical habitat areas
Intensive field study
Literature review
Annual hunter harvest
Defense of life and property kills
Other unreported losses
Relate known salmon spawning areas to brown bear use
Interview with long-term residents

APPENDIX II

PERSONAL CONTACTS, 1984.

Ted Bailey USFWS
Tom Balland ADF&G
Ed Bangs USFWS
Vern Berns USFWS
Joe Blackwell
Ralph Browning USFS
Ken Condit
Jack Dean USFWS
Jim Faro ADF&G
Jim Friedersdorff USFWS
John Gaule
Steve Hammerstrom ADF&G
Kelly Hepler ADF&G
Dave Holderman ADF&G
Rick Johnson USFWS
Sid Logan ADF&G
Patsy Martin
Ted McHenry ADF&G
Dave Nelson ADF&G
Kurt A. Nelson USFS
Kurt J. Nelson USFS
Ludwig Pfleger
George Pollard
Tom Schrader ADF&G
Chuck Schwartz ADF&G
Ted Spraker ADF&G
Roger Smith ADF&G
Ken Tarbox ADF&G
Dave Waite ADF&G

APPENDIX III

BROWN BEAR HABITAT EVALUATION REPORTS

The following is a list of potential brown bear foods on the Kenai Peninsula. We rated their potential use based on their importance in other areas and on limited information we were able to collect on food habits during our surveys and interviews. We used this list as a guide for evaluating habitat during our surveys.

Food Item	Spring (To Mid-June)			Summer (Mid-June -Aug)			Fall (Sept-Nov)		
	Maj	Min	Sus	Maj	Min	Sus	Maj	Min	Sus
Calamagrostis		x							
Other grasses	x			x				x	
Sedges	x			x				x	
Equisetum	x			x				x	
Athyrium	x				x			x	
Other ferns					x				
Heracleum	x				x				
Angelica	x				x			x	
Astragalus/ Oxytropis		x						x	
Hedysarum	x			x			x		
Taraxacum		x							
Oxyria			x						
Streptopus			x						
Frittilaria			x						
Willow					x				
Cottonwood			x			x			
Blueberry					x		x		
Salmonberry				x			x		
Crowberry	x						x		
Devil's club				x				x	
Highbush cranberry				x			x		
Lowbush cranberry		x		x			x		
Bearberry				x			x		
Mountain ash								x	
Current					x		x		
Elderberry						x			x
Rose/Raspberry						x		x	
Salmon		x		x			x		
Moose	x				x			x	
Rodents		x			x			x	
Insects		x			x			x	

Maj- Potentially a major food source during this time period

Min- Probably a minor food source during this time period

Sus- A suspected food source

BROWN BEAR HABITAT EVALUATION REPORT

Area: Johnson Pass Trail Dates: 6/11-6/14, 1984
Personnel: Bevins, Risdahl

Segment A

For the first four miles, the Johnson Pass Trail follows closely along the northwest shoreline of Upper Trail Lake. The first mile passes through a hardwood/spruce forest with a mixed forb-dominated understory. It then continues through a spruce/hemlock stand with a menziesia/moss-dominated understory. Bear foods are scarce except along a few creeks crossing the trail, which have moderate amounts of graminoids and horsetail. The trail passes through one small area with a good concentration of current, highbush cranberry and elderberry. No scats were found along this stretch of trail.

The trail runs adjacent to a large wet meadow at the north end of Upper Trail Lake. The meadow is rich in spring bear foods including sedges, grasses, horsetail, angelica, and cow parsnip. There was no evidence of feeding by bears, but one spring scat was found. A narrow creek meanders through the meadow and ten salmon carcasses were found along it's banks. A large patch of highbush cranberry and a scattering of elderberry were found within the meadow.

Segment B

From this point, the trail slowly climbs for approimately three miles to the Johnson Creek drainage. The trail continues through spruce/hemlock with few bear foods. It runs adjacent to a few large seasonally-moist meadows, where sedges are abundant. No bear activity was evident within them. The trail crosses a narrow drainage with containing few graminoids and forbs and some highbush cranberry.Three individual sets of bear tracks were noted along the trail between This drainage and Johnson Creek; two of these were small and probably black bear tracks, while the other was definitely made by a brown bear.

The trail passes through mixed hardwood and spruce/hemlock forests along Johnson Creek for the next two to three miles. Spring bear foods are scattered along the creekbottom and in a few small meadows. Open-timbered knobs support scattered amounts of crowberry, lowbush cranberry and bog blueberry.

Segment C

Timber is patchy along the upper three miles of the Johnson Creek drainage and the trail continues through alder, willow and meadows. The upper valley is rich in spring/early summer bear foods. Sedges and grasses are abundant along the creek, in wet meadows interspersed along the valley bottom. Beaver activity is common above, below and on the west side of the lake, creating moist feeding sites. Cow parsnip and lady ferns are common on lower slopes. Horsetail is sparse.

The dense willow stands found along the creekbottom immediately below Johnson Lake contains an abundance of cow parsnip and twisted stalk and a little hosestail. Oak ferns are also common.

The lower slopes above Johnson Lake are a mosaic of alder shrubfields and bluejoint meadows. Alder is thickest on the west-facing slope. Lady ferns form thick patches throughout the lower slopes. Large patches of salmonberry bushes offer a good fall food source to brown bears. Scattered mountain ash, elderberry and current bushes provide additional fall foods.

Midslopes and bottoms of side drainages are dominated by bluejoint and a variety of forbs. These areas where either snow-covered or just beginning to green up at this time and are probably utilized by brown bears during mid-June through July as feeding sites. Crowberry is common on the uppermost slopes and side ridges, where it is probably used by brown bears in the late summer and fall. Lowbush cranberry, bog blueberry and alpine bearberry are less common.

Two bear scats were found in the west-facing slope above Johnson Lake. One contained graminoids while the other was comprised of leaves and berries of lowbush cranberry and alpine bearberry. A large set of brown bear tracks was observed along the trail adjacent to and above Johnson Lake.

Segment D

The slopes in the Upper Bench Lake valley are very similar to those of Johnson Creek. Salmonberries appear to be more abundant on the Bench Lake side. The flats extending for about a mile below Bench lake are largely covered by willows with some small wet bluejoint meadows interspersed within. Graminoids were just beginning to green in the bottoms. A set of brown bear tracks continued along the trail for a mile below the pass.

We walked a secluded side drainage on the east side of the valley and approximately one mile north of Bench Lake. A small hummock separate this drainage from the main valley. Sedges are abundant in the moist bottoms at the base of this smaller valley while horsetail is available in small amounts. Further up the valley bottom of this drainage, snow is patchy and a few snow-free areas are rich in spring bear foods. We observed a few old sets of bear tracks crossing the snow.

Segment E

The trail continues to follow close to Bench Creek, passing through alder and bluejoint meadows for the next several miles. Beaver activity within the bottoms provides much wet habitat where horsetail and sedges are abundant. Salmonberries continue to be abundant along the lower slopes. We found two vegetation scats along this portion of the trail; one contained moose hair. We saw brown bear tracks on a gravel bar next to the creek approximately three miles from the pass.

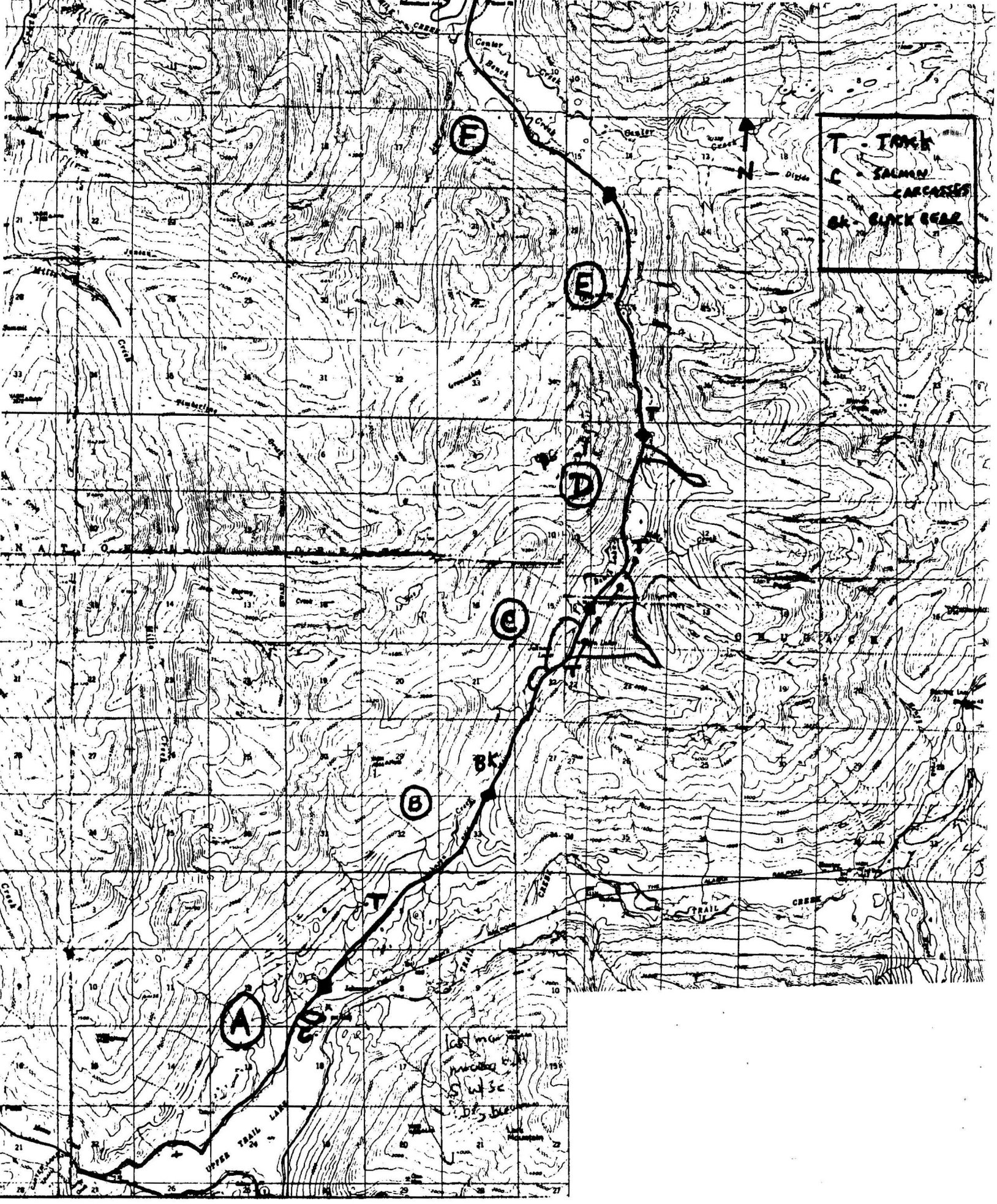
As the valley narrows, four miles from the pass, the trail passes through patches of timber. The east-facing slope is a timber/alder mosaic while the west-facing slope is solid alder. Ferns dominate the understory and salmonberry drops out. Elderberry occurs in scattered clumps along the

trail. Horsetail and grasses are common along the side drainages crossing the trail. Moist meadows occur along the creekbottom between Groundhog Creek and Center Creek. Three horsetail scats were seen along this stretch.

Segment F

For the last three miles (below Center Creek) cottonwood and spruce dominate the overstory along the creekbottom. Willow and bluejoint dominate the understory and cow parsnip is common. Horsetail is spotty. Adjacent upland timber is dominated by spruce/hemlock with a menziesia/moss understory and patches of crowberry and bog blueberry. Several lowland wet meadows and ponds adjacent to Center and Bench Creeks provide spring bear foods.

In summary, the Johnson Creek and Bench Creek drainages offer year-round food sources to brown bears. Early spring foods are available along the upper shoreline of Upper Trail Lake and in meadows within timbered areas at the lower ends of both drainages. In addition, several creekbottoms contain good amounts of grasses, sedges, horsetail and other forbs. The upper creekbottoms and side drainages become available to the bears in late spring and early summer. During midsummer, sockeye salmon are utilized by bears along the tributaries of Upper Trail Lake. during late summer and fall, berries are widespread throughout both drainages. Salmonberries on lower slopes near Johnson Pass, and crowberries at higher elevations, are particularly abundant.


T - TRACK
C - SALMON CARCASSES
BK - BLACK BEAR
A
B
C
D
E
F
BK
T
UPPER TRAIL LAKE
TRAIL CREEK

Brown Bear Habitat Evaluation Survey

Area: Upper Russian/Resurrection River Dates: 6/19-22, 84
Personnel: Bevins, Risdahl

Efforts of this survey were concentrated in lowland areas between Cooper and Upper Russian Lakes and throughout the Resurrection River drainage. Much of the area evaluated is adjacent to Forest Service trails. We also looked at the Goat Lake (above Upper Russian Lake) and Boulder Creek drainages.

Segment A begins at the Cooper Lake trailhead, following the Russian Lakes trail through a spruce/hemlock forested valley bottom containing several small lakes and wet meadows. The trail follows closely to creekbottoms or wet meadows for the first 5 miles, to the Resurrection River trail junction. Willows are common along the bottoms and alders are found along the steeper side drainages. Spring/summer foods such as graminoids, cow parsnip, twisted stalk and ferns are common throughout the bottoms. Grasses and sedges are abundant along beaver ponds and in wet meadows. Grasses, sedges and horsetail are also productive along the Cooper Lake shoreline. Fall foods include crowberries and blueberries, common on open-timbered knobs, and small amounts of highbush cranberry and devil's club along the creekbottoms. We observed two sets of brown bear tracks along the trail 2 miles from the Cooper Lake trailhead. We also saw tracks at the Cooper Lake shoreline and in a wet meadow above the lake.

The trail passes through alder shrubfields and bluejoint meadows on the pass between Cooper and Russian Lakes, approximarely 5 miles from the trailhead. Graminoids, ferns and cow parsnip are common along this stretch, which is about 2 miles long. Fall foods include elderberry and a little devil's club. We saw brown bear tracks in the mud frequently along this section of trail. Bear scats were numerous

Segment B begins in the timber zone, on the Upper Russian Lake side of the pass. Here, spring foods are abundant along creekbottoms, as are berry producers such as elderberry, current, devil's club and highbush cranberry. Upland sites are unproductive for bear foods, except for a few open hilltops which contain good patches of crowberry and blueberry. Wet meadows are frequent, especially along the east shore of Upper Russian Lake, where grasses and sedges are predominant. We observed a large black bear feeding in a large wet meadow adjacent to the lake.

Segment C includes the Goat Lake drainage, from the mouth of the creek to a point about 2 miles upstream. The first half mile is flat and the creek meanders through grassy meadows and willows. Sedges, horsetail and cow parsnip are available adjacent to the creekbottom. A grove of cottonwoods, with a bluejoint understory, is located about a mile up the creek. Adjacent upland slopes are timbered and contain few bear foods.

We found several red salmon carcasses (last years) along the banks of the creek within the first mile stretch. We found a black bear bed and 5 scats under a large cottonwood tree in the cottonwood grove. We also found five other spring scats along the first mile stretch of creek. We observed one set of brown bear tracks on a sandbar near the mouth of the creek.

A series of falls occurs about a mile up Goat Creek, which prevents upstream migration to salmon. This may also be a lucrative fishing spot for bears. After the first mile, the creek flows through a steep, narrow canyon with timbered slopes. These slopes contain little bear foods. Some crowberry and blueberry is available on open knobs and a little devil's club occurs in side draws.

We investigated several wet meadows on a bench immediatly east of the creek, where several digs were located in 1983. We noticed no fresh digs on this trip, but found several spring scats in the meadows.

Segment D begins at Upper Russian Lake and passes through a timbered slope on the east side of the lake, then drops into a tributary drainage containing extensive willow stands and large grass/forb meadows. We walked up the drainage to a low pass and over into the headwaters of Resurrection River.

The timbered slope above Upper Russian Lake contains very little foods for bears. There is a small amount of crowberry in the understory. The drainage, however, is rich in spring bear foods; cow parsnip, horsetail and grasses are plentiful. A well used game trail follows the drainage and we observed brown bear tracks in the mud in several places along this trail.

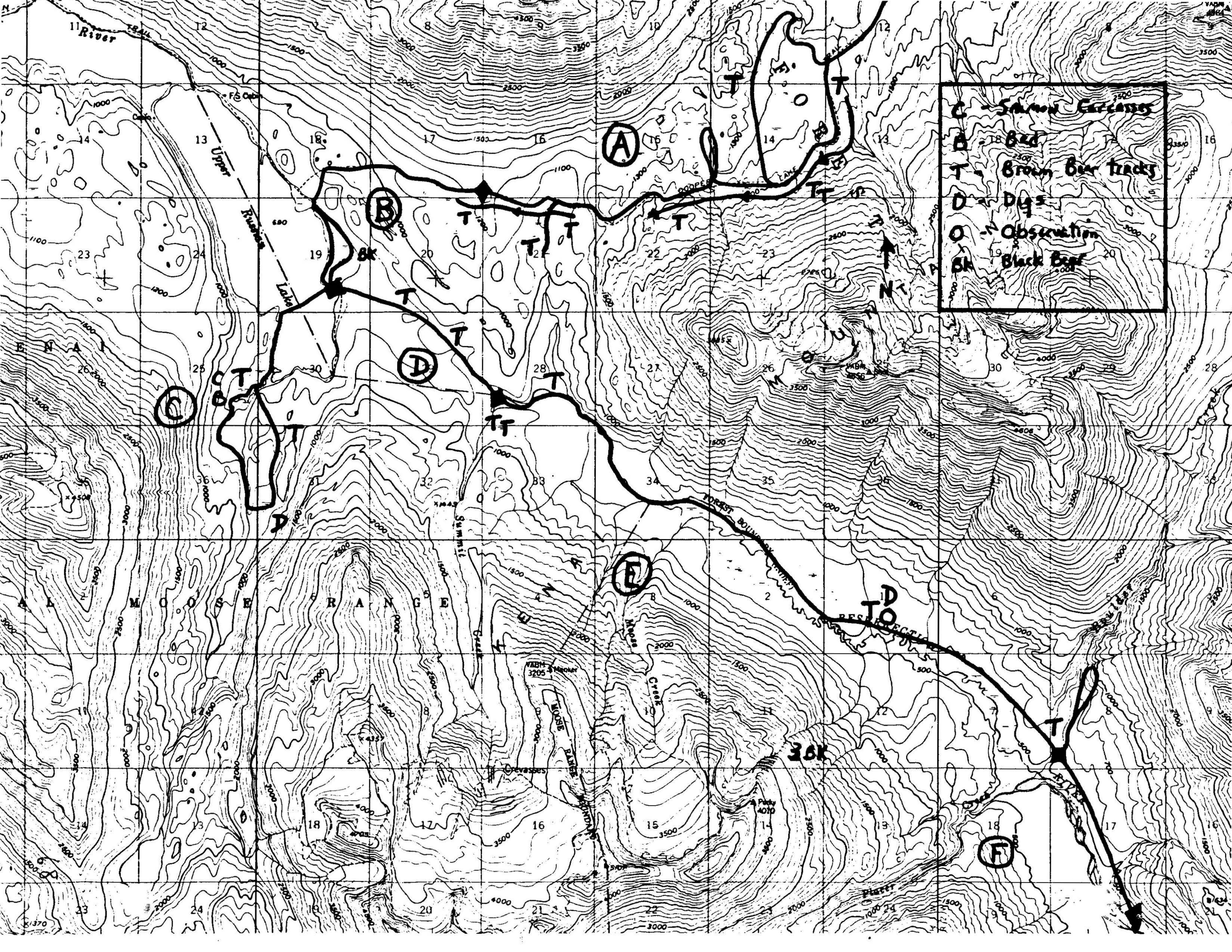
Segment E begins at the headwaters of the Resurrection River drainage at a large willow-covered gravel bar. The river bottom narrows quickly from here, and the banks are timbered, with alder common in the understory. ferns and bluejoint are common and there is some horsetail. We reached the USFS trail approximately 3/4 mile downstream.

The trail passes through spruce/hemlock forest all the way to Boulder Creek. The understory varies considerably, depending on slope and drainage. Alder is common in draws and immediately adjacent to the riverbottom. Lady ferns are common throughout the drainage. Horsetail is very productive on low sites adjacent to the riverbottom and along creekbottoms. Cow parsnip and twisted stalk occur in small amounts along moist sites. Devil's club is very common on moist sites. Extensive patches of devil's club occur within larger draws; the west side of Boulder Creek is especially productive. We found a good blueberry understory on timbered benches along the last mile of trail above Boulder Creek. The trail passes through alder shrubfields in a few locations, where cow parsnip, highbush cranberry and elderberry are all common. A few bluejoint meadows occur along the lower slopes of the drainage. These are productive for bear foods including graminoids, cow parsnip and angelica. Good patches of elderberry and highbush cranberry also occur in these openings. Large wet meadows are common throughout the valley bottom. These offer good sources of graminoids and horsetail for spring and early summer feeding.

Heavily used game trails occur intermittantly throughout the flagged portion of the trail (a five mile stretch above Boulder Creek). Spring bear scats were abundant. Greg observed a large brown bear at the edge of a large bluejoint meadow about 1 1/2 miles above Boulder Creek. The bear had been digging, possibly for chocolate lily corms. We also saw brown bear tracks on sand bars along the upper mile of the river and near the mouth of Boulder Creek.

Segment F runs from Boulder Creek to the trailhead at Exit Glacier. On this section, the trail remains within the timber. Much of the trail runs adjacent to the riverbottom where horsetail and graminoids continue to be productive. Several side drainages also contain these spring bear foods. No large bluejoint or sedge meadows occur along this stretch, however. Lady fern is common on upland sites. Devil's club is common throughout this portion of the drainage, and is particularly abundant adjacent to Boulder and Martin Creek. Currents are also common. Small patches of elderberry and highbush cranberry are also available. We did not observe any definite brown bear sign along this section of trail. We observed several bear scatscontaining graminoids and horsetail, however.

In conclusion, the valley bottoms and passes between Cooper Lake, Upper Russian Lake and the upper Resurrection River offer good yearround food sources to brown bears. Large numbers of tracks, bear trails and scats, coupled with the heavy use which occurs on salmon spawning areas during the late summer and fall months, is supportive evidence this is a high use area.


C - Salmon Carcasses
B - Bed
T - Brown Bear tracks
D - Digs
O - Observation
BK - Black Bear
A
B
C
D
E
F
Upper Russian Lake
River
Trail
F.S. Cabin
Cooper Lake
Summit Creek
Moose Creek
Forest Boundary
Resurrection River
Crevasses
Moose Range Boundary
Kenai Moose Range
Mount

BROWN BEAR HABITAT EVALUATION REPORT

Area evaluated: Lost Lake / Upper Boulder Creek Dates: 7/9 - 7/13 '84
Personnel: Bevins, Risdahl

Areas evaluated on this trip include the Lost Lake trail, beginning near mile 5 of the Seward Highway, and the alpine slopes and valleys at the headwaters of Martin, Boulder, Primrose, and Ship Creeks. The accompanying map shows the routes travelled.

Segment A begins at the Seward Highway and includes 3 miles of the Lost Lake trail. The trail passes through a spruce/hemlock forest and runs adjacent to creekbottoms for most of its length. The trailhead is at 400 ft. in elevation and breaks timber at around 1500 ft.The lower mile of the trail passes beneath a dense timber overstory. Menziesia and blueberry are the predominant shrubs. Mosses and oak ferns are also common. Devil's club, lady fern, and twisted stalk are found along moist draws.

The trail runs adjacent to an open creekbottom where lady fern and cow parsnip are abundant for the next 2 miles. There are moderate amounts of devil's club and a little highbush cranberry. There are small amounts of grasses and sedges along the creekbottom. Adjacent timber contains menziesia, ferns, and mosses in the understory. Salmonberry bushes are abundant at the very upper end of this segment.

This section has good spring/early summer potential for bears because of the dense cover of forbs and ferns along the creekbottom. High late summer/fall use of this drainage can be expected because of the abundance of blueberries at lower elevations and salmon berries higher up. We saw four bear scats along this section; all of which contained green vegetation.

Segment B includes the section of the Lost Lake trail from timberline (mile 4) to the south end of Lost Lake. This section passes first through alder along the south-facing slope of an unnamed drainage for about a mile. The upper slope of the drainage contains an abundance of salmonberry and elderberry bushes and some mountain ash. Lady ferns are common, and grasses, sedges, and cow parsnip occur in moderate amounts.

The trail then follows along a ridge at the head of the Lost Creek drainage for about a mile. Vegetation here is a mosaic of hemlock, forb/grass meadows and wet sedge meadows. Grasses and sedges are abundant, while ferns and cow parship are available in smaller amounts. The last 2 miles of the trail follow along a ridgetop where low growing shrubs (crowberry, blueberry, alpine bearberry) are predominant. Grasses and sedges are common in adjacent creekbottoms.

This section of trail passes through a diversity of habitats, offering good year-round food sources to bears. Grasses and forbs are available from late spring through the summer. Berries are abundant in the late summer and fall. We found graminoid scats along this section of trail.

Segment C runs west from the south end of Lost Lake over a low pass to a gradual, south-facing slope above Martin Creek. This section is entirely in the alpine. Narrow bands of low growing willows occur along portions of the creekbottoms draining into Lost Lake and Martin Creek from the pass. Small patches of alder occur at lower elevations on south-facing slopes and along lower portions of the tributaries to Martin Creek.

Large patches of wet sedge meadows occur along the creekbottoms and on more gradual slopes where drainage is poor. Grasses and sedges are common where there is good soil accumulation, such as along drainages and on alluvium at the bases of steep slopes. Areas where soil buildup is less, such as along rocky knobs and ridges, low-growing shrubs are common. Crowberry is the most abundant of these. Alpine bearberry, blueberry, and lowbush cranberry are also found in good quantities. Many of the lower slopes have just become snowfree and are beginning to green up. Several bands of snow still remain throughout this and other valleys.

We observed a small brown bear on the morning of July 10, on a lower north -facing slope above Lost Lake. When we saw the bear, it was about 75 yards away and running from us. It ran to the bottom of the drainage, up the south-facing slope, and over the ridge to the north. We observed two black bears on a southfacing slope (further down the trail).

This area provides good summer habitat for bears because of the large amounts of grasses, sedges, and forbs. These foods are available to bears from early June throughout the summer when south-facing slopes become snowfree. Berries are also abundant, providing excellent fall habitat.

Segment D covers a north-facing ridge of Mount Ascension and an adjacent drainage above Martin Creek. The north-facing slope is predominantly covered with low growing, shrubs. Much of this slope was still snow covered. Both slopes of the adjacent drainage contain a mosaic of grass/forb meadows and alder. We observed two black bears feeding in meadows on the northfacing slope of this unnamed drainage. Several spring scats, one containing leaves and seeds of alpine bearberry and crowberry were found along our route.

Segment E begins at the headwaters of Primrose Creek and runs northeast through a large valley. This valley contains the same habitats as does section C. The north-facing slope is very rocky and low growing shrubs are predominant. Much of this slope was snow covered or recently snowfree at the time of our survey. Sedges and grasses are abundant along the creekbottom. The area north of the creek is very hummocky, offering a good mixture of berries and graminoids. The south-facing slope was snowfree and green.

Near the end of this section, the valley narrows and the slope steepens. Hemlock and alder begin to pick up and low growing shrubs drop out. Grassy meadows are extensive here.

The only bear sign we saw on this section was a few spring scats located in meadows at the east end of the valley.

Section F traverses the valley immediately north of Section E. Tributary creeks flow from the east and south through this valley into a canyon to the north, forming Ship Creek. The south-facing slope at the east end of the

valley is very lush with graminoids and forbs and is mostly snow free. Alders are common along the lower portion of this slope. The north-facing slope is rockier and is made up of meadows and low growing shrub patches. Large wet sedge meadows occur throughout the valley bottom. Both drainages become canyons at the northwest end of the valley. The area between the canyons is composed of a series of ridges, dominated by hemlock and crowberry, interspersed with valleys rich in graminoids. The steep canyon walls are lined with hemlock and alders.

We observed a sow brown bear with two cubs of the year from a distance of 100 yards in a large grassy meadow. Upon catching our scent, the bears fled toward the canyon. We also observed two black bears within this section. One was in a sedge meadow while the other was feeding along a grassy slope.

Section G follows another tributary of Ship Creek which flows from the west. It continues over a low pass to the headwaters of Boulder Creek. This valley contains the same vegetation types as the others. Rocky knobs containing crowberry and other low growing shrubs are most common on the north-facing slope. Grass/forb meadows are most common on the south-facing slope, but also occur throughout the lower slopes. The valley bottom is narrow at the east end and contains willows, grass/sedge meadows, and a little cow parsnip. The valley widens at the west end and wet sedge flats are extensive. Willow stands occur throughout the valley bottom.

The upper end of Boulder Creek also contains the same vegetation types. Willows are most common along the creekbottom, but occur throughout the lower slopes. The drainage contains a good mixture of meadows and low shrubfields.

We observed a black bear feeding in a meadow on an east-facing slope above Boulder Creek. No other bear sign was observed.

In conclusion, this area provides good early to mid summer habitat for bears; large alpine meadows become snowfree at this time and the succulent shoots of grasses and forbs are available relatively late in the season. We observed 8 black bears and 4 brown bears in meadows within a four day period. The large wet meadows at the heads of Ship and Primrose Creeks appeared especially suitable because of the available cover nearby. Large quantities of berry producing shrubs, especially crowberry, grow along the lower alpine slopes in these valleys, providing potentially good fall habitat for bears as well.

SNOW
South
Fork
Lost Lake
Divide
Creek
Lake
Cr.
Mt.
Peak
Ridge
Basin
Meadow
Meadows
Trail
Road
Creek
Lake
Mountain
Pass
Valley
Canyon
Spring
Springs
Camp
Ranger
Station
Forest
Service
Boundary
Wilderness
Primitive
Area
Scenic
Recreation
Historic
Monument
Park
Campground
Picnic
Area
Lookout
Tower
Cabin
Guard
Station
Airport
Landing
Strip
Helicopter
Pad
Trailhead
Parking
Area
Bridge
Ford
Crossing
Gate
Fence
Corral
Building
Church
School
Cemetery
Power
Line
Pipeline
Telephone
Line
Fire
Hydrant
Water
Tank
Windmill
Well
Mine
Shaft
Tunnel
Quarry
Gravel
Pit
Dump
Site
Levee
Dam
Reservoir
Lake
Pond
Swamp
Marsh
Glacier
Snowfield
Rock
Outcrop
Talus
Cliff
Escarpment
Sand
Dune
Beach
Island
Reef
Rapids
Falls
Waterfall
Geyser
Hot
Spring
Fumarole
Mud
Pot
Sinkhole
Cave
Entrance
Arch
Natural
Bridge
Petroglyph
Pictograph
Ruins
Fortification
Battlefield
Grave
Marker
Historic
Site
Prehistoric
Site
Archaeological
Site
Boundary
Line
Township
Line
Section
Line
Quarter
Section
Line
Meander
Line
Survey
Monument
Bench
Mark
Triangulation
Station
Spot
Elevation
Contour
Line
Index
Contour
Intermediate
Contour
Depression
Contour
Hachures
Hill
Shading
Water
Color
Land
Color
Urban
Area
Color
Vegetation
Color
Grid
Lines
Latitude
Longitude
Declination
Diagram
Magnetic
North
True
North
Grid
North
Scale
Bar
Contour
Interval
Datum
Projection
Title
Legend
Neatline
Border
Inset
Map
Index
Map
Key
Compass
Rose
Symbol
Point
Line
Area
Text
Label
Font
Size
Color
Weight
Style
Alignment
Placement
Leader
Line
Callout
Box
Frame
Margin
Padding
Spacing
Kerning
Leading
Tracking
Baseline
Ascender
Descender
Cap
Height
x-Height
Serif
Sans-serif
Monospace
Bold
Italic
Underline
Strikethrough
Superscript
Subscript
Ligature
Glyph
Character
Set
Encoding
Unicode
ASCII
UTF-8
Font
Family
Font
Weight
Font
Style
Font
Size
Font
Color
Font
Smoothing
Anti-aliasing
Hinting
Subpixel
Rendering
Gamma
Correction
Color
Profile
sRGB
Adobe
RGB
ProPhoto
RGB
CMYK
Color
Space
Color
Depth
Bit
Depth
Alpha
Channel
Transparency
Opacity
Blend
Mode
Layer
Mask
Clipping
Mask
Vector
Mask
Raster
Image
Vector
Graphic
Bitmap
Image
Pixel
Resolution
DPI
PPI
Image
Size
File
Size
File
Format
JPEG
PNG
GIF
TIFF
BMP
SVG
PDF
EPS
RAW
Compression
Lossless
Lossy
Quality
Factor
Color
Table
Palette
Indexed
Color
Grayscale
Monochrome
Dithering
Halftone
Screen
Frequency
Screen
Angle
Moiré
Pattern
Aliasing
Jaggies
Smoothing
Filter
Blur
Sharpen
Edge
Detection
Noise
Reduction
Contrast
Brightness
Hue
Saturation
Lightness
Value
Chroma
Tint
Shade
Tone
Gamma
Curve
Levels
Histogram
Exposure
Shadow
Highlight
Midtone
White
Point
Black
Point
Color
Balance
Temperature
Tint
Vibrance
Saturation
Hue
Shift
Color
Wheel
Color
Harmony
Complementary
Analogous
Triadic
Tetradic
Split
Complementary
Monochromatic
Color
Scheme
Color
Palette
Color
Swatch
Color
Picker
Eyedropper
Color
Sampler
Color
Mixer
Color
Blender
Color
Gradient
Linear
Gradient
Radial
Gradient
Angular
Gradient
Diamond
Gradient
Reflected
Gradient
Gradient
Stop
Gradient
Editor
Gradient
Preset
Gradient
Map
Duotone
Tritone
Quadtone
Color
Overlay
Color
Dodge
Color
Burn
Linear
Dodge
Linear
Burn
Vivid
Light
Linear
Light
Pin
Light
Hard
Mix
Difference
Exclusion
Subtract
Divide
Darken
Lighten
Multiply
Screen
Overlay
Soft
Light
Hard
Light
Normal
Dissolve
Behind
Clear
Erase
Replace
Color
Only
Hue
Only
Saturation
Only
Luminosity
Only
Preserve
Transparency
Lock
Position
Lock
Pixels
Lock
All
Group
Ungroup
Merge
Down
Merge
Visible
Flatten
Image
Duplicate
Layer
New
Layer
Delete
Layer
Rename
Layer
Layer
Order
Move
Layer
Up
Move
Layer
Down
Bring
to
Front
Send
to
Back
Layer
Opacity
Layer
Fill
Layer
Style
Drop
Shadow
Inner
Shadow
Outer
Glow
Inner
Glow
Bevel
and
Emboss
Stroke
Satin
Color
Overlay
Gradient
Overlay
Pattern
Overlay
Layer
Effects
Smart
Object
Smart
Filter
Rasterize
Layer
Convert
to
Smart
Object
Edit
Contents
Export
As
Save
As
Save
Save
for
Web
Print
Page
Setup
Print
Preview
Print
Close
Close
All
Exit
Undo
Redo
Step
Forward
Step
Backward
Revert
History
Panel
Snapshot
Cut
Copy
Copy
Merged
Paste
Paste
Special
Paste
in
Place
Clear
Select
All
Deselect
Reselect
Inverse
Selection
Feather
Selection
Modify
Selection
Grow
Selection
Similar
Selection
Transform
Selection
Save
Selection
Load
Selection
Quick
Mask
Mode
Edit
in
Quick
Mask
Mode
Edit
in
Standard
Mode
Find
Find
Next
Find
Previous
Replace
Spell
Check
Preferences
General
Interface
File
Handling
Performance
Scratch
Disks
Cursors
Transparency
&
Gamma
Units
&
Rulers
Guides,
Grid
&
Slices
Plug-Ins
&
Scratch
Disks
Type
Image
Mode
Bitmap
Grayscale
Duotone
Indexed
Color
RGB
Color
CMYK
Color
Lab
Color
Multichannel
8
Bits/Channel
16
Bits/Channel
32
Bits/Channel
Color
Table
Image
Size
Canvas
Size
Pixel
Aspect
Ratio
Rotate
Canvas
180°
90°
CW
90°
CCW
Arbitrary...
Flip
Canvas
Horizontal
Flip
Canvas
Vertical
Crop
Trim
Reveal
All
Duplicate...
Apply
Image...
Calculations...
Variables
Data
Sets...
Define
Pattern...
Define
Brush
Preset...
Define
Custom
Shape...
Purge
Adobe
PDF
Presets...
Manage
Workflow...
Export
Color
Settings...
Color
Settings...
Assign
Profile...
Convert
to
Profile...
Proof
Setup
Proof
Colors
Gamut
Warning
Pixel
Aspect
Ratio
Correction
Color
Management
Policies...
Embed
Profile
Extract
Profile
Delete
Profile
Profile
Mismatch
Missing
Profile
Paste
Profile
Mismatch
Missing
Profile
Paste
Convert
to
Profile
Destination
Space
Preserve
Embedded
Profiles
Don't
Color
Manage
Use
Dither
(8-bit/channel
images)
Compensate
for
Scene-referred
Profiles
Use
Black
Point
Compensation
Use
Adaptive
Resolution
Default
Rendering
Intent
Perceptual
Saturation
Relative
Colorimetric
Absolute
Colorimetric
Blend
RGB
Colors
Using
Gamma
Blend
Text
Colors
Using
Gamma
Extras
Description
Working
Spaces
RGB
CMYK
Gray
Spot
Color
Dot
Gain
Gray
Gamma
Separation
Options
Ink
Colors
Separation
Type
GCR
Preview
Black
Generation
Black
Ink
Limit
Total
Ink
Limit
UCA
Amount
Under
Color
Removal
Black
Generation
Curve
Edit
Curve
Load
Curve
Save
Curve
Smooth
Curve
Reset
Curve
Invert
Curve
Flatness
Maximum
Flatness
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Flatness
Default
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Reflected
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Smoothing
Gradient
Preset
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Duotone
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Smoothing
Tritone
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Smoothing
Quadtone
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Overlay
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Smoothing
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Dodge
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Smoothing
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Smoothing
Linear
Dodge
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Smoothing
Linear
Burn
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Smoothing
Vivid
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Smoothing
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Difference
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Exclusion
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Smoothing
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Lighten
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Pixels
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Smoothing
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Smoothing
Flatten
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Smoothing
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Smoothing
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Smoothing
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Shadow
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Smoothing
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Shadow
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Smoothing
Outer
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Glow
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Smoothing
Bevel
and
Emboss
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Smoothing
Stroke
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Smoothing
Satin
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Smoothing
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Smoothing
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Object
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Smoothing
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Filter
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Smoothing
Rasterize
Layer
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Convert
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Object
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Smoothing
Edit
Contents
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Smoothing
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Undo
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Redo
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Forward
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Smoothing
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Backward
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Smoothing
Revert
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Smoothing
History
Panel
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Smoothing
Snapshot
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Smoothing
Cut
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Smoothing
Copy
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Smoothing
Copy
Merged
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Smoothing
Paste
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Smoothing
Paste
Special
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Smoothing
Paste
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Place
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Smoothing
Clear
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Smoothing
Select
All
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Smoothing
Deselect
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Smoothing
Reselect
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Smoothing
Inverse
Selection
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Smoothing
Feather
Selection
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Modify
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Smoothing
Grow
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Smoothing
Similar
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Smoothing
Transform
Selection
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Smoothing
Save
Selection
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Smoothing
Load
Selection
Font
Smoothing
Quick
Mask
Mode
Font
Smoothing
Edit
in
Quick
Mask
Mode
Font
Smoothing
Edit
in
Standard
Mode
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Smoothing
Find
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Replace
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Spell
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Preferences
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General
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Smoothing
Interface
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Smoothing
File
Handling
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Smoothing
Performance
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Smoothing
Scratch
Disks
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Smoothing
Cursors
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Smoothing
Transparency
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Gamma
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Smoothing
Units
&
Rulers
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Guides,
Grid
&
Slices
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Smoothing
Plug-Ins
&
Scratch
Disks
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Grayscale
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Smoothing
Duotone
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Smoothing
Indexed
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Smoothing
RGB
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Smoothing
CMYK
Color
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Smoothing
Lab
Color
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Smoothing
Multichannel
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Smoothing
8
Bits/Channel
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Smoothing
16
Bits/Channel
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Smoothing
32
Bits/Channel
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Smoothing
Color
Table
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Smoothing
Image
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Smoothing
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Smoothing
Pixel
Aspect
Ratio
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Smoothing
Rotate
Canvas
180°
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Smoothing
90°
CW
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Smoothing
90°
CCW
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Smoothing
Arbitrary...
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Smoothing
Flip
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Horizontal
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Smoothing
Flip
Canvas
Vertical
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Smoothing
Crop
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Smoothing
Trim
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Smoothing
Reveal
All
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Smoothing
Duplicate...
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Smoothing
Apply
Image...
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Smoothing
Calculations...
Font
Smoothing
Variables
Font
Smoothing
Data
Sets...
Font
Smoothing
Define
Pattern...
Font
Smoothing
Define
Brush
Preset...
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Smoothing
Define
Custom
Shape...
Font
Smoothing
Purge
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Smoothing
Adobe
PDF
Presets...
Font
Smoothing
Manage
Workflow...
Font
Smoothing
Export
Color
Settings...
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Smoothing
Color
Settings...
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Smoothing
Assign
Profile...
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Smoothing
Convert
to
Profile...
Font
Smoothing
Proof
Setup
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Smoothing
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Colors
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Smoothing
Gamut
Warning
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Smoothing
Pixel
Aspect
Ratio
Correction
Font
Smoothing
Color
Management
Policies...
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Smoothing
Embed
Profile
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Smoothing
Extract
Profile
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Smoothing
Delete
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Mismatch
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Smoothing
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Profile
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Smoothing
Paste
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Mismatch
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Smoothing
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Profile
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Smoothing
Paste
Convert
to
Profile
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Smoothing
Destination
Space
Font
Smoothing
Preserve
Embedded
Profiles
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Smoothing
Don't
Color
Manage
Font
Smoothing
Use
Dither
(8-bit/channel
images)
Font
Smoothing
Compensate
for
Scene-referred
Profiles
Font
Smoothing
Use
Black
Point
Compensation
Font
Smoothing
Use
Adaptive
Resolution
Font
Smoothing
Default
Rendering
Intent
Font
Smoothing
Perceptual
Font
Smoothing
Saturation
Font
Smoothing
Relative
Colorimetric
Font
Smoothing
Absolute
Colorimetric
Font
Smoothing
Blend
RGB
Colors
Using
Gamma
Font
Smoothing
Blend
Text
Colors
Using
Gamma
Font
Smoothing
Extras
Font
Smoothing
Description
Font
Smoothing
Working
Spaces
Font
Smoothing
RGB
Font
Smoothing
CMYK
Font
Smoothing
Gray
Font
Smoothing
Spot
Color
Font
Smoothing
Dot
Gain
Font
Smoothing
Gray
Gamma
Font
Smoothing
Separation
Options
Font
Smoothing
Ink
Colors
Font
Smoothing
Separation
Type
Font
Smoothing
GCR
Font
Smoothing
Preview
Font
Smoothing
Black
Generation
Font
Smoothing
Black
Ink
Limit
Font
Smoothing
Total
Ink
Limit
Font
Smoothing
UCA
Amount
Font
Smoothing
Under
Color
Removal
Font
Smoothing
Black
Generation
Font
Smoothing
Curve
Font
Smoothing
Edit
Curve
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Smoothing
Load
Curve
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Smoothing
Save
Curve
Font
Smoothing
Smooth
Curve
Font
Smoothing
Reset
Curve
Font
Smoothing
Invert
Curve
Font
Smoothing
Flatness
Font
Smoothing
Maximum
Flatness
Font
Smoothing
Minimum
Flatness
Font
Smoothing
Default
Flatness

BROWN BEAR HABITAT SURVEY

LOCATION: Lost Lake

TRANSECT #:

DATE: 7/9/84

OBSERVERS: JB/GR

H = High
M = Medium
L = Low
t = trace

SPECIES	TRANSECT SEGMENT						
	A	B	C	D	E	F	G
Sedge (Carex sp.)	L	H	H	H	H	H	H
Other sedge (Cyperaceae)	-	-	-	-	-	-	-
Grasses (Graminae)	L	H	H	H	H	H	H
Horsetail (Equisetum sp.)	L	t	t	t	t	L	-
Lady Fern (Athyrium sp.)	H	M	t	L	L	L	-
Other ferns	M	M	t	L	L	L	L
Cow Parsnip (Heracleum lanatum)	H	M	t	L	L	-	t
Angelica (Angelica sp.)	-	M-	-	-	-	-	-
Dandelion (Taraxicum sp.)	-	-	-	-	-	-	-
Mountain Sorrel (Oxyria digyna)	-	-	-	-	-	-	-
Wild Cucumber (Streptopus amplexifolia)	L	-	-	-	-	-	-
Chocolate Lily	-	L	-	-	t	-	-
Astragalus sp./Oxytropis sp.	-	-	-	-	-	-	-
Hedysarum sp.	-	-	-	-	-	-	-
Willow (salix sp.)	-	M	M	M	M	M	M
Cottonwood (Populus trichocarpa)	-	-	-	-	-	-	-
Blueberry (Vaccinium sp.)	H	M	H	M	M	M	M
Salmonberry (Rubus spectibilis)	M	H	-	-	-	-	-
Crowberry (Empetrum nigrum)	-	H	H	H	H	H	H
Devil's Club (Oplopanax horridium)	M	t	-	-	-	-	-
Highbush Cranberry (Viburnum edule)	L	t	-	-	-	-	-
Lowbush Cranberry (Vaccinium vitis-idaea)	-	L	M	L	L	L	L
Bearberry (Arctostaphylos sp.)	-	M	M	M	M	M	M
Mountain Ash (Sorbus sp.)	-	L	L	t	L	L	L
Current (Ribes sp.)	t	L	-	t	-	-	-
Elderberry (Sambucus racemosa)	M	H	-	t	t	t	-
Rose/Raspberry (Rosa sp., Rubus sp.)	-	-	-	-	-	-	-
Salmon	-	-	-	-	-	-	-
Moose	?	-	-	L	L	L	-

BROWN BEAR HABITAT EVALUATION SURVEY

Area: Twin Lakes / Benjamin Creek Dates: 7/16 - 7/20
Personnel: Bevins, Risdahl

Segment A includes the basin containing Alpine Lake and the east end of Twin Lakes and the adjacent mountainside to the north. The valley bottom above Twin Lakes is very moist and contains good quantities of grasses and sedges. Gramnoids are also common on alluvium on the west-facing slope. Crowberry is common on lower slopes and on the south-facing ridge above Alpine Lake. Alpine bearberry, blueberry and lowbush cranberry occur in smaller amounts.

The lower slopes above Skilak Glacier (in the drainage immediately to the east) contain a mosaic of alders and meadows. Wet areas adjacent to the glacier contain good quantities of sedges. Patches of cow parsnip and ferns occur along the lower slopes. We observed a sow black bear with two cubs of the year on the west-facing slope above Skilak Glacier and another black bear in a meadow on the east-facing slope. No bear sign was observed on the Twin Lakes side.

Segment B includes from the west (lower) end of Twin Lakes to the confluence of Benjamin Creek and the creek draining the lakes. Willows and gramnoids are common along the creekbottom and lakeshore. A series of knobs and ravines occurs adjacent to the creekbottom immediately below the lake. The knobs are dominated by shrub birch and contain small amounts of crowberry, blueberry and bearberry. The ravines are dominated by wet sedge meadows. Lower slopes on the south side of the lakes contain a mosaic of low shrubs, meadows and a little alder.

The side slopes at the lower end of this segment are dominated by a mosaic of alders and bluejoint meadows. Mountain ash does well on these slopes. Elderberry and highbush cranberry occur in small patches. Gramnoids, cow parsnip and horsetail are all common along the creekbottom and in side drainages at the lower end of this segment. Lady fern is common.

We noted very little bear activity along this portion of the transect. We found a few green vegetation scats and a berry scat.

Segment C includes the Benjamin Creek valley bottom from the end of segment B to the creek's confluence with the Killey River. Timber is restricted to a narrow band along the creekbottom. The upper 2 miles is sparsely timbered with spruce and hemlock and a few cottonwood groves; timber is more continuous for the last three miles. Willow shrubfields are extensive along the creekbottom and on lower benches. Alders dominate much of the upper slopes. Several large bluejoint meadows occur adjacent to the creekbottom. These contain a large variety of forbs, and cow parsnip is very common. There are also a few large wet meadows adjacent to the creek with large quantities of sedges and some horsetail.

A heavily used game trail exists along the north side of the creek. Moose activity in this drainage is extensive. Moose use the creekbottom during the winter months as evidenced by the large number of antlers that we found. We

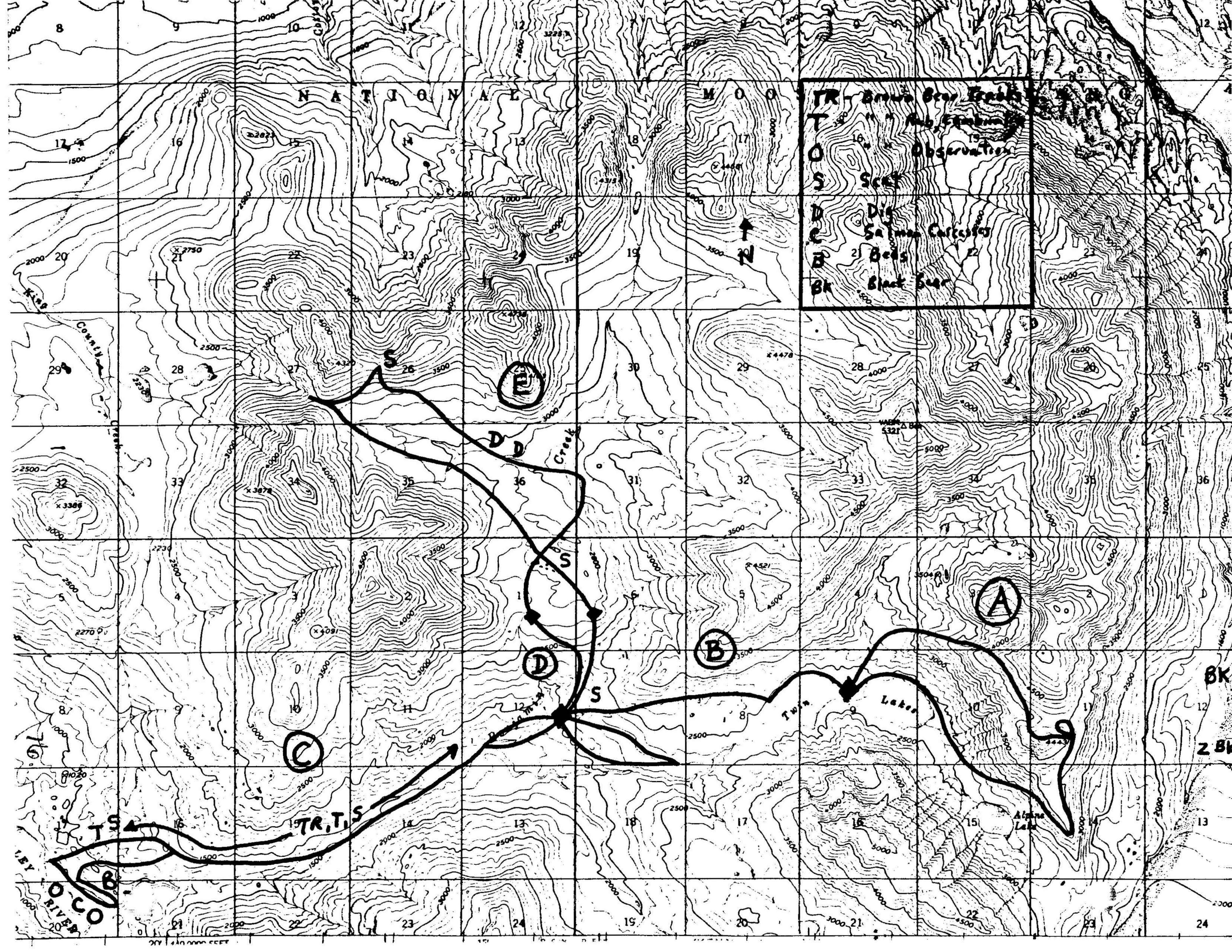
also saw a few bull moose and an abundance of fresh sign. We found the remains of a cow moose, apparently this spring's mortality, in the timber next to the trail. Bears also use the Benjamin Creek valley bottom heavily. We found green vegetation scats frequently along the trail. We also observed over twenty rubbed trees. These were small and medium sized spruces with broken tops or branches, and they had large clumps of brown bear fur hanging from them. They typically had large sections of bark missing. The bears had repeatedly stepped in the same spots, leaving well-worn tracks leading to the trees. We observed beds at the bases of a few of these trees. The trail climbs onto a plateau above the creek about a mile from the confluence, thus avoiding a steep canyon. It then descends a steep slope through alders and spruce to the creek. While descending, we observed several large diameter scats, a bed at the base of a spruce tree and several trees which had been stripped of their bark. The exposed cambium had been scraped away from the "stripped trees" by a bear.

The mile stretch of Benjamin Creek between its mouth and the canyon is used as spawning grounds by king salmon during midsummer. A few brown bears fish for the salmon during this time. We arrived at the spawning grounds at 5:00 p.m. and observed two medium-sized brown bears in the creek, approximately one-third mile apart. Several salmon were in the creek, but we couldn't make an accurate count due to the murkiness of the water. We didn't make an extensive survey of the creek because of the bear's presence. We did see seven carcasses on the banks, including one whole carcass, a few with meat stripped from the flanks and a few with only the head and some bones remaining. Beds had been constructed on bare ground right next to the creek. There were several spots where the tall grass had been matted down. A well worn trail runs along the north side of the creek.

Segment D covers a south-facing slope above the confluence of Benjamin Creek and the Twin Lakes drainage. This slope is a mosaic of alders and bluejoint meadows, with some willow and shrub birch. Blueberry is abundant near the exposed end of the slope. Benjamin Creek flows through a narrow canyon down this slope. Cow parsnip, Lady fern and horsetail all do well on this slope. Forbs are abundant in the meadows. Mountain ash is fairly common on the lower slope. We found no bear sign on this segment.

Segment E covers a portion of the large basin above (north of) segment D. Benjamin Creek originates in this basin. This valley is characterized by low, rolling terrain with several poorly drained areas. Grasses, sedges and forbs are abundant throughout the valley bottom. Low areas are covered with extensive sedge- meadows and willow shrubfields. Crowberry and blueberry bushes are common on better drained areas in the valley and are patchy on lower slopes. We observed two brown bear digs in this basin. It appeared that the bear was digging for small rodents or their caches. We found two green vegetation scats; one was in a saddle of the ridge at the head of the basin while the other was adjacent to the creek.

In summary, The Benjamin Creek drainage (segment C) receives heavy brown bear use, as evidenced by the well established trail, tracks, rub trees and other sign. No bears were observed in alpine areas, but a few scats and digs indicate that the area receives some use. Lush meadows and berry patches are widespread above timberline, so there is probably no concentrated use of a specific site.



TR - Brown Bear Tracks
T " " Rub, Excavation
O " " Observations
S Scat
D Dig
C Salmon Carcasses
B Beds
Bk Black Bear
N
NATIONAL MOOSE
Twin Lakes
Alpine Lake
Creek
King County Creek
RIVER
TR, T, S
T S
O CO
A
B
C
D
E
76

BROWN BEAR HABITAT SURVEY

LOCATION: Twin Lakes TRANSECT #:

DATE: 7/16/84 OBSERVERS: JB/GR

H = High
M = Medium
L = Low
t = trace

SPECIES	TRANSECT SEGMENT				
	A	B	C	D	E
Sedge (Carex sp.)	H	H	H	H	H
Other sedge (Cyperaceae)	-	-	-	-	-
Grasses (Graminae)	M	H	H	H	H
Horsetail (Equisetum sp.)	t	L	L	M	M
Lady Fern (Athyrium sp.)	-	L	L	M	-
Other ferns	-	L	M	L	-
Cow Parsnip (Heracleum lanatum)	t	L	H	M	t
Angelica (Angelica sp.)	-	L	L	L	-
Dandelion (Taraxicum sp.)	-	-	-	-	-
Mountain Sorrel (Oxyria digyna)	-	-	-	t	L
Wild Cucumber (Streptopus amplexifolia)	-	L	L	L	-
Chocolate Lily	-	L	L	-	-
Astragalus sp./Oxytropis sp.	L	L	-	-	M
Hedysarum sp.	-	-	-	-	-
Willow (salix sp.)	M	M	H	M	M
Cottonwood (Populus trichocarpa)	-	-	M	-	-
Blueberry (Vaccinium sp.)	L	M	L	H	M
Salmonberry (Rubus spectibilis)	-	-	-	-	-
Crowberry (Empetrum nigrum)	M	L	L	M	M
Devil's Club (Oplopanax horridium)	M	t	-	-	-
Highbush Cranberry (Viburnum edule)	-	t	L	L	-
Lowbush Cranberry (Vaccinium vitis-idaea)	L	t	L	t	t
Bearberry (Arctostaphylos sp.)	L	t	L	L	t
Mountain Ash (Sorbus sp.)	-	M	L	M	-
Current (Ribes sp.)	-	t	t	t	-
Elderberry (Sambucus racemosa)	-	L	t	t	-
Rose/Raspberry (Rosa sp., Rubus sp.)	-	-	M	-	-
Salmon	-	-	L	-	-
Moose	t	L	H	t	-

APPENDIX IV

SALMON SPAWNING AREA EVALUATION WRITEUPS

Benjamin Creek 7/17/84

Benjamin Creek is a slightly glacial tributary stream of the Killey River with a 3/4 mile stretch of spawning habitat located in section 20, T2N, R6W. A moderately steep canyon prevents further upstream access. A population of about 600 King salmonn spawn in Benjamin creek from mid-July through late August. A few brown bears are typically seen using this stretch by ADF&G fisheries personnel at this time.

On July 17, we followed a heavily used game trail on the north side of the creek from Twin Lakes to within a 100 yards of its confluence with the Killey. We then walked the entire stretch of spawning habitat. We found this game trail to be heavily used by brown bears, as evidenced by the abundance of vegetation scats, rub trees and footprint trails leading to mark trees (trees clawed and bitten). The trail climbs onto a plateau above the creek about a mile from the confluence, thus avoiding the steep canyon. It then descends a steep slope through alders and spruce to the creek. While descending, we observed several large diameter scats, a bed at the base of a spruce tree and several trees which had been stripped of their bark. The exposed cambium had been scraped away from the "stripped trees" by a bear.

We arrived on the spawning grounds at 5:00 PM and observed two medium-sized brown bears in the creek, approximately one-third mile apart. Several salmon were in the creek, but we couldn't make an accurate count, due to the murkiness of the water. We didn't make an extensive survey because of the bear's presence. We did see several carcasses on the banks, including one whole carcass, a few with meat stripped from the flanks and a few with only the head and some bones remaining. Beds had been constructed on bare ground next to the creek and the tall grass had been matted down in several spots. The rotten smell indicated that there were more salmon carcasses present than the ones we counted. A well-worn trail runs along the north side of the creek.

Juneau Creek 7/31/84

Juneau Creek is a small tributary of the Kenai River, entering from the north near mile 52 on the Sterling Highway, in section 30, T5N, R3W. This creek is a spawning area for a small number of King Salmon. Kings enter Juneau Creek in mid-July. Spawning occurs in the lower 3/4 mile of the creek.

We surveyed Juneau Creek on July 31. This creek averages about five yards in width. The banks are timbered with spruce and some cottonwoods. Alder and willow are thick in places, while bluejoint is common in others.

We counted 72 live king salmon in the creek, many of which were spawned out and weak. Most of the fish were concentrated near the lower quarter mile of the creek.

There were no well-used trails along the creek bottom, although the grass was beaten down along a few stretches. We saw 2 sets of bear tracks near the upper end of the spawning area, one of which may have been that of a small brown bear. The claws were 1.5 inches from the toes. We saw a small black bear walking toward the creek about a quarter mile from the mouth. We found one salmon carcass which had been fed on, but this was directly below an active bald eagle nest and was probably being utilized by the eagles.

We noted several berry scats on a bench a few hundred yards above the creekbottom. The scats contained devil's club berries and highbush cranberries.

Anchor River 8/1-3/84

King salmon enter the Anchor River from early May to the first of July. The majority reach their spawning grounds on August 1. Spawning occurs all the way up the headwaters of the Anchor, with most occurring below Beaver flats. Aerial counts indicate that around 1500-2000 kings spawn in the Anchor.

We surveyed portions of the river from its headwaters to the North Fork road at Twitter Creek from August 1 to August 3. The river ranges from a few yards to 15 yards in width and meanders greatly. Depth is quite variable, ranging mostly from a few inches to 2.5 feet, with some sites as deep as 4 feet. The water is coffee brown. Sand and mud bars are common, providing good substrate for tracks.

Vegetation in the river bottom is a mosaic of willows and bluejoint, most of which is over 5 feet high. Horsetail and sedges are common. Cottonwood groves occur throughout the bottoms. Spruces are scattered in the bottoms, but dominate adjacent slopes.

We walked cross-country from Falls Creek above the East End road to the headwaters of the Anchor. We followed a tractor trail from the upper end of the north branch of the river for several miles, untl we reached a seismic road which we followed south to the south branch.

We saw at least two different sets of brown bear tracks in mud while hiking the tractor trail. We found a brown bear rub tree on the seismic road between the two forks of the river.

We first encountered salmon in the south branch of the river about a mile above the junction. From this point to about 2 river miles below the junction, we counted about 50 live salmon. Many of these appeared spawned out and rotting. We could not accurately count bear-killed carcasses, due to the thick vegetation, but could smell many which we didn't see. We estimated that there were over 75 carcasses along this stretch. We walked down the middle of the creek, examining sand and gravel bars for tracks as we went. Brown bear

tracks, as well as black bear and wolf tracks, were very numerous. We didn't attempt to determine the number of individual brown bears using the river, due to the different ages of the tracks and the different substrates. We found tracks on nearly every sand and mud bar. Trails leading from the creek, through the grass and willow, were also abundant. We found feeding sites over 100 yards from the river.

We walked an old tractor trail above the river for approximately 5 miles, then dropped back into the riverbottom about a mile above Beaver Creek. We observed tracks of a large brown bear along the whole length of the tractor trail, along with vegetation scats. We walked the river bottom from this point to where the North Fork Road crosses the river (12 to 15 river miles). Most of the salmon were either spawned out or dead along this stretch also. We estimated about 150 live salmon and 200 carcasses along this stretch. The heads and stomachs were the only portions consumed on most of the dead fish. Fresh black bear tracks were abundant along this stretch of riverbottom. Brown bear tracks were numerous, but all were over a few days old. Tracks were most abundant above Beaver Creek, but the substrate along the area below this point was more gravelly and not as good for tracks. Wolf tracks were also common along this whole stretch. We saw tracks of all three species within a half-mile of the road.

Although the portion of the Anchor River drainage which we surveyed contains no roads, the area does receive considerable human use. Several cabin sites have been built by individuals on the ridges above the river. We saw 4 cabins along the north branch of the river. These cabins are probably used mainly during the hunting season in the late summer and fall. Several lightly used three-wheeler trails occur at the upper end of the drainage. We followed tractor trails which parallel the river on adjacent hillsides several hundred yards away, for several miles. It appears that there is access to the whole drainage by ATV's on these trails and on old seismic roads. Vehicle access to the river is limited to a few locations at this time. The portion of the river below South Beaver Creek appears to be popular with fishermen.

Moose Creek 8/6/84

Moose Creek enters Tustumena Lake near the lake's southeast end, in section 29, T1N, R8W. Sockeye Salmon enter Moose Creek in mid-July. Peak numbers reach around 14,000 fish. Pink salmon are present in small numbers.

We surveyed Moose Creek on August 6. The creek is narrow, averaging about 5 yards wide. Salmon spawn in the lower 2.5 miles of the creek. The lower half of the spawning area is on a gentle slope and this portion of the creek meanders slighty. The upper half is on a moderate slope, containing numerous small falls and large rocks. Salmon are restricted from further upward migration by a large series of falls.

The creek runs through a spruce/cottonwood forest. Alder is common in the understay adjacent to the creek and small bluejoint meadows occur adjacent to portions of the spawning area. Crowberry, lowbush cranberry and bluberry are

common on timbered benches above the creek, especially near the upper portion of the spawning area.

We counted over 11,000 live salmon spread out fairly evenly over the spawning area. Numbers were slightly smaller in the upper mile stretch. Many of the fish were in shallow water and were spawned out and weak. Bear predation was intense. Well-worn bear trails existed along both banks and several side trails led from selected fishing spots to adjacent uplands. We counted 577 carcasses which had been killed and fed on by bears. We only counted those carcasses found in the creekbottom or along one bank. The number of carcasses along the other bank and further in the timber would easily double the number that we counted. We observed a few carcasses over 30 yards from the creek. The heaviest predation occurred within the first 1 1/2 mile of stream. Predation on this creek has been intense for several weeks as evidenced by the well-worn trails and the large percentage of carcasses where only the skeletons remained. Bears were consuming only small portions of the recently caught fish. Heads, guts and small portions of the back were being selected. In some cases, only the skin was eaten.

Scats containing salmon, grasses and berries were common along the bear trails. Berry scats examined contained cranberries and crowberries. Trees stripped of their bark were common adjacent to the creek, however most of these were from past years. We found black bear hair in the sap of a freshly stripped tree. Torn up logs and dug up yellow jacket nests were also common, indicating a high use of insects.

We found quite a bit of evidence indicating brown bear use of this creek. There was very little exposed substrate suitable for clear tracks; the one track we found was that of a small brown bear. Along the steeper, upper portion of the spawning area, alders hang over the creek, and we found several patches of brown bear hair on the alder branches. We also found several rub trees containing brown bear hair and a hollow log used as a bedding site.

Bear Creek 8/7/84

Bear Creek enters Tustumena Lake on tthe lake"s east side in section 35, T2N, R9W. Sockeye salmon enter Bear Creek in mid-July. ADF&G maintains a weir at the mouth of the creek for egg take for their hatchery. They release a few thousand fish above the weir each day from mid-July until they collect eggs in mid-August. Salmon spawn throughout a fifteen mile stretch of the creek, from the mouth to timberline. Peak numbers are in excess of 50,000 fish.

ADF&G conducted an aerial survey of the creek prior to weir placement in mid-July. At that time, 2000 fish were in the creek. On August 7, the date of our survey, 25,000 salmon were in the creek above the weir.

We walked the first 2.5 miles of the creek. This lower section of the creek passes through a flat, wide valley. The valley bottom contains extensive bluejoint/forb meadows intermixed with groves of birches, cottonwoods and spruce. Much of the creek is lined with alders or young cottonwoods. Approximately 3 miles above its mouth, the creek runs close to heavily timbered slopes. The creek is shallow and averages between 5 and 10 yards wide.

The first half mile of creek receives very little bear use. Human activity at this lower end includes an ADF&G camp of the weir site and two permanent residents within a quarter mile of the creek. The residents own several dogs and a few horses. We observed horse sign on both sides of the creek for the first half-mile and a good trail runs parallel to the creek, less than 100 yards away, for several miles.

We did not count live fish, but kept track of salmon utilized by bears for the first mile and a half. We counted 138 carcasses in the stream and along one bank. After the first half mile, bear use is heavy. Trails are common along the banks and leading from the creek to adjacent cover. Berry scats (crowberry, lowbush cranberry) were abundant. Several cottonwoods and spruces adjacent to the creek were stripped of their bark. We found brown bear hair on one rub tree.

We encountered 4 black bears about 1 1/2 miles from the mouth of the creek. We treed two small bears (possibly yearlings) and could hear another bear, probably a sow, walking around in adjacent cover. Within a few minutes, we encountered a small sow and cub in the creek a few hundred yards upstream. The cub treed and the sow disappeared into the brush after running toward us.

We talked with Joe Blackwell, a year round resident at Bear Creek about brown bear activity on the creek. He has encountered brown bears on the creek about 4 miles above the mouth. There, the creek passes through a narrow canyon and brown bears bed on the benches above the creek. He believes that brown bear activity is extensive from mile 3 to the end of the spawning area, near timberline. He has seen brown bears on the beach in the spring and fall, looking for salmon carcasses. Some moose calving occurs near the lake, also attracting bears.

Nikolai Creek 8/9/84

Nikolai Creek is the longest tributary Creek of Tustumena Lake, entering in section 9, T1N, R10W. The creek is approximately 25 miles long and salmon spawn throughout its length. This creek has a run of up to 35,000 sockeye salmon which arrive in late May. A large run of silvers begin entering the creek in early August.

We surveyed 2.5 miles of this creek, from the mouth, on August 9. The creek has a moderate flow rate and is coffee brown. Stream width varies from a few to 10 yards. It meanders quite a bit and gravel and mud bars are numerous, providing good substrate for tracks. Head-high bluejoint lines both banks, while alder is scattered. An occasional clump of cottonwoods and spruce occur adjacent to the creek, while timber occurs in dense stands 20 yards away.

We counted 1229 live and 250 dead salmon on this survey. Most living salmon appeared spawned out and decayed. There was relatively little evidence of bear predation. Twenty one carcasses had been killed or utilized by bears. Sign of activity along the banks was light. We saw tracks of a sow and cub brown bear along the creek, from a mile above the mouth to the upper end of our survey area. The bears had walked upstream. We also saw a few black bear tracks.

Silver salmon were just beginning to enter Nikolai Creek at the time of our survey. Several persons were fishing for silvers and dolly varden at the mouth of the creek. Footprints on mud bars indicated that at least two fishermen had walked the creek as far as we had surveyed.

Crystal Creek 8/8/84

Crystal Creek enters Tustumena Lake at the lake's south end, in section 4, T2S, R8W. It receives a late sockeye run beginning in early August. Sockeye numbers may reach 10,000 to 15,000, but is usually much less. The run peaks in mid-August. Spawning occurs in the first mile of the creek.

We surveyed Crystal Creek on August 8. It is a small, moderately swift stream averaging 5 yards in width. The banks are gravelled and vegetation is sparse for 10 to 30 yards on both sides. Adjacent upland slopes are a combination of spruce forest, alder and bluejoint meadows.

Sockeyes were just entering this stream at the time of our survey. Seventy fish were in the lake at the mouth of the creek, while 70 were spread out over the first mile of creek.

Bear use of this creek appeared minimal at this time. We counted only 3 bear-killed carcasses and observed a few sets of black bear tracks adjacent to the creek. We walked portions of the adjacent slopes to look for additional sign. The slope to the north was timbered, while much of the slope to the south contained meadows and alder. The timbered slope contained an old blazed trail running parallel to the creek. The trail is overgrown and we saw no recent human sign. Berry scats were common along this trail. Devil's club was common on this slope. Meadows in the south slope contained good amounts of devil's club, raspberry and elderberry and a little highbush cranberry. We observed a dug-up wasp nest on this slope.

Clear Creek 8/8/84

Clear Creek enters Tustumena Lake about a mile east of Crystal Creek, in section3, T2S, R8W. This creek receives two sockeye salmon runs. The first run of from one to two thousand fish enters the creek around June 1, while the later run of up to 5000 fish enters in August. Spawning is restricted to the first half mile of stream, by the steep terrain.

We surveyed Clear Creek on August 8. This narrow creek (5 yards wide) winds through a closed spruce/cottonwood forest. Large bluejoint meadows occur on adjacent benches above the creek.

We counted 397 live fish, 26 untouched carcasses and 38 carcasses fed on by bears. We didn't conduct an accurate count of bear-consumed carcasses due to the thick vegetation. Well used trails occur along the creek bottom and on adjacent timbered slopes. Several paths occured through the head-high

bluejoint. We also observed dozens of berry scats. Black bear tracks occurred in the few places where prints were visible. We found several clumps of brown bear fur on a downed tree laying chest high across the creek. It appeared that the bear had been scratching himself on the tree.

Several berry producing shrubs occur adjacent to the creek. All appeared very productive. These included devil's club, lowbush and highbush cranberry and elderberry. Devil's club, cranberry and blueberry fruits were common in scats.

Seepage Creek 8/9/84

Seepage Creek enters Tustumena Lake in section 10, T1S, R8W. Sockeye salmon enter Seepage Creek in mid-July. Run size averages less than 5000 fish, but may reach up to 25,000.

We surveyed Seepage Creek on August 9. Salmon spawn in a mile-long stretch of this creek. The creek averages between 5 and 10 yards wide and its banks are lined with a thick row of alders for most of its length. The creek runs adjacent to a timbered slope for the first half mile, then continues through a gravelly glacial flat containing scattered young cottonwoods, bunch grasses and a few forbs. Near the upper most end of the spawning area, the creek narrows to a few yards and passes through a wet meadow.

We counted 1657 live salmon and 84 bear-used carcasses. All of the carcasses that we observed were in the creek or on the banks a few yards away. Bear trails existed along portions of both banks, but use did not appear extensive. We observed several berry scats (lowbush cranberry, devil's club), a few beds and four dug up wasp nests. We found clumps of brown bear fur on alder branches overhanging the creek and on a small spruce rub tree in an adjacent meadow. There was very little substrate suitable for tracks.

Glacier Creek 8/8/84

Glacier Creek enters Tustumena Lake a few hundred yards from Seepage Creek, in section 10, T1S, R8W. It recives a run of sockeyes which is in excess of 75,000 fish. The salmon begin entering the creek around July 10. ADF&G places a weir near the mouth of the creek in early August for egg collection.

We surveyed Glacier Creek on August 8. The creek originally was fed by Tustumena Glacier, but the glacial creek cut a new path and the creek is now fed by seepage water and runoff from the mountain to the north. The creek runs along a gravelly glacial flat for 2 miles. The banks are lined with chest-high bluejoint. Adjacent terrain is partially vegetated with bunch grasses and a few types of forbs.

Alders, birches and young cottonwoods are patchy in the flat and, in a few places, run adjacent to the creek. Spruce is found near the creek at its

upper end. The creek averages 5-10 yards wide and becomes very narrow in a few places. The creek forks near its mouth and the side channel rejoins the main creek about a mile upstream.

At the time of our survey, we estimated that there were about 15,000 fish in the main channel of the creek and 2000 in the side branch. The ADF&G crew had placed the weir across the creek the day before our survey and several thousand fish were concentrated below the weir. The crew were passing a few thousand fish a day.

We saw 2 medium-sized black bears on Glacier Creek, about a mile from the mouth. We watched one bear catch several salmon in a period of 10 minutes. The bear would herd a large group of salmon through a narrow section of the creek. He would snatch a salmon as he ran down the creek, then carry it into the grass. He repeated this several times. The other bear walked within 15 yards of us before we scared it off.

Black bear tracks were numerous along the creek and we counted over 300 carcasses along the banks. Narrow stretches of the creek appeared to be the favorite fishing spots. Other bear sign included overturned rocks; done by bears searching for insects, numerous berry scats (cranberry, devil's club) and several stripped trees near the upper end. We found no definite brown bear sign.

Moose Creek 8/14/84

Moose Creek is a short stream that runs south and empties into Upper Trail Lake next to the Trail Lake Fish Hatchery, in section 27, T5N, R1W. The stream has two main branches and one major tributary, Carter Creek. An annual run of approximately 4,000 to 5,000 sockeye salmon spawn here.

We surveyed Moose and Carter Creeks on August 14. The number of living fish was dwindling because spawning activity had peaked by the end of July. Spawning begins around mid-July in these two creeks.

We began our survey at the mouth of Moose Creek by boat. Here, the stream consists of slow-moving pools that meander through the sedge meadows near the hatchery.

The first section of Moose Creek winds through tall grass and alder, closely paralleling the Seward Highway. Bear activity here was limited to about 200 yards in the grass and alder beginning at the edge of the sedge meadows. Beyond that point, the stream flows in view of the highway. The stream's closeness to the road from there is a probable cause of the diminished bear sign. Human sign was present in abundance along the stream where it is adjacent to the highway. Only black bear sign, in the form of tracks and hair, was found in this area. Bear trails ran along the stream bank through the grass and alder. Thirty seven bear-killed carcasses and three bear scats were found in this area. The scats were composed primarily of currant berries and grass.

The distance fish spawn up Carter Creek is less than 1/4 of a mile. The sockeye's travel is abruptly ended by a steep cascading water fall orginating at Carter Lake. There were 60 live fish, 138 spawned-out mortalities and only three bear-killed fish counted in this tributary. The banks of this narrow stream are shadowed by large cottonwoods and spruce trees growing in grassy meadows. Devil's club and a little equisetum are mixed in with the grass and cottonwoods along Carter Creek.

The second section of Moose Creek surveyed runs a total distance of just under a mile from where Carter Creek enters it to where it branches on the east side of the highway. This winding piece of water is faster on the west side of the road as it flows through alder and grass. It slows tremendously and has numerous pools on the sedge-covered, boggy eastern side. Very few salmon spawn here because the water speed, temperature and silt content are not condusive to good spawning conditions. No bear sign was seen in this entire mile-long stretch.

The last portions of the stream we surveyed were its two forks. The west fork received slightly greater use by salmon than the east fork. Both forks are used by salmon to water depths of just a few inches and stream widths of less than one foot. Both sections are about one mile long. Vegetation along these portions was similar to the other sections, except that more spruce was encountered nearer the headwaters. total counts of 1,909 live sockeye salmon, 2,677 spawned-out mortalities and 140 bear-killed salmon were made in Moose Creek. There was definite sign of both brown and black bear activity along these last sections of Moose Creek. The bear sign increased further away from the highway to the point where the sockeye quit spawning. One large tree lying across the east fork had been rubbed and scraped extensively by a brown bear and hair was abundant. No actual tracks were observed in these areas as no mud or soil appear along the stream here. Bear trails were common and well-used, however.

Johnson Creek 8/15/84

Johnson Creek is a tributary of Trail Creek, entering approximately one-half mile above Upper Trail Lake in section 8, T5N, R1E. The creek forks into two main branches a quarter mile above the mouth. We surveyed the west fork on August 15. The salmon utilize a half mile of this fork for spawning; further migration is blocked by a large log which straddles the creek. Less than 500 sockeyes used this area each year from 1980 to 1983, but numbers may reach several thousand in a particular year. Salmon enter the creek in late July.

The lower half mile of Johnson Creek consists of several braids which meander through flat terrain dominated by willow and sedges. The creek bottom substrate is composed of silt and small gravel. The upper portion which we surveyed, consists of a single channel which runs through a spruce/cottonwood forest. Alder and devils club are common in the understory. Here, the creek meanders considerably less and the substrate consists of large rocks. The creek is less than 5 yards wide, and some braids are as narrow as a few feet.

We counted 221 live and 668 dead sockeyes during our survey. Roughly 60

percent of the mortalities were utilized by bears. Tracks indicated that at least three brown bears had visited Johnson Creek in the last few weeks. The small size of one track indicated to us that a sow and yearling had fished at the creek. We also observed several black bear tracks.

Many of the tracks were located in mud flats between Trail Creek and the railroad bridge crossing Johnson Creek a hundred yards away. Railroad workers were making repairs to the bridge during the time of our survey; this activity probably eliminated bear use of the creek during working hours. Along the upper end of the spawning area, substrate suitable for tracks was minimal, but we did find one set of tracks along the creek. No well-worn paths occurred along the banks of the creek. We found a few clumps of brown bear hair on a fallen log which straddled the creek. The four scats we found all contained devils club berries and highbush cranberries. I noted several small digs where bears had grubbed for insects.

Railroad Creek 8/15/84

Railroad Creek is a small tributary which enters Upper Trail Lake near its northeast end, in section 18, T5N, R1E. Sockeyes enter Railroad Creek in late July and peak escapement counts over the last five years have ranged from 1200 to 2500 fish.

We surveyed Railroad Creek on August 15. Salmon spawn in the first mile stretch, to where the Johnson Pass trail crosses the creek. Spawning activity is heaviest in the lower half of the creek, where it meanders through willow bottoms and sedge meadows. The main creek is, on average, a few yards wide and several side channels are only a foot or so wide. A few beaver dams have created wide spots in the channels and salmon work their way into most of these side channels. The banks are lined with willows up to 6 feet high.

The upper end of the spawning area lies within a spruce/cottonwood forest. Alders and willows are common in the understory adjacent to the creek which is only a few yards wide along this section. The slope increases slightly and the creek is relatively straight.

We counted 152 live salmon and approximately 1200 carcasses in the lower stretch of the creek. The fish are highly vulnerable to bears because of their confinement in the narrow channels. Approximately 75% of the mortalities showed sign of bear use. Cover for bears is excellent along most of this stretch of the creek. The majority of bear activity may occur during the hours between late evening and early morning, however, due to human activity during the day. A large camp is set up about a quarter mile from the creek, and someone was operating a chainsaw in the camp when we conducted our survey.

We counted 124 live and approximately 600 dead salmon along the upper, timbered stretch of creek. Again, most mortalities had been utilized by bears.

We observed two different sets of brown bear tracks in mud adjacent to a

beaver-dammed channel of the creek on the willow flats. Another set, further upstream, was equal in size to the larger track found below. We also found both black bear and brown bear hair on trees overhanging the creek. Matted down trails through bluejoint patches occurred in several locations and a well-worn dirt path occurred in a few stretches along the timbered bank. We found a half dozen scats, consisting of highbush cranberries, which was very abundant along the creek, and devil's club, which was less common.

Trail Creek 8/22-24/84

Trail Creek is a glacial tributary of the Kenai River system, entering Upper Trail Lake in section 12, T5N, R1E. An undetermined number of sockeye and silver salmon spawn in the Trail Creek drainage above Johnson Creek. Red salmon enter Trail Creek in late July while silvers appear in early September.

We surveyed three clearwater tributaries of Trail Creek on August 22-23 to determine the extent of red salmon spawning activity in these creeks. We were unable to check a few other tributaries because of high water in the main creek. We also surveyed the main creek for bear activity.

We surveyed a 2.5 mile stretch of Trail Creek above Hunter. We observed no carcasses along its banks and only 2 live fish in the creek. It appears that few red salmon spawn in this creek and those which do are concealed well by the murkiness of the water. Spawned out fish are probably swept downstream quickly by the swift current. We did see an old set of brown bear tracks on a gravel bar.

The first clearwater tributary we surveyed enters Trail Creek from the north, below the tracks, a little over one river mile above Hunter. Red salmon spawn in a one-half mile stretch which meanders through a willow/sedge flat. The creek is only a few yards wide and has several side channels. It also has a good gravel substrate. We counted 15 live salmon and over 300 carcasses, most of which had been partially consumed by bears. We found no tracks, but did find a few brown bear hairs on willows next to the creek.

The second tributary creek we surveyed enters fromm the north, 2.5 miles below Hunter. Salmon utilize a 1.5 mile stretch below the railroad tracks for spawning. Alders line the banks of this creek throughout its length. The lowest quarter mile section is wide and deep and is not utilized by salmon or bears. Above this, the creek narrows and salmon are fairly numerous. We observed 10 live salmon and over 150 bear-utilized carcasses. Again, we observed no tracks, but found a few clumps of brown bear fur on overhanging trees.

The third tributary also enters from the north, on the north side of the tracks about a half mile downstream of the second tributary. This mud-bottomed creek passed through large grass/sedge meadows and alder thickets. We counted 6 salmon in this creek and found no evidence of bear use. The bottom substrate of this creek appears unsuitable for spawning. We did find a brown bear rub tree in a birch grove immediately north of the creek.

The Chickaloon River and it's tributaries make up an extensive system containing many miles of spawning habitat for 4 species of salmon. It's remoteness insures that the system recieves relatively little use by humans. Consequently, it provides ideal summer habitat for several brown bears.

Pink salmon move into the river in early August and are on their spawning grounds between river miles 9 and 19 of the Chickaloon by mid-August. Numbers were extimated at 50,000+ this year. Pinks are typically a 2 year spawner and numbers are expected to be low next year.

From August 28 to August 30, we surveyed the Chickaloon River by canoe from river mile 26 to river mile 3. We were flown into a small lake approximately 100 yards from our starting point, by USFWS pilot Bill Larned. Bill picked us up on the river when our trip was completed.

The section of river which we surveyed consists of three stretches which differ in physical charactoristics and in salmon use. The uppermost stretch, to about river mile 15, flows over very flat terrain and is slow moving. Here, the river meanders greatly, often doubling back on itself. Adjacent vegetation is a mixture of wet bluejoint and sedge meadows, with scattered timber, and white spruce/hardwood forest. The river has a fairly uniform width of about 20 yards. At the time of our survey, depths varied from 2 feet to several feet. Heavy rains had raised the water level about a foot during that week. The water is coffee brown in color.

King and pink salmon spawn in this stretch of water, but numbers are relatively low compared to other portions of the river. Although numbers are low and fishing appeared to be difficult for bears, due to high waterr, we saw an abundance of sign on portions of this stretch. We saw very few carcasses along the first 7 miles, but immediately after the river swings south, sign was fairly common. During low water levels, salmon are vulnerable to bears along gravel bars, where the river is only a few inches deep. We found the remains of between 75 and 100 salmon carcasses on this 4-5 mile stretch. We saw brown bear tracks in the few mud bars along the banks, and several places where bears had clawed the bank to pull themselves out of the water. From our 00mpsite at mile 15, we followed a heavily-used bear trail on foot, along a timbered slope above the river, for about 2 miles. We observed over a dozen brown bear rub trees and several digs along this stretch. Some digs had been made to get at hornet nests; we couldn't determine the reason for others. We found several scats full of lowbush cranberries; these were the only berries available in abundance. Rose hips were common but we didn't see any evidence of their use. Many less-used side trails led upland and to the river.

The second portion of the river we surveyed is between mile 15 and mile 7. Here the river also meanders, but it is swifter and shallower. Coarse gravel occurs along the bottom of this stretch. Spawning habitat is of higher quality and the majority of pink salmon spawn there. Adjacent terrain is forested, with occasional meadows throughout. Downed timber and log jams occur frequently in the river. Width varies from a few yards to 20 yards and the river splits into 2 to 3 channels several times.

We found this stretch to be heavily used by brown bears. Salmon are very abundant and accessible for a short time. At the time of our survey, spawning activity was completed and we saw less than a dozen live pink salmon. Carcasses littered the banks and log jams. Some of the carcasses appeared very fresh, indicating recent bear use. In some locations, fish lay in piles on the banks, with only the heads missing. We saw numerous brown bear tracks in mud and sand bars; all had been made previous to the heavy rains occurring over the past weekend. We observed a few black bear tracks at the very lower end of this stretch.

The third stretch of the river, from mile 7 to the mouth, is a deep, wide channel. Water is silty and tidal, and mud flats surround the river. Pink salmon occur here, but are used little by bears.

Snow River 9/10-13

The Snow River consists of two forks which join approximately 4 miles south of its termination point at the south end of Kenai Lake. Both forks are glacial fed and travel from the east through wide valley bottoms.

The South Fork is approximately 15 miles in length. Little is known about the salmon numbers and distribution in this drainage, but sockeyes, pinks and silvers are known to spawn there. At the time of our survey, the water level was very low and confined to channels no more than 10 yards wide. We easily forded the river with hip boots several times and found no stretches over 3 feet deep. Tracks showed that several 4-wheel drive vehicles had driven within a few miles of the head of the drainage. During early summer and after heavy rain falls, the river is considerably higher, making fording difficult.

We found 40 red salmon carcasses along the main river channel. All but one of these were dried up and few had been partially consumed by bears. One carcass was less than a day old and had been partially consumed. Many carcasses had probably been washed down the river by this time. The river is very murky, but we saw several live sockeyes in a few clear backwater areas. We observed no pinks or silvers.

We investigated 9 tributaries, identified from aerial photographs, for possible spawning activity and bear use. We found that all but three of these were unavailable to sockeye salmon because of beaver dams, falls, shallow water or swift glacial water. The remaining 3 creeks all received brown bear use.

The first spawning stream which we investigated occurs about 3.5 miles above the junction of the two forks of the river. It is narrow and meanders through a large willow shrubfield. We counted 300 sockeye salmon carcasses which had been partly consumed by bears. Many of these were dried up while others were relatively fresh looking. A group of 10 sockeye salmon were present in a large, deep pool. We noticed the tracks of two brown bears and a black bear, along with several beds and trails.

The second tributary creek contains about a half-mile of suitable habitat, but

salmon are restricted to the first few hundred yards due to heavy log jams. This tributary passes through a spruce/cottonwood forest with a willow/grass understory. We found 50 carcasses partly consumed by bears and one set each of brown bear and black bear tracks.

The third tributary utilized by salmon is actually part of the river which seeps underground and emerges as clear water. This stretch is a few hundred yards long and we counted 75 salmon carcasses on its banks. A fresh set of brown bear tracks covered much of the sandy banks.

The river bottom appears to be an ideal travel corridor for bears because of its open, flat terrain and the relatively little use it receives by humans. We found brown bear tracks of uniform size (front pad was 5-5 1/2 inches) on almost every sand bar and tributary creek which we investigated. This showed either extensive use by one bear or use by a few bears of nearly equal size. We also observed large brown bear tracks (front pad width 7 3/4 inches) in a few locations. We found brown bear fur on downed timber across an old trapping trail which parallels the river bottom in the adjacent spruce forest. We also observed a black bear sow with 3 cubs crossing the river bottom during midday and tracks of several black bears throughout the river bottom.

The main fork of the Snow River flows through a long, narrow canyon about 2.5 miles above its junction with the South Fork. This stretch is impassible to salmon. The stretch of river below the canyon is wide, deep and murky. If salmon use this river, they are most likely unavailable to bears. We found no carcasses on the river banks and no clearwater tributaries entering below the canyon. We did find clumps of brown bear hair on a small spruce tree beside an overflow pond just north of the river.

We also looked at several small tributary creeks flowing into the river below the junction of the two forks. One creek had 6 live sockeye salmon in it, just below the railroad, while the rest contained no fish. These creeks are mud-bottomed and pass through marshy areas, appearing unsuitable for salmon spawning. We found a few brown bear rub trees and a couple of scats containing berries (highbush cranberry, blueberry,and crowberry) but no sign of heavy use. Devil's club is extensive along the lower slopes above the creeks and is probably used by brown bears during the summer months.

Ptarmigan Creek 9/13/84

Ptarmigan Creek is a glacial-fed stream entering Kenai Lake immediately south of the Kenai Lake Work Center in section 25, T4N, R1W. There is about 3 miles of available habitat to spawning salmon in Ptarmigan Creek. A large series of falls prevents further travel to Ptarmigan Lake. Sockeye and King Salmon begin entering the creek in mid-August and peak numbers occur in early September. The highest sockeye count recorded by fisheries biologists was 9578 fish in 1983. King numbers peaked at 54 in 1981. We surveyed Ptarmigan Creek on September 13 and estimated sockeye numbers to be in excess of 50,000. We found the majority of fish in the lower mile and upper half mile of the creek. The middle section passes through a narrow canyon containing

larger boulders and deep, fast water. We found several bear-killed carcasses along with some black bear sign (tracks, hair, scats), at the upper end of the creek but no brown bear sign. Forest Service seasonal, Darwin Wiltse, reported seeing a small brown bear at the creek approximately 1 mile below the lake while he was moose hunting in early September. We found no sign of bear activity in the lower mile section. This area receives heavy human use, which probably deters bears from the area.

Russian River 9/24-26/84

Sockeye Salmon begin to enter the Russian River in early June and are concentrated on a spawning area in a tributary creek (Upper Russian Creek) at the south end of Upper Russian Lake by late July. A second run of sockeye reaches the river by mid-July. This group spawns in the Upper 2.5 miles of the river, along the edges of Upper Russian Lake, and in tributary creeks located at the south end and along the east shore of the lake. Sockeye numbers exceed 60,000 in this system. A small number of king salmon spawn in the river below Lower Russian Lake. Cohos enter the river from August to October. Coho escapement now averages about 2,500 fish. Little is known about their spawning distribution, but they probably spawn throughout the system.

During our August 1983 survey, we found evidence of brown bear use of salmon in several locations along the river and concentrated use in the first mile stretch of Upper Russian Creek. ADF&G Fisheries Biologist, Dave Nelson, reported seeing sign of brown bear predation of salmon throughout the system, with heaviest use occurring along the tributary creeks and at the upper end of the river (see Appendix II of the 1983 Russian River Brown Bear Survey report). Several brown bears sightings were reported by fishermen at the lower end of the river when salmon were concentrated there. reports included a sow with cubs, one single adult bear a small subadult brown bear.

A subadult brown bear died of an accidental overdose administered by ADF&G biologists near the Russian River campground on July 17. The bear was to be relocated because it was approaching too close to fisherman along the river and was a potential threat.

We conducted a ground survey of the Russian River system on September 24-26. Harbor Air pilot, Ludwig Pfleger, flew us to Upper Russian Lake in a Cessna 185 floatplane. Prior to landing, we flew over Upper Russian Creek and observed no live salmon in the creek and no brown bears. After landing on the south end of the lake, near the ADF&G cabin, we walked its east shore checking each tributary creek for bear use (see map).

Bear Creek is beaver dammed approximately 100 yards from its mouth. The creek passes through a large grass/sedge meadow and much of this is flooded above the beaver dam. Below the dam, the meandering creek is a few yards wide.

We found several thousand live sockeyes in Bear Creek below the dam and at the creek's mouth in the lake. The remains of several hundred carcasses had been almost totally consumed, with only the gill plates remaining. Large swaths of

grass were matted down on both banks. We found a few black bear tracks in the mud and brown bear hairs on an alder limb.

Salmon are able to get above the beaver dam through narrow side channels of water. We explored the edge of the flooded area for a few hundred yards and found heavy use here also. Due to the heavy alder cover along the edge of the flooded area, and the high amount of bear use, we did not explore the drainage further.

We found the spruce forest adjacent to the creek to contain several heavily used bear trails. The most worn trail runs parallel to the creek, approximately 30-40 yards away. We found several brown bear rub trees showing recent rubbing activity along the first quarter mile of this trail.

A well-worn bear trail leads north from the creek, below the beaver dam, across an adjacent meadow to a timbered hillside. Here, an old blazed trail follows through the timber along the edge of the meadow. This trail follows the timber back toward the lake and continues north, close to the shore, until it joins the maintained Forest Service trail.

The trail is probably used occasionally by hunters and fishermen, but is now used regularly by bears. Brown bear mark trees and rub trees are common.

An extensive beaver dam near the mouth of Beaver Creek greatly limits salmon access to this creek. Several determined salmon were able to enter the creek through a spillway along the dam's north edge. We found the remains of 15 salmon along the spillway and saw about 12 live salmon in the beaver pond and 6 live salmon in the creek above the pond (100 yards above the mouth). We found 40 carcasses partly consumed by bears in one small stretch of the creek just above the pond.

Canyon Creek is a narrow, shallow creek with about 300 yards of spawning habitat available to salmon. The creek runs through the timber and has a thick growth of alders along its banks. Between 500 and 1000 live salmon were in the creek and bear predation was heavy. Over 200 carcasses were on the creek's banks, several of which had only a bite or two missing. Well-worn trails existed along its banks and we found brown bear hair on alder branches overhanging the creek.

Salmon are vulnerable to bears in several location along the lake shore. They are concentrated at the mouth of tributary creeks and smaller numbers spawn along the rest of the lakeshore. We noted several carcasses on the bank between the ADF&G cabin and Bear Creek.

We surveyed the river from Upper Russian Lake to just below the canyon approximately one mile above Lower Russian Lake. We found evidence of brown bear use (tracks, trails, hair) throughout this stretch of river, but most of the fishing activity was scattered. Only one stretch about a mile in length, and located above Aspen Flats cabin (see map), appeared to receive heavy use. Here, we found heavily beaten down trails along the river banks and several piles of salmon carcasses. We found a couple of brown bear rub trees and a small spruce whose top was freshly broken off 7 feet from the ground. We observed very few uneaten salmon carcasses in the river. Most of these were in a short stretch immediately below the lake, where we found no indication of

bear use. We saw between 500 and 1000 live silver salmon in this stretch of the river, most of which were grouped in deep pools.

We found very little evidence of bear activity below Lower Russian Lake. This is not surprising since this stretch received heavy human use during the peak of salmon activity. However, both brown and black bears have been observed by fishermen and we found a fairly fresh brown bear track on the fisherman's trail one-half mile above the campground. We observed a dozen carcasses along the banks of the river. We noted that berry quantities have diminished significantly along the river bottom at this time. All devil's club berries had shrivelled. Much of the highbush cranberry crop is gone, but a few bushes still contain good clusters. We observed very few crowberries and no blueberries on those bushes. Lowbush cranberry fruits appeared to be the most persistant; many of these are still available.

South Fork of Snow River 10/11

We surveyed the first 6 miles of the South Fork and it's tributary creeks a second time on October 11, to check for silver salmon activity. The tributary creek located 3.5 miles from where the river's two forks join contained 15 live silver salmon and six fresh bear-kills. The log jam, restricting salmon use on the second tributary creek (see other writeup on the South Fork), had washed loose and a mile stretch of this creek was being used by silvers. We counted 46 partially consumed carcasses and 12 live silver salmon there. Most of the salmon killed on this stretch were almost completely devoured; only the jaws remained. A well-beaten path existed along the banks of this creek. Here, we also observed 2 beds and a scat consisting of highbush cranberries and salmon.

Although we observed no other salmon activity, brown bear tracks were common throughout the riverbottom. A minimum of 4 different brown bears, including a sow and yearling, had travelled through the drainage.

Resurrection River 10/15-17

The Resurrection River drainage receives a run of from 30 to 40 thousand silver salmon beginning in late August. Silvers spawn in the river and it's tributary creeks from September to mid-November.

We surveyed portions of the river and several of it's tributary creeks on October 15-17. Our efforts were concentrated on the main river above Boulder Creek and on the tributaries along the Chugach National Forest (east) side of the drainage. Of the tributaries we surveyed, only three contained more than a couple of silver salmon. The uppermost clearwater creek, which is paralleled by the newly-constructed trail, contained the majority of the observed fish. A series of 3 old beaver dams cross this creek close to it's mouth, but salmon have access to the creek through gaps in the dams. We surveyed a quarter mile of this creek and counted 120+ live salmon in this

stretch, most of which were in a deep area near the mouth. We also found 4 partially consumed carcasses along the banks, along with brown bear tracks and paths beaten through the grass. The majority of live salmon were in deep pools, unavailable to bears.

The remainder of the silver salmon which we observed were in a 2 mile stretch of the river beginning approximately one mile below the other observed concentration area. We counted 141 live salmon and 7 carcasses along this stretch; most of these were concentrated at the mouths of two clearwater tributaries. We did not survey these streams, but from where they cross the trail, we noted one carcass in one and no fish in the other. On each stream, there is a stretch of perhaps 200 yards below the trail where silvers may spawn.

There appears to be an abundance of suitable spawning areas within the upper end of the river beginning at the northeast corner of section 12, T2N, R3W, with little apparent use. We also observed no salmon in several clearwater tributaries near the lower end of this section. The majority of salmon we saw were located in deep areas beneath alders overhanging the banks of the river. Tracks indicated that at least 4 brown bears, including a sow and cub, had been walking along this stretch of the riverbottom. Several game trails parallel the river.

We investigated the large meadows above Boulder Creek, and found the river to be several feet deep throughout this section. We observed no salmon in this portion of the river, however the water was murky. It appears that salmon are unavailable to bears here, and we found no bear sign.

We walked a half mile stretch of Boulder Creek and a quarter mile stretch of Martin Creek and observed no salmon or bear activity on either of these drainages. Water levels are down in both creeks at this time and salmon would have great difficulty migrating up them.

Although we covered a large portion of the river and it's tributaries, we found very little salmon spawning activity. Considering the high estimated escapement, we were surpised at the little amount of activity. Concentrations may occurr in areas which we did not survey. Many of the creeks entering from the Kenai National Fjords National Park (west) side of the drainage are glacial and appear to be similar to Boulder and Martin Creeks. Further field efforts are necessary to determine concentration areas on this system.

APPENDIX V

VISITOR SURVEY OF THE RUSSIAN RIVER / RESURRECTION RIVER TRAIL SYSTEM
MAY - SEPTEMBER, 1984

Introduction

Several bear/human encounters, resulting in human injury or bear mortalities, have occurred within the Russian River drainage in the past several years (Johnson and Apgar map. 1981). A U.S. Forest Service trail closely parallels the Russian River for its entire length and human activity is high during the summer months. The trail continues over a low pass and ends at the Snug Harbor Road, near Cooper Lake. Another trail, completed in September 1984, closely parallels the Resurrection River for most of its length and joins the Russian River trail approximately 9 km (5.5 miles) from the Cooper Lake trailhead. Prior to 1984, human activities were mostly restricted to a 10 km (6 mi) stretch of the trail from the Exit Glacier bridge to Boulder Creek. Bear activity within this drainage is heavy and a few bear/human encounters have also occurred there.

Information concerning these encounters, such as the location of the encounter and the circumstances surrounding the incidents is incomplete. Human use of this trail system will increase, resulting in greater chances for bear/human encounters.

A survey was initiated in 1984 to monitor human activities and bear/human encounters within the Russian River / Resurrection River trail system. Trail counters were used to record travel through the system, and questionnaires were used to obtain information on visitor use and bear observations.

METHODS

1. Trail Counters

Four electric eye trail counters were used to determine visitation levels within the trail system. Trail counters were placed within 1 km of the Cooper Lake and Resurrection River trailheads. Counters placed 4 km and 6 km from the Russian River trailhead allowed us to differentiate between persons only hiking as far as Lower Russian Lake from those hiking further. A person entering and exiting the trail system at the same trailhead would register twice by a trail counter, while a person entering and exiting at different locations would register once each on two trail counters.

Trail counters were installed for the Cooper Lake, Russian River, and Resurrection River trailheads on May 22, May 23 and July 9, respectively. Our work schedule did not allow us to check trail counters at equal time intervals; time between checks varied from 6 to 22 days but was usually within 2 weeks. Data was collected until early September. Battery failure resulted in a loss of data from each location for various lengths of time.

2. Questionaires

Visitor questionaire cards were placed at stations located within a few hundred meters of each trailhead. Stations consisted of a sign requesting each party of trail users to fill out a card upon completion of their trip. The map accompanying the sign was divided into 10 designated units. Visitors were asked information concerning their trip and about bear sightings they made (figure 1). They were also instructed to record the units and sections in which they saw the bear(s). Persons making observations were asked to leave their name and phone number if they observed a bear so we could further verify the sighting. Questionaires were collected from mid July to early October.

3. Determining Trail User Levels

Average counts per day were determined for each counter by dividing the number of counts registered by the number of days the counter was active. The number of days varied between counters due to battery failure, or malfunction of specific counters during different trial periods (Table 1). Questionaire respondants were asked to give their points of entry and exit; this information was used to determine what percent of persons using a specific trailhead both entered and exited at that trailhead and what percent only entered or exited at that trailhead. We assumed that these percentages were representative of all backcountry users (Table 2). They were used to estimate the number of users per day at each trailhead.

The average number of persons per day traveling from the Russian River trailhead to below the the Upper Russian trail counter, and returning was determined by subtracting the number of persons per day tripping the Upper Russian counter twice (3.2 - 3.9) from the average number of persons per day both entering and exiting at the Russian River Trailhead (37.6).

The total number of visitors using a particular portion of trail was estimated by multiplying the estimated number of persons per day using the trail by the number of days the information was collected. Estimates for the Russian River and Cooper Lake segments were from late May to early September, while the Resurrection River estimates were only from mid July to early September.

RESULTS

1. Visitor Use

The following are estimates based on our interpretation of the data collected. Confidence intervals cannot be placed on these statistics, but the information will be useful for looking at trends. Approximately 4900 visitors used the area accessed by the three trailheads in 1984.

An average of 37.6 persons entered and returned at the Russian River trailhead each day from May 30 to September 3. From 3.6 to 4.0 persons per day went past Lower Russian Lake for an estimated 346 to 384 persons from May 30 to September 3. The remainder, from 3226 to 3264, went no farther than Lower Russian Lake.

Approximately 499 persons both entered and exited the trail system via the Cooper Lake trailhead from May 22 to September 3. About 312 persons made the trip from the Cooper Lake trailhead to the Russian River trailhead (or vice versa) during the same time period.

Approximately 364 persons made round trip visits into the Resurrection River drainage via the Exit Glacier trailhead from July 9 to September 4. Our data indicated that during this same time period, 106 persons made the trip from the Russian River trailhead to Exit Glacier (or vice versa). Actually, this latter number is probably high; a large percentage of the questionaire respondants making this trip were all in one party and our sample size at this trailhead was comparatively small. According to our data, none hiked from Cooper Lake to Exit Glacier.

Table 1. Information collected from the Russian River, Cooper Lake and Resurrection River trail counters, 1984.

Location	Registered Counts	# days	Periods of operation	# Average counts/day
Lower Russian	7674	96	5-30 to 9/3	79.4
Upper Russian	679	56	5-23 to 5-30 6-19 to 7-3 7-9 to 8-13	12.1
Cooper	1005	80	5-22 to 6-9 7-3 to 9-3	12.6
Resurrection	851	57	7-9 to 9-4	14.9

Table 2. Estimated numbers of persons using portions of Russian River / Resurrection River trail system, as determined by questionaire and trail counter information.

	# of Respondents	In and out %	Est. # In and Out per Day	In or Out %	Est. # In or out per Day	Total Use per Day
L. Russian	482	89.8%	37.6	10.2%	4.2	41.8
U. Russian	--	--	3.6-4.0		4.2-4.9	8.2-8.5
Cooper	80	61.3%	4.8	38.7%	3.0	7.8
Resurrection R.	70	76.5%	6.5	23.5%	1.9	8.4
Total	632		52.5-52.9		13.3-14.0	66.2-66.5

* These calculations are shown in Appendix 1.

2. Bear Observations

A total of 236 parties, comprising 557 visitors, completed questionaires. Thirty nine black bears were seen during 22 observations (Table 3). Three individual brown bears were also seen. One brown bear observation was verified by telephone, one report appeared truthful, but unverified, and the third report was questionable.

There were no reported incidents of human injury or bear mortality from these sightings. In almost all observations, the bear was unaware of humans, or fled upon seeing them. Only one party reported an aggressive black bear in the Lower Resurrection River drainage, this was a sow accompanied by a cub which was approached to within 20 feet. One U.S.F.S. employee was injured by a black bear at Boulder Creek in the Resurrection River drainage on June 6, 1984. This incident was not included in the list because the incident occurred several weeks before the survey began.

Table 3. Bear observations occurring within the Russian/Cooper/Resurrection trail system, July - October, 1984.

Date	Species[1]	Number[2]	Distance	Location[3]	Sow w/cubs?	Bear's Reaction
7-17	1	4	300+ ft.	III	yes	unaware
7-17	1	1	300+ ft.	III	no	unaware
7-19	1	1	100 ft.	II-9	no	ran
7-20	1	1	100 ft.		no	ran
7-22	1	3	300+ ft.	III	yes	unaware
7-23	1	1	100 ft.	III	no	ran
7-27	1	1	100 ft.	VI-14/23	no	ran
8-5	1	1	100 ft.	II	no	ran
8-5	1	1	100 ft.	III	no	ran
8-7	1	2	20 ft.	IX-33	yes	aggressive
8-11	1	2	100 ft.	II-9	yes	indifferent
8-12	2	1	100-300 ft.	XII-8	no	unaware
8-12	1	1	100-300 ft.	III-11	no	ran
8-17	1	1	100 ft.	II-34	no	ran
8-29	1	1	300+ ft.	II	no	indifferent
8-29	2	1	NO RESPONSE			
9-3	1	1	1 mile	IV	no	unaware
9-3	1	1	300+ ft.	VI-13	no	unaware
9-7	1	3	100-300 ft.	III	yes	unaware
9-13	1	1	100 ft.	II-35	no	ran
9-13	1	3	300+ ft.	II	yes	unaware
9-13	1	1	100-300 ft.	II-34	no	ran
9-16	1	1	1/2 mile	II	no	unaware
9-16	2	1	300+ ft.	Russian	no	unaware
9-24	1	1	300+ ft.	II-15	no	unaware
9-25	1	1	100 ft.	II-15	no	unaware
9-25	1	4	---	--	yes	---
9-28	1	1	100 ft.	II-9	no	ran

1. 1 - black bear 2 - brown bear
2. total number of bears observed
3. Unit and Section number where the bears were observed

Formulas used for determining the number of users on the Resurrection River - Russian River trail system. (Example using data from Cooper trailhead)

1. From trailcounter information

   # counts per day = counts registered on counter ÷ # of days counted

   example: 12.6 = 1005 ÷ 80 days (5/22 - 6/9 ; 7/3 - 9/3)

2. From questionnaire responses

Percent of persons entering and exiting at a given trailhead (trip counter twice)	=	Number or respondents who entered and exited at a given trailhead	÷	Total # of respondants using the trailhead at least once
example: 61.3%	=	49	÷	80

3. Determining Trail User Levels

Percent of persons entering or exiting at a given trailhead (trip counter once)	=	Total respondants	-	% of persons entering and exiting at the trailhead
38.7%	=	100%	-	61.3%

So, the Cooper Lake trailhead trail counter was tripped an average of 12.6 times per day; of those persons using the Cooper Lake trailhead, 61.3% entered and exited, thus tripping the counter twice, while 38.7% entered or exited there, tripping the counter only once.

Thus -

4. Persons per day using trailhead = Counts per day ÷ [percent of persons tripping counter twice (2) + percent of persons tripping counter once]

   example: 7.8 = 12.6 ÷ [.613 (2) + .387]

5. # of People per day going in and out (tripping counts twice) = Counts per day x $\left(\frac{\text{Percent of persons tripping counter twice}}{\text{total percentages}}\right)$

   example: 4.8 = 12.6 x $\left(\frac{.613}{(.613\ (2) \times .387)}\right)$

6. # of people going in or out (tripping counter once) = Persons per day using trailhead - # of people going in and out

3.0	=	7.8	-	4.8

(Thus, 12.6 counts per day = 3.0 counts per day/for persons tripping counter once + 2 x 4.8 counts per day for persons tripping counter twice)

Mathematics for other two trailheads

Resurrection trailhead

1. 14.9 = 851 ÷ 57
2. 76.6% = 59 ÷ 77
3. 23.4% = 100% - 76.6%
4. 8.4 = 14.9 ÷ [.766 (2) + .234]
5. 6.5 = 14.9 x [.766 ÷ (.766 (2) + .234)]
6. 1.9 = 8.4 - 6.5

Lower Russian trailhead

1. 79.4 = 7624 ÷ 96
2. 89.8% = 433 ÷ 482
3. 10.2% = 100% - 89.8%
4. 41.8 = 79.4 ÷ [.898 (2) + .102]
5. 37.6 = 79.4 [.898 ÷ (.898 (2) + .102)]
6. 4.2 = 41.8 - 37.6

Appendix 6 Example of the brown bear observation cards.

BROWN BEAR OBSERVATION FORM

DATE:___/___/___ TIME:_____HOURS

OBSERVER/AGENCY:_____ OBSERVED FROM:_____

LOCATION (DRAINAGE/MOUNTAIN):_____

TOWNSHIP:_____ RANGE:_____ SECTION:_____

HABITAT/VEGETATION TYPE:_____

DESCRIPTION OF BEAR(S) / TRACKS:_____

COMMENTS:_____