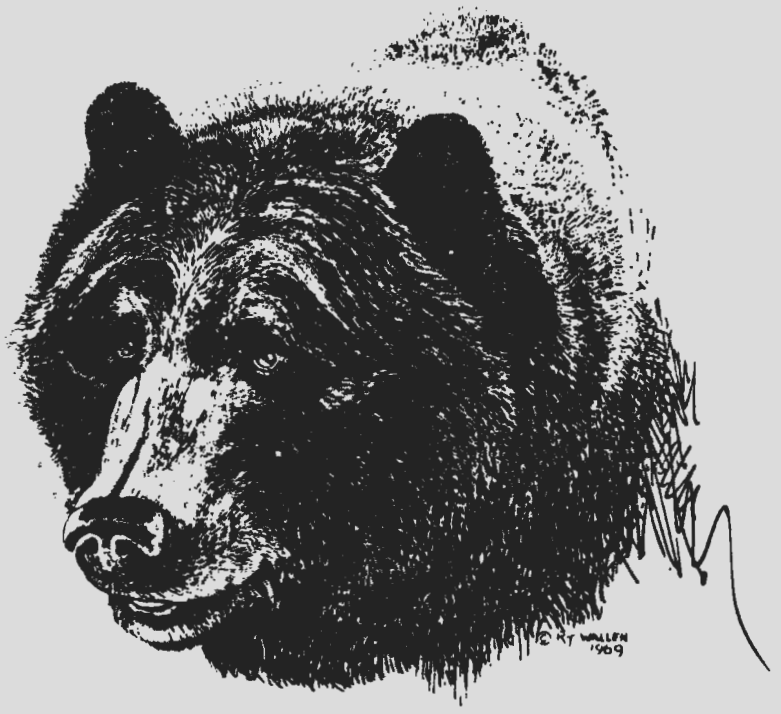
Alaska Department of Fish and Game
Division of Wildlife Conservation
Federal Aid in Wildlife Restoration
Research Progress Report

Population and Habitat Ecology of Brown Bears on Admiralty and Chichagof Islands



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Project W-23-4
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PROGRESS REPORT (RESEARCH)

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SUMMARY

Long-term brown bear population ecology studies associated with the Greens Creek Mine, Admiralty Island, Alaska, continued through this report period. Seventy-two individual bears were radio-collared from 1981 through 30 June 1991. As of July 1991, 19 brown bears were being monitored within the study area, including 3 females with > 9 years of monitoring data. Telemetry flights and ground visits indicate continued bear-use of the lower Zinc Creek and Greens Creek watersheds adjacent to the mine road during the peak salmon spawning period. No changes in cub-production were noted during this time period.

Radio-telemetry studies were initiated on a 1,000 km^2 highly-roaded and intensively managed forested area on the northeast portion of Chichagof Island. This study area was chosen because of its easy road access and increasing brown bear harvest rates, many of which were taken under defense-of-life-and-property (DLP) provisions. From October 1989 through June 1991, 51 brown bears were captured and radio-collared 55 times. At least 25% of the bears lost their radio-collars during this report period. To assess the impacts of logging on bears, emphasis was placed on radio-collaring bears in watersheds scheduled for logging. At least 13 bears were radio-collared that have parts or all of their home ranges within 3 watersheds scheduled for logging. At least 10 bears were initially radio-collared in alpine habitats and were subsequently found to use portions of a watershed that was intensively logged in the mid-1980s. One radio-collared male brown bear was harvested during the sport-hunting season and another was killed under DLP provisions. One radio-collared bear moved outside the study area, crossing Tenakee Inlet. We radio-collared 4 bears at the Hoonah dump (landfill) and had 2 other radio-collared bears that traveled across the study area to the dump. All bears observed and/or handled at the Hoonah dump were males, and most were large (>250 kg). During summer

evenings, from 0 to 5 vehicles were parked at the Hoonah dump at any given time viewing bears.

CONTENTS

BACKGROUND

It is widely recognized that brown bear (*Ursus arctos*) populations are affected when development occurs within areas of pristine habitat. Studies in southeast Alaska by Schoen (1982, 1990), Schoen and Beier (e.g., 1983, 1985, 1989), Archibald et al. (1987), McLellan and Shackleton (1988, 1989), McLellan (1989*a*, *b*), and others demonstrated that many attributes of development are negatively associated with brown bear populations. Within southeast Alaska, mining and timber development have altered the landscape and provided access to formerly pristine habitats. As a result, some dense populations of brown bears have recently become vulnerable to high rates of exploitation. This presently happens on portions of Chichagof Island where logging camps, logging roads, and clearcutting occur in pristine habitats.

Clearcut logging is a major means of altering forested habitat in southeast Alaska. Once clearcutting of old-growth timber occurs, bears seldom used clearcut habitat (Schoen and Beier 1987, 1988). Mining is another resource extraction industry that is increasing in

southeast Alaska. The focal activity of mining development may cause brown bears to shift their activities away from active construction (Schoen and Beier 1988). Road development results in bears' decreased use of nearby habitats (McLellan and Shackleton 1988). This may increase direct mortality such as occurred on northeast Chichagof Island (Schoen 1990). These cumulative impacts on the population, including hunting combined with a lower carrying capacity of the habitat, will probably lower brown bear populations in the future. A focal problem for resource managers centers on identifying and accurately predicting these changes through time. This research will provide the necessary information to make these predictions and determine ways in which a long-lived species with a low reproductive rate can survive in an area of competing interests. Brown bear harvest in Game Management Unit (GMU) 4, encompassing Admiralty, Baranof and Chichagof islands, has doubled from a mean of 47 bears/year from 1961-1965 to a mean of 98 bears/year from 1983-1987. Brown bear harvest in GMU 4 is annually the fourth highest in the state. Specifically on northeast Chichagof Island, the combination of timber harvest, roadbuilding, and public access has resulted in high annual brown bear harvest rates. Concerns over increasing brown bear harvest rates on northeast Chichagof Island resulted in the closing of the autumn sport-hunting season and hunter access restrictions for the spring season. Whether these increased mortality rates exceeded the brown bear population's ability to remain stable is unknown.

The brown bear has been recommended as a management indicator species on the Tongass National Forest (Sidle and Suring 1986). Subsequently, a model was developed (Schoen et al. 1989) to assist with the evaluation of brown bear habitat quality and long-term carrying capacity in the presence of forestry operations.

The Alaska Department of Fish and Game (ADF&G) began brown bear population ecology studies in southeast Alaska in 1981. Studies focused on northern Admiralty Island which contains the Greens Creek watershed, where a large mine was subsequently developed. That mine became operational in 1989 and the current study is assessing the longer-term impacts of this industrial activity on brown bear movements, space use, and population ecology. Schoen and Beier (1990) also studied habitat use and selection by brown bears associated with clearcut logging on Chichagof Island. The current study is an expansion of this work in cooperation with the U.S. Forest Service. The northeast Chichagof study is centered on the Hoonah road system, an area of easy human access and high bear density.

OBJECTIVES

The objective of this research is to evaluate and predict short- and long-term changes in brown bear populations as influenced by human-induced changes to their habitat and demography. Specific objectives follow.

1. Evaluate long-term changes in the home range and centers of activity of selected brown bears in the vicinity of Greens Creek, Admiralty Island.

2. Evaluate the degree of site tenacity by female brown bears and their offspring to developed areas of Greens Creek.

3. Determine trends in numbers of brown bears on a 344km^2 study area centered on Greens Creek.

4. Determine the extent to which brown bears exhibit short-term changes in home ranges or centers of activity as a result of logging activity on northeast Chichagof Island.

5. Determine seasonal and annual home ranges of selected brown bears, particularly in areas where data can be acquired both before and after roadbuilding and intensive logging activities.

6. Evaluate the interagency brown bear habitat capability model with independent data from northeast Chichagof Island.

7. Estimate brown bear density on northeast Chichagof Island.

8. Estimate annual survival and reproduction rates of brown bears on northeast Chichagof Island.

9. Determine the degree of population isolation of brown bears on northeast Chichagof Island.

10. Estimate the types of brown bear mortality on northeast Chichagof Island.

11. Use population projection models for evaluating the future status of brown bears on northeast Chichagof Island given differing demographic parameters.

12. Assess the seasonal distribution and habitat use patterns of brown bears on northeast Chichagof Island.

13. Evaluate survey methods for indexing brown bear populations by indirect methods.

14. Determine the association between logging roads, logging camps and associated development and attributes of annual brown bear harvest in southeast Alaska.

15. Develop management guidelines for intensive land development within southeast Alaska brown bear range.

STUDY AREAS

The Admiralty Island study area is centered on Hawk Inlet and the Greens Creek watershed. This area encompasses 344 km^2 and is described in Schoen (1982), Schoen and Beier (1983) and Schoen and Beier (1990).

The northeast Chichagof Island study area is that 1,000 km^2 island-like area north of Tenakee Inlet and east of Port Frederick (Figure 1). The connection of this area with the rest of Chichagof Island is by a narrow neck of land at the Portage. This study area was chosen because 1) the land-base has undergone extensive roadbuilding and clearcut logging in the last decade, 2) access has increased dramatically with the roadbuilding and via the Alaska Marine Highway System, and 3) high brown bear harvest rates raised concerns about population status.

The topography of northeast Chichagof Island is rugged with mountains rising from sea level to 1,100 m. Forests are primarily western hemlock (*Tsuga heterophylla*) - Sitka spruce (*Picea sitchensis*) mosaics. Poorly drained areas include non-forested muskegs, and tree species such as Alaska cedar (*Chamaecyparis nootkatensis*) and lodgepole pine (*Pinus contorta*). Mountain hemlock (*Tsuga mertinsiana*) is common in the transition zone. Nonforested steep slopes are common above 300 m and are composed of rock, vegetated avalanche slopes and alpine habitat. Common forest understory species include several species of blueberry and huckleberry (*Vaccinium* sp.), rusty menziesia (*Menziesia ferruginea*), devils club (*Oplopanax horridus*), salmonberry (*Rubus spectabilis*), elderberry (*Sambucus racemosa*), skunk cabbage (*Sichiton americanum*), bunchberry (*Cornus canadensis*), and trailing raspberry (*Rubus pedatus*). Detailed descriptions of plant associations can be found in Martin et al. (1985).

Hoonah and Tenakee Springs are the two communities within the study area. Logging camps exist near Hoonah and on Kennel Creek at Freshwater Bay, and a small, private farm/community is on Game Creek. The northeast Chichagof Island study area underwent extensive roadbuilding during the 1980s, all associated with logging activities. More than 250 km of roads were built during the 1980s. This road network is accessible by Alaska Marine Highway ferry from Juneau and Sitka.

METHODS

Radiotelemetry (Kenward 1987, White and Garrott 1990) was chosen as the primary method to monitor bear movements, habitat use patterns, and mortality rates. Direct observation is not a viable field method given the forested habitat, mountainous terrain, and associated bear movements.

Three methods were used to capture bears for radio tagging and generally follow Schoen and Beier (1990). The most common method used was to capture brown bears in alpine

habitat above 700 m elevation with the aid of a helicopter. This method was used in late June and early July and again in October. A fixed-wing spotter plane was initially used to help locate bears for helicopter tagging. The use of a spotter plane was subsequently abandoned as not being cost-effective. The helicopter tagging crew could locate enough bears for tagging without this aid. Brown bears were also captured along salmon streams, bear trails, and at the Hoonah dump with Aldrich foot snares. Some bears were captured by 'free-ranging' them in appropriate situations.

At the Admiralty Island study area, bears were not randomly selected for capture. Priority was given to recapturing bears that had been previously captured, females with cubs within the Greens Creek watershed, and other females within the Greens Creek watershed. Subadult males were given the lowest capture priority.

At the northeast Chichagof Island study area, bears were randomly selected for capture. Females with small cubs spotted in locations where cub safety might be jeopardized were avoided.

Bears were immobilized with either 3.5 mg/kg of tiletamine hydrochloride and zolazepam hydrochloride (Telazol®; see Taylor et al. 1989) or 0.04 mg/kg etophine (M-99). Bears immobilized with M-99 were subsequently injected with its antagonist, M50-50 (dieprenorphine). Bears were ear tagged and fitted with radio-collars appropriate for their size and sex. Standard morphometric measurements were taken, a premolar tooth was extracted when possible for aging, weights were estimated or measured directly with the aid of a helicopter, and hair and blood samples were collected when practical.

Radio-tagged bears were monitored with the help of a fixed-wing aircraft using the protocol of Schoen and Beier (1990). We also determined the feasibility of ground-based telemetry with the aid of a truck along the Hoonah road system. Ground-based telemetry can be fraught with problems in the mountainous terrain of southeast Alaska (e.g., Garrott et al. 1986, Chu et al. 1988). Ground-based telemetry sites were chosen for their accessibility by vehicle. All sites give a clear view of the terrain being sampled for bear radio signals.

At the Hoonah dump, we recorded data on the number of bears present at the dump and the number of marked bears present. We explored the feasibility of collecting data on the human-use of the dump as a bear-viewing site.

RESULTS AND DISCUSSION

Admiralty Island/Hawk Inlet Study Area

Bears captured and radio collared. From the autumn of 1981 through 30 June 1991, 77 brown bear were captured on northern Admiralty Island and 72 individuals were fitted with radio collars (Table 1). Three females with long-term radio-collar histories were recaptured in 1989 since the final report of Schoen and Beier (1990). Three additional individuals were captured in 1990 and radio-collars were fitted to 2. For the 1991 field season through 30 June, 4 bears were captured and 3 radio-collars were affixed, including the recapture of bear #75. As of 30 June, 8 female and 2 male bears with active radio collars were known to be within the Hawk Inlet study area. Nine additional bears were captured and radio collared in alpine habitat with the aid of a helicopter in July 1991. Four of these individuals were recaptures of adult females.

Long-term bear monitoring. Greens Creek Mine became operational in February 1989. We continued the monitoring of individual brown bears, especially females. In the summer of 1991, 5 adult females were recaptured. This ongoing radio-collaring program allows for the monitoring of 3 to 5 females in the Greens Creek valley adjacent to mining activity, along with the monitoring of 2 to 4 females away from human activity.

Telemetry flights in the summers of 1990 and 1991 indicate continued high bear-use of Zinc and Greens creeks watersheds where pink (*Oncorhynchus gorbuscha*) and chum (*O. keta*) salmon spawn. Schoen and Beier (1990) suggest that many radio-collared bears remained in their traditional home ranges while shifting their activity patterns away from active development. Casual examination of the data supports this notion. Additional data are required to determine if individuals shift their mid-summer centers of activity away from Zinc Creek to Greens Creek for salmon fishing.

Cub production and mortality of females associated with the Greens Creek valley and associated mining activity has not changed over the study period (Table 2). We now have productivity data for females #64, #43 and #56 over 9, 10 and 10 year periods, respectively. Long-term data sets on individuals such as this are necessary to detect any population and productivity changes (McLellan 1990, Miller 1990, Reynolds 1990).

Northeast Chichagof Island Study Area

Bears captured and radio collared. Fifty-one brown bears were captured 55 times from October 1989 through June 1991 (Table 3). Seventy-one percent of the captures took place with the aid of a helicopter, while 24% were snared. Four bears were recaptured, 3 at the Hoonah dump. One cub-of-the-year was snared, and this bear was still alive as of August 1991.

No direct capture related mortalities occurred. One bear slid ~100m down a steep avalanche slope after being darted and may have broken his nose, but subsequent tracking indicated no lasting injuries. Another large male was snared at the Hoonah dump and broke free with the cable attached to his paw. Considerable efforts were unsuccessfully expended to recapture that individual in the autumn of 1990. That bear subsequently lost his radio collar and was not encountered in 1991, so his fate is unknown.

Bears were captured and radio-collared across the northeast Chichagof Island study area (Figure 2). We identified bear concentration areas in certain alpine locations. For example, 8 different individuals were captured in < 1 km^2 alpine area where helicopter tagging was particularly successful (Figure 2).

Thirty-three of 51 (65%) radio-collars were still affixed to bears and transmitting through June 1991. A minimum of 13 (25%) bears were known to have lost their radio collars, mainly by slipping them off their necks. Four of 5 large, radio-collared male bears that could be observed at the Hoonah dump lost their radio-collars within a few months of their initial capture.

Population characteristics. We considered our sample of captured bears to be a random sample of the population ≥ age 4. Unlike the Hawk Inlet study area, no selection was made for capturing specific sex and age classes. Consequently, we can make some assessment of the age structure of this population. For example, of the 21 males captured, 10 (48%) were ≤ age 6, 4 (19%) were between 7-10, and 7 (33%) were > age 10 (Table 3). Of the 30 females captured, 12 (40%) were ≤ age 6, 8 (27%) were between 7-10, and 10 (33%) were > age 10 (Table 3). This age structure is similar to that reported for the northcentral Alaska Range (Reynolds 1990). The reproductive status of female brown bears is difficult to obtain on an annual basis when working in forested habitats. Nineteen females > age 5 were radio-collared in 1990, yet through 30 June 1991 we were only able to obtain reproductive status information on 2 of these individuals (Table 4). Few of these females were in alpine habitats in the spring of 1991 where their cub production could be determined.

Mortality patterns. Two radio-collared bears were shot during this report period (Table 3). Bear #140 was harvested during the spring bear hunting season, and bear #129 was shot in Hoonah under defense-of-life-and-property (DLP) provisions. The fate of bear #144 was unknown because no telemetry locations were obtained subsequent to initial capture. Additional mortality information is required to develop patterns that can be used for modeling and management purposes.

Population isolation. One 4-year old male bear left the study area and established a home range across Tenakee Inlet to the south. Bear #103 did not leave the study area but was observed swimming in Freshwater Bay > 3 km from the nearest shore. These observations indicate that expanses of water may not be barriers to some individuals, most probably sub-adult males.

Short- and long-term home range changes relative to logging and roadbuilding. Thirteen bears have been radio-collared and have parts or all of their home ranges within the Game, Seagull, and Bear creek watersheds that are scheduled for logging. Aerial telemetry flights were conducted to establish pre-logging home ranges for these individuals.

Ecology of bears associated with the Hoonah dump. The Hoonah dump (landfill) is well-known by locals as a popular bear-viewing area. On any given evening in the summer, from 0 to 5 vehicles and upwards of 15 people were viewing bears at any point in time. Direct observations indicate that some people save their trash and fish scraps to feed these bears.

Four male bears were snared and radio-collared at the dump (Figure 2, Table 3). Two additional large males that were captured elsewhere on the study area were subsequently observed and/or recaptured at the dump. Evening observation bouts in the summers of 1990 and 1991 indicate that female bears seldom, if ever visit the dump.

Some bears travel long distances to the dump and different bears use the dump to varying degrees. For example, #142 is a chronic dump bear, with a small home range centered on the dump. In contrast, bear #129 was initially captured and radio-collared on 26 June 1990, 24 km from the dump. This large male was not near the dump until early October 1990 when it travelled essentially 'straight-line' to the landfill. This bear was shot a few days later under DLP provisions. Male #146 was initially captured at the dump and visits the facility on an irregular basis (Figure 3) as part of its large home range. This bear denned within 2 km of the dump while during the next spring it was encountered for a one week period 29 km across the study area.

Patterns of human access and brown bear mortality. It is useful for land and wildlife managers to understand if and how patterns of human access to pristine habitats relate to patterns of brown bear mortality. McLellan (1990) and others reviewed this topic and found varying short- and long-term impacts to bear use of space, habitats, and ultimately population size. It has been demonstrated elsewhere that those activities associated with resource extraction result in population declines or extirpation (e.g., Horejsi 1989). We explored the relationship between human access and brown bear mortality for northeast Chichagof Island as part of a larger viability analysis and conservation plan (Appendix A). The situation is somewhat different in southeast Alaska than in many other portions of brown/grizzly bear range because the populations are high and insular.

To correlate some of the attributes of resource extraction and brown bear harvest, we collated three data bases. We obtained all brown bear harvest records from 1961 through 1989 for southeast Alaska and extracted those kills that occurred on the northeast Chichagof Island study area. This totalled 213 harvest records. Next, we acquired 12 years of ferry traffic records from the Alaska Marine Highway System, focusing on the monthly number of passengers and vehicles disembarking at Hoonah during October and

November. From 1985 to 1989, November ferry traffic to Hoonah was the busiest of any month of the year. We believe that this ferry traffic was associated largely with deer hunting. Fourteen years of road construction records for the Hoonah road system (about 75% of the roads) were provided by the Forest Service. Data were provided as miles of road built by year.

Records of total brown bear harvest on northeast Chichagof Island from 1961 through 1989 indicate that no DLP deaths were reported before 1972 (Figure 4). Logging camps and road construction began in the late 1970s and early 1980s. Reported DLP brown bear deaths rose from 2 during the period from 1961-1975, to 26 from 1976-1989. Much of the increase in bear mortality occurred during autumn. Of 57 brown bears hunter-killed from 1985-1988, 56% were shot during autumn, essentially being an additive mortality from historic patterns. Of 213 total known harvested brown bears, 88% were hunting kills, 10% were DLP deaths, and 2% were known illegal kills.

Simple correlations indicated significant positive associations between the autumn brown bear kill and the sum of roads built per year ($r = 0.93$; $P < 0.01$, $n = 11$ years), and the DLP deaths and the sum of roads built per year ($r = 0.59$; $P < 0.05$, $n = 11$ years). We believe that there is a strong relationship between road access and increased human-induced brown bear mortality (Figure 5). Increases in ferry traffic were also positively associated with bear mortality. For example, autumn brown bear kill and both passengers and vehicles disembarking at Hoonah in October and November were correlated ($r = 0.82$, $r = 0.84$, P's < 0.01, $n = 11$ years). Owing to agency concerns over the high harvest rate, the autumn brown bear hunting season was closed in 1989 for northeast Chichagof, and subsequent harvest was reduced (Figure 5).

Population projection modeling. A series of Monte Carlo simulations were conducted to estimate the long-term viability of the northeast Chichagof Island bear population under mortality rates we believed occurred in the late 1980s (Appendix A). Population size over time was modeled using POPDYN4 by J. W. Grier of North Dakota State University (Grier 1980, 1988, Grier and Barclay 1988). We assumed a starting population size of 250 brown bears for a few convenient reasons. The Tongass Land Management Plan Revision Draft Environmental Impact Statement used this number for Admiralty, Baranof and Chichagof islands separately in their viability assessment. We also felt that 250 was a reasonable estimate of the actual population size for the study area. Given the best available data from southeast Alaska, we determined that an initial population of 250 brown bears had a high probability of not remaining viable under moderate mortality rates. These simulations indicated that emergency closure of bear hunting on northeast Chichagof Island was prudent. Further refinement of the modeling methods will aid with conservation planning (see Appendix A) and help with a more accurate viability analysis (e.g., Dennis et al. 1991).

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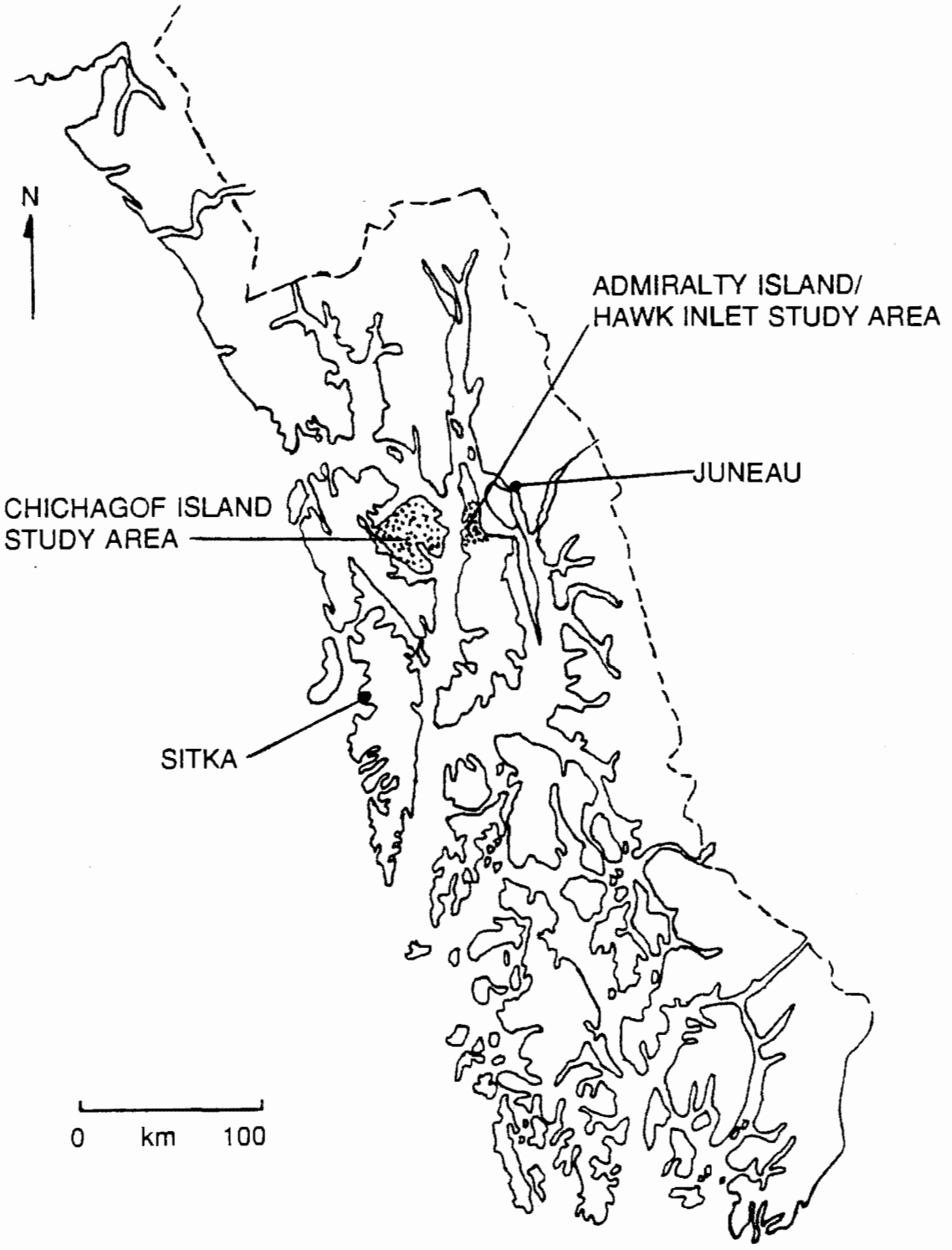

Figure 1. Locations of brown bear study areas on Admiralty and Chichagof islands, southeast Alaska.

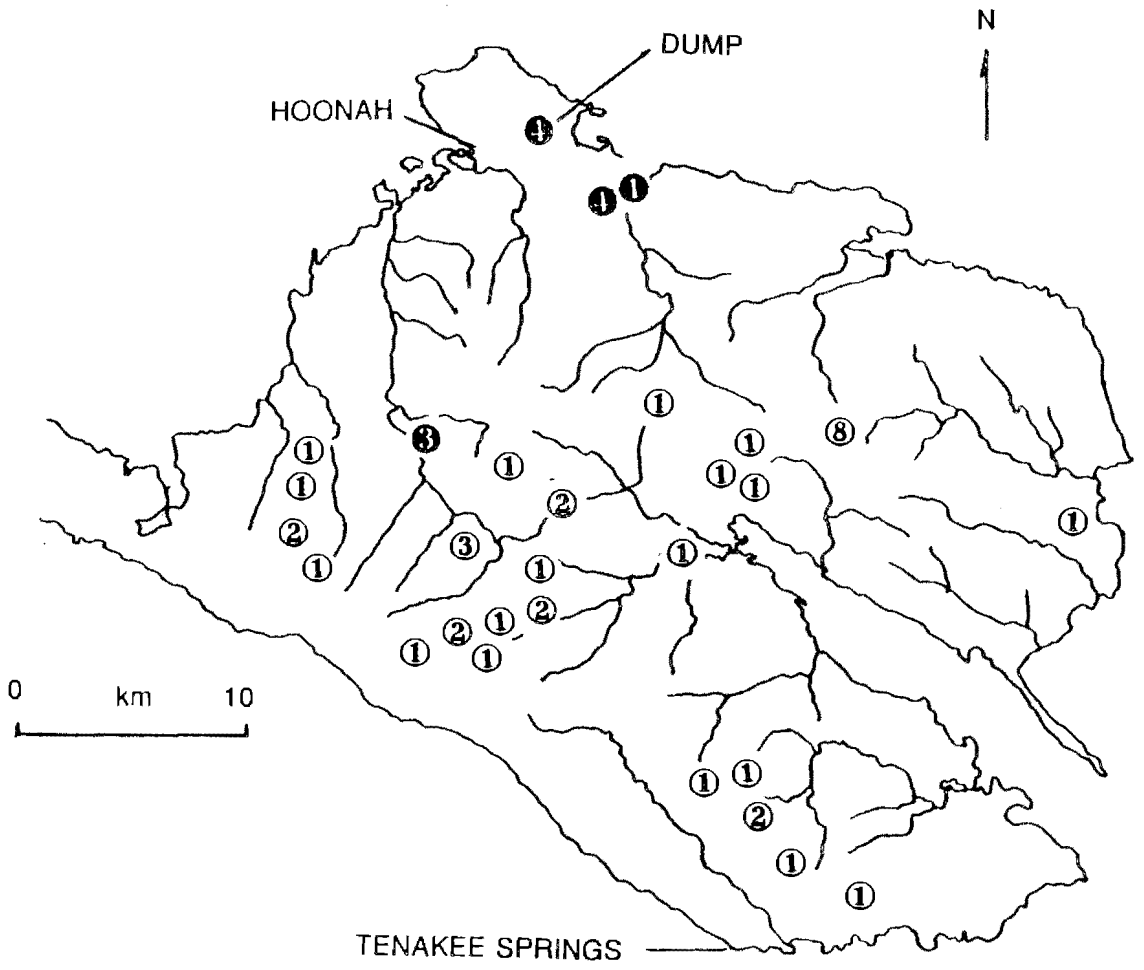

Figure 2. Number of brown bears initially captured by location on northeast Chichagof Island, Alaska, October 1989 through June 1991. Light circles represent bears captured via helicopter and dark circles represent bears captured with snares or free-ranged.

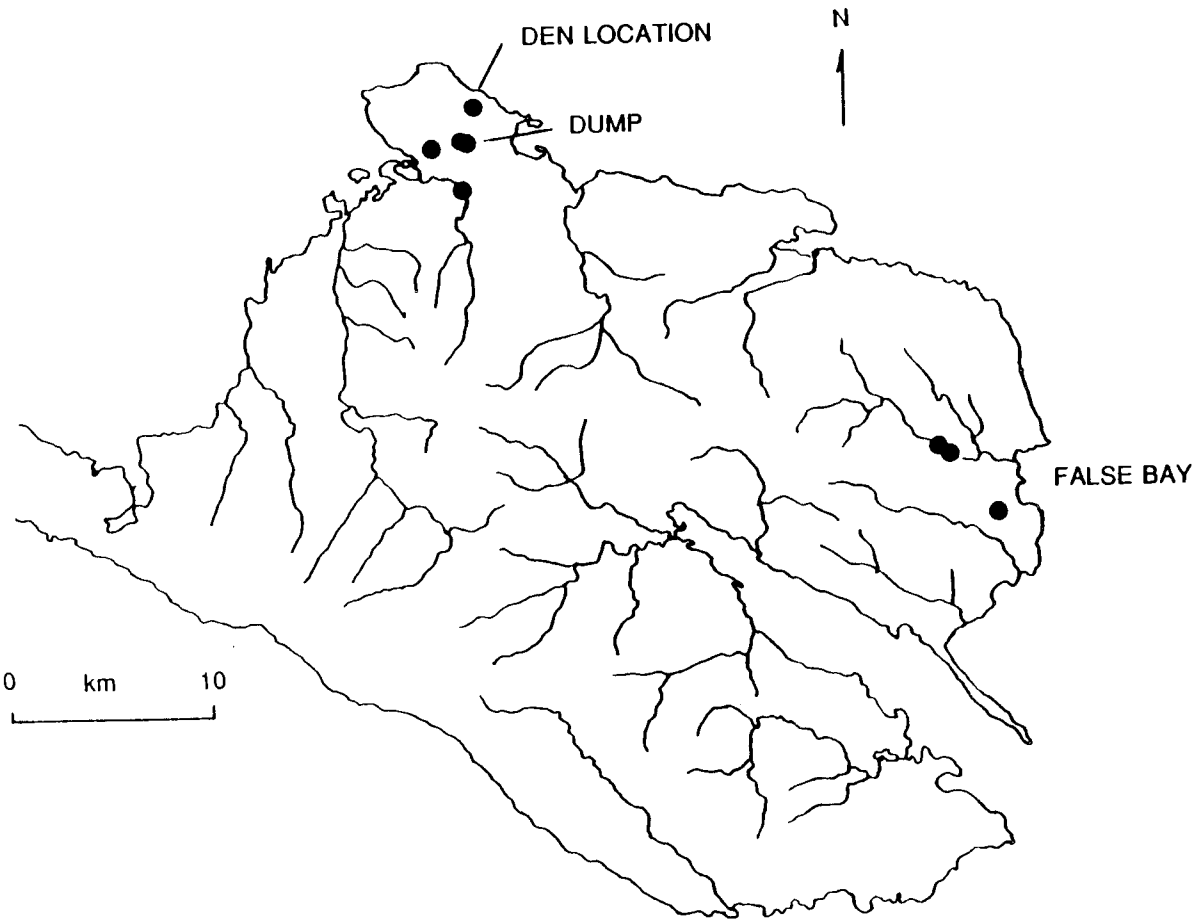

Figure 3. Eight radio-telemetry location estimates for male brown bear #146 first captured at the Hoonah dump on 13 August 1990.

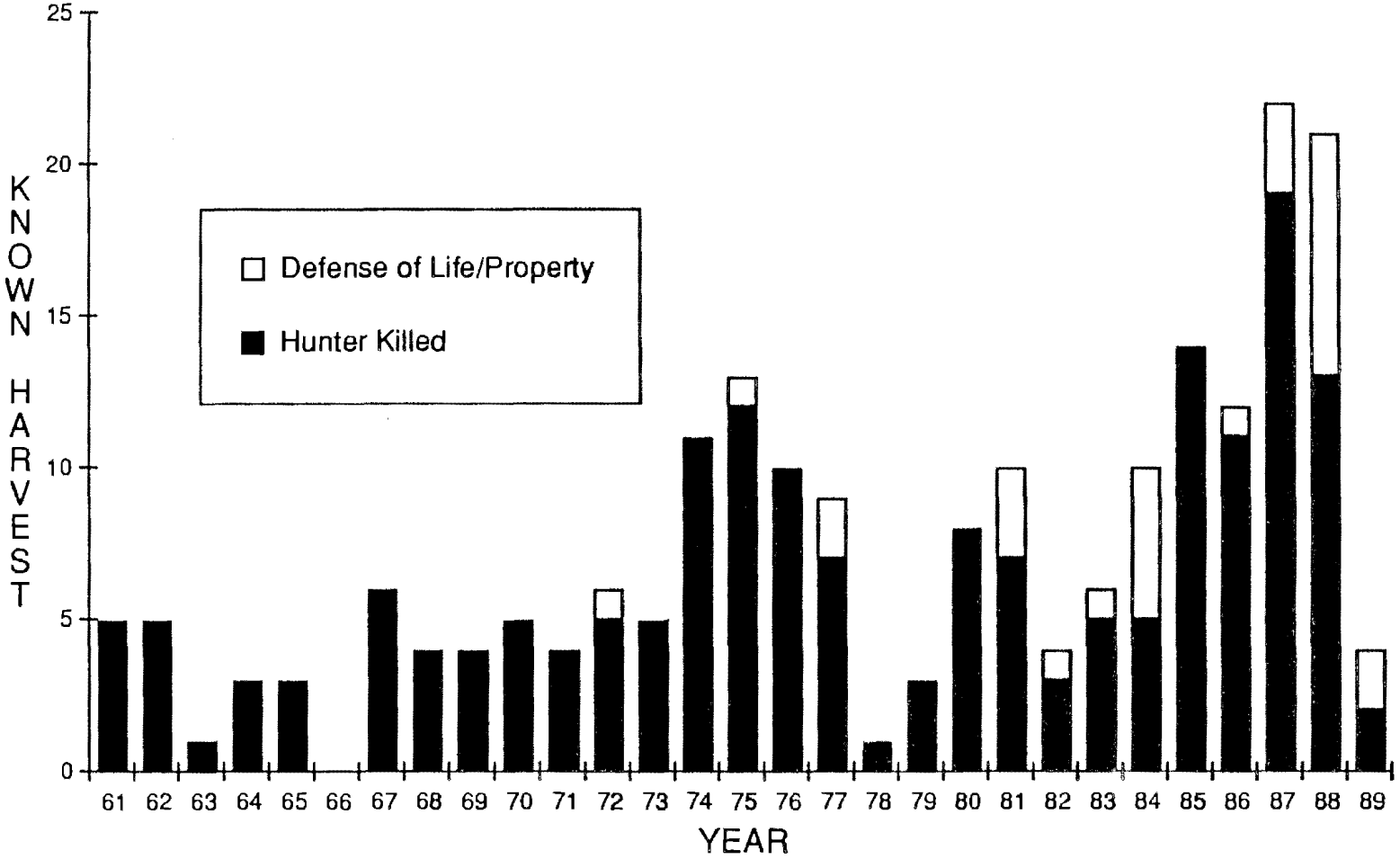

Figure 4. Annual brown bear harvest on the northeast portion of Chichagof Island, 1961-1989.

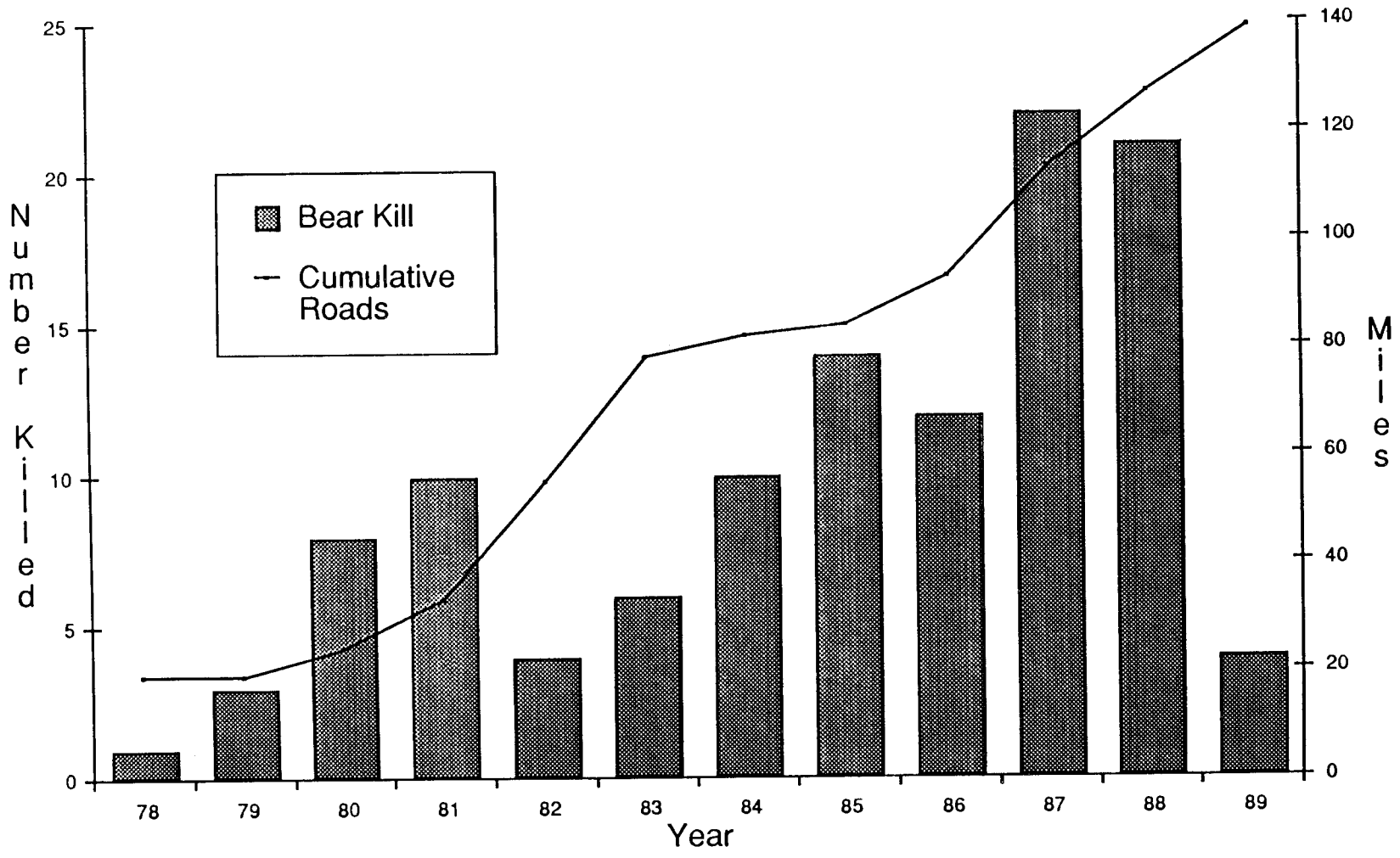

Figure 5. Annual brown bear harvest and cumulative miles of roads built on the northeast portion of Chichagof Island, 1978-1989. The autumn brown bear season was closed in 1989 and other restrictive regulations were imposed resulting in a lower harvest.

Table 1. Summary and status of brown bears captured on Admiralty Island, autumn 1981 through 30 June 1991.

Bear No.	Location	Sex	Capture (recapture) Age[a]	Weight(kg)	Date	CaptureCurrent Status techniques[c](30 June 1991)
04 Greens Creek	F	6	214[d]	9/29/83	H	Sport harvest 9/87
06 King Salmon	F	8	150[d]	9/27/81	H	--
06 Wheeler Creek	F	10	153[d]	(6/14/83)	H	Lost radio 5/86
07 Pack Creek	F	11	150	8/26/82	D	No radio
08 Pack Creek	F	10	150	8/26/82	T	--
08 Pack Creek	F	16	120	(7/19/88)	D	Removed radio
09[f] Pack Creek	F	1	54	8/26/82	D	No radio
10 Greens Creek	M	11	280[d]	7/2/82	H	--
10 Greens Creek	M	13	288[d]	(7/6/84)	H	--
10 Hawk Inlet	M	15	315	(6/9/86)	S	Lost radio 5/87
11 Pack Creek	M	4	120	8/28/82	T	Sport harvest 5/83
13 Greens Creek	M	15	284[d]	6/14/83	H	--
13 Greens Creek	M	16	270[d]	(7/6/84)	H	--
13 Hawk Inlet	M	18	270	(6/11/86)	S	Sport harvest 5/88
14 Greens Creek	F	7	120	9/26/81	H	--
14 Greens Creek	F	8	90	(7/2/82)	H	--
14 Greens Creek	F	11	95[d]	(7/8/85)	H	Bear kill 8/88
B14	King Salmon	F	2	100	9/26/81	HMortality
16 Greens Creek	F	4	90[d]	6/16/83	H	--
16 Wheeler Mountain	F	8	170[d]	(6/28/87)	H	Last located 3/90
17 Greens Creek	M	(3)	68	7/13/90	H	No radio
18 Greens Creek	M	6	214[d]	6/17/83	H	Last located 8/85
19 King Salmon	F	13	191	9/29/83	H	Mortality
20 Greens Creek	M	5	100	7/30/82	S	--
20 King Salmon	M	6	135	(5/1/83)	H	Mortality
25[k] Greens Creek	M	2	68	6/26/87	H	Last located 9/89
27[h] Greens Creek	M	2	77	6/11/86	S	--
27[h] Greens Creek	M	3	154[d]	(6/28/87)	H	--
27[h] Lake Florence	M	5	159	(7/6/88)	H	Removed radio
28 Greens Creek	M	13	260	6/11/86	S	
28 Wheeler Mountain	M	13	260	(7/10/86)	H	Sport harvest 5/87

(continued)

Table 1. (continued)

Bear No.	Location	Sex	Capture (recapture) Age[a]	Weight(kg)	Date	CaptureCurrent Status techniques[c](30 June 1991)
29 Wheeler Mountain	F	12	158	(7/5/84)	H	Last located 11/84
34 Mansfield Peninsula	F	2	70	7/8/82	H	Sport harvest 9/83
35 Wheeler Creek	F	8	135[d]	6/17/83	H	Mortality
36 Mansfield Peninsula	F	14	230	9/26/81	H	Lost radio 5/82
37 Mansfield Peninsula	F	10	270	8/3/82	S	Sport harvest 10/83
38 Greens Creek	F	23	280	7/2/82	H	--
38 Greens Creek	F	26	180[d]	(7/8/85)	H	Found dead 5/86
39 Mansfield Peninsula	F	9	270	8/7/82	S	--
39 Mansfield Peninsula	F	12	171[d]	(7/9/85)	H	--
39 Mansfield Peninsula	F	15	181[d]	(6/16/89)	H	Transmitting
40 Greens Creek	M	10	180	6/21/83	H	Last located 8/85
41 Mansfield Peninsula	M	2	135	6/21/84	H	Sport harvest 9/86
43 King Salmon	F	15	250	9/27/81	H	--
43 Greens Creek	F	20	114	(7/3/86)	H	--
43 King Salmon	F	23	136[d]	(6/20/89)	H	Transmitting
46 Greens Creek	M	11	248[d]	6/26/86	H	Last located 1988
47 Wheeler Mountain	M	15	480	7/3/90	H	Transmitting
48 Greens Creek	M	adult	300	8/3/82	S	Lost radio 6/83
49 Mansfield Peninsula	M	3	100	6/16/84	H	No radio
50 Greens Creek	M	3	120	9/26/81	H	--
50 Greens Creek	M	5	146	(6/17/83)	H	Lost radio 5/85
51 Greens Creek	M	1	60	8/28/81	S	Lost radio 9/81
52 Greens Creek	M	5	190	6/26/86	H	Last located 9/89
54[l] Eagle Peak	M	3	73	6/26/87	H	Lost radio 1988
55 Greens Creek	F	7	124	6/21/83	H	--
55 Greens Creek	F	10	155[d]	(7/10/86)	H	--
55 Greens Creek	F	11	113	(6/26/87)	H	Last located 1988
56 Greens Creek	F	13	17ʊ	7/30/82	S	--
56 Greens Creek	F	16	158[d]	(7/8/85)	H	--
56 Greens Creek	F	19	181	(6/16/89)	H	Transmitting
57 Greens Creek	F	11	203[d]	9/28/83	H	Last located 7/85

(continued)

Table 1. (continued)

Bear No.	Location	Sex	Capture (recapture) Age[a]	Weight(kg)	Date	CaptureCurrent Status techniques[c](30 June 1991)
58	Eagle Peak	M	4	180	9/21/81	H --
58	Hawk Inlet	M	5	194	(8/8/82)	S Sighted 9/84
59[e]	Greens Creek	M	3	80	9/21/81	H --
59[e]	King Salmon	M	5	113[d]	(5/1/83)	H Mortality
60	Greens Creek	F	20	160	9/21/81	H --
60	Greens Creek	F	21	135[d]	(7/2/82)	H --
60	Greens Creek	F	24	125[d]	(7/8/85)	H --
60	Greens Creek	F	25	125	(7/3/86)	H --
60	Greens Creek	F	26	163	(6/28/87)	H Unknown
61	Hawk Inlet	M	10	215	6/12/86	S --
61	Hawk Inlet	M	12	215	(6/27/88)	H Sport harvest 5/89
62	Young Bay	F	14	150	6/16/82	S Last located 9/86
63	Greens Creek	F	17	160	7/8/82	H Last located 10/84
64	Eagle Peak	F	14	190[d]	6/24/83	H --
64	Young Bay	F	17	159	(7/3/86)	H Last located 1988
66	Greens Creek	M	4	180[d]	6/22/83	H Last located 8/85
67	Greens Creek	F	2	60	8/2/82	S Sighted 9/85
68	Greens Creek	F	5	146[d]	9/28/83	H Sport harvest 9/88
69[g]	Eagle Peak	M	2	59	7/9/85	H Lost radio 5/86
70	Greens Creek	F	3	77	7/16/87	H --
70[m]	King Salmon	F	4	118	(9/16/88)	H Unknown
71	Wheeler Mountain	F	3	148	6/29/87	H Lost radio 8/87
72	Eagle Peak	M	6	200	7/8/82	H Last located 9/86
74N		King Salmon	M	(3)	160	6/28/91 HNo radio
75	Wheeler Mountain	F	15	159	7/3/90	H --
75	Greens Creek	F	16	159	(6/28/91)	H Transmitting
76[l]	Greens Creek	M	2	130[d]	7/10/86	H --
76[l]	Lake Florence	M	3	168	(7/6/88)	H Transmitting
77	Greens Creek	M	3	115	6/26/86	H Sport harvest 5/89
78	Greens Creek	F	(3)	91	7/10/86	H Mortality 8/86
79	Hawk Inlet	F	5	124	6/11/86	S Sport harvest 9/87
80	Greens Creek	F	6	127	7/3/90	H Transmitting

(continued)

Table 1. (continued)

Bear No.	Location	Sex	Capture (recapture) Age[a]	Weight(kg)	Date	CaptureCurrent Status techniques[c](30 June 1991)
81 Mansfield Peninsula	F	14	200	6/21/84	H	Last located 9/85
83 Greens Creek	M	(9)	425	6/28/91	H	Transmitting
84 Wheeler Mountain	F	11	147	7/9/86	H	Last located 4/90
85 Wheeler Mountain	F	11	150	7/11/86	H	Last located 1988
86 Wheeler Mountain	F	adult	375	7/16/87	H	Last located 1988
87 Greens Creek	M	(6)	300	6/28/91	H	Transmitting
89 Admiralty Cove	F	15	150	7/9/86	H	DLP 8/87[i]
91 Pack Creek	F	19	162[d]	6/21/83	H	Unknown
92 Pack Creek	F	16	159[d]	6/21/83	H	Lost radio 5/86
93 Pack Creek	M	5	158[d]	6/21/83	H	--
93 Pack Creek	M	10	170	(6/27/88)	H	Removed radio
94 Pack Creek	F	10	156[d]	7/13/83	T	--
94 Pack Creek	F	15	114	(7/19/88)	D	Removed radio
95 Mansfield Peninsula	F	8	170	7/8/82	H	--
95 Mansfield Peninsula	F	14	200	(9/16/88)	H	Transmitting
96 Mansfield Peninsula	F	7	148	7/3/86	H	Last located 10/87
97 Greens Creek	M	11	293[d]	7/10/86	H	Unknown
98 Greens Creek	M	19	315[d]	6/26/86	H	Last located 4/90
99 Greens Creek	F	17	200	7/8/82	H	--
99 Greens Creek	F	19	158	(6/21/84)	H	Lost radio 9/85

[a] Age determined by tooth sectioning or (estimated).
[b] Weight estimated.
[c] S = snare; H = helicopter; D = darted, free ranging; T = trap.
[d] Actual weight.
[e] Offspring of No. 60.
[f] Offspring of No. 7; Pack Creek problem bear called "Pest".
[g] Offspring of No. 9.
[h] Sibling of No. 76, probably offspring of No. 56.
[i] DLP = defense of life property.
[j] Sibling of No. 27, probably offspring of No. 56.
[k] Offspring of No. 55.
[l] Offspring of No. 64.
[m] Offspring of No. 60.

Table 2. Reproductive history of radio-collared female brown bears on Admiralty Island, autumn 1981 through 30 June 1991.

Bear No.	Age at capture (yrs)	Offspring[a] by year								
		1981	1982	1983	1984	1985	1986	1987	1988	1989
04	6	--	--	0	2 coy	2 1-yr	--	--[j]	--	--
06	8	--	--	1 coy[f]	0	0	--	--	--	--
07	11	--	--	1 1-yr	1 2-yr	--	--	--	--	--
08	10	--	0	0	2 coy	2 1-yr	2 2-yr	2 3-yr[b]	1 coy	--
09	1	--	0	0	0	0	0	0	0	0
14	7	0	0	0	2 coy	0[d]	0	2 coy	2 1-yr[e]	--
16	4	--	0	0	--	--	0	0	0	0
19	13	--	--	1 2-yr	--	--	--	--	--	--
29	12	--	--	--	3 1-yr[i]	--	--	--	--	--
34	2	--	0	0[j]	--	--	--	--	--	--
35	8	--	0	--	--	--	--	--	--	--
36	14	2 coy	--	--	--	--	--	--	--	--
37	10	--	--	1 coy[j]	--	--	--	--	--	--
38	23	--	0	0	0	0	0	--	--	--
39	9	--	0	0	2 coy	0[f]	1 coy	?	1 coy	1 1-yr
43	15	0	2 coy	2 1-yr	--	--	--	2 coy	2 1-yr	2 2-yr
55	7	--	0	--	--	--	1 1-yr	1 2-yr	1 3-yr[b]	
56	13	--	2 2-yr	2 3-yr[b]	2 coy	2 1-yr	2 2-yr[b]	1 coy	0[f]	0[g]
57	11	--	--	2 2-yr	2 3-yr	2 coy	--	--	--	--
60	20	1 2-yr	1 3-yr[b]	2 coy[c]	1 coy	1 1-yr	1 2-yr	1 3-yr	1 4-yr[b]	0
62	14	--	0	0	0	0	0	--	--	--
63	17	--	2 cubs	0	0	2 coy	--	--	--	--
64	14	--	--	1 1-yr	1 2-yr[b]	2 coy	2 1-yr	2 2-yr	1 3-yr[b]	0
67	2	--	0	--	--	--	--	--	--	--
68	5	--	--	0	0	0	0	?	0[j]	--
70[1]	3	--	--	--	--	--	--	0	0	0
71	6	--	--	--	--	--	--	0	--	--
75	15	--	--	--	--	--	--	--	--	--
78	3	--	--	--	--	--	--	0	--	--
79	4	--	--	--	--	--	0	0[h]	--[j]	--
80	6	--	--	--	--	--	--	--	--	--
81	14	--	--	--	0	0	--	--	--	--

(continued)

Table 2. (continued)

Bear No.	Age at capture (yrs)	Offspring[a] by year								
		1981	1982	1983	1984	1985	1986	1987	1988	1989
84	10	--	--	--	--	--	2 coy	2 1-yr	2 2-yr	2 3-yr[b]
85	7	--	--	--	--	--	1 coy	1 1-yr	1 2-yr[e]	--
86	adult	--	--	--	--	--	--	2-2-yr	2 3-yr	--
89	10	--	--	--	--	--	2 coy	2 1-yr[k]	--	--
91	19	--	0	--	--	--	--	--	--	--
92	16	--	0	2 coy	--	--	--	--	--	--
94	10	--	--	0	2 coy	2 1-yr	2 2-yr[b]	2 coy	2 1-yr	2 2-yr
95	8	--	2 1-yr	2 2-yr	0	2 coy	2 1-yr	--	2 coy	2 1-yr
96	7	--	--	--	--	--	3 coy[f]	2 1-yr	--	--
99	17	--	2 3-yr	2 coy	2 1-yr	1 2-yr[f]	--	--	--	--

Bear No.	Age at capture (yrs)	Offspring[a] by year	
		1990	1991
04	6	--	--
06	8	--	--
07	11	--	--
08	10	--	--
09[m]	1	2 coy	--[f]
14	7	--	--
16	4	--	--
19	13	--	--
29	12	--	--
34	2	--	--
35	8	--	--
36	14	--	--
37	10	--	--
38	23	--	--
39	9	--	3 coy
43	15	2 3-yr	0
55	7	--	--

(continued)

Table 2. Continued.

Bear No.	Age at capture (yrs)	Offspring[a] by year 1990	1991
56	13	--	1 coy
57	11	--	--
60	20	--	--
62	14	--	--
63	17	--	--
64	14	--	3 coy
67	2	--	--
68	5	--	--
70	3	--	--
71	6	--	--
75	15	2 coy	2 1-yr
78	3	--	--
79	4	--	--
80	6	0	0
81	14	--	--
84	10	2 coy	--
85	7	--	--
86	adult	--	--
89	10	--	--
91	19	--	--
92	16	--	--
94	10	--	--
95	8	--	--
96	7	--	--
99	17	--	--

[a] coy = cub of year
1-yr = yearling
2-yr = 2-year-old
cub = cub older than coy
0 = no cubs observed.
[b] Cubs left over summer.
[c] Male killed cubs in June.
[d] Female ate cubs in den.
[e] Female killed by marked male, fate of cubs unknown.
[f] Cubs disappeared over winter.
[g] Female lactating but no cubs present.
[h] Observed breeding.
[i] One cub disappeared over summer.
[j] Sport harvested.
[k] Female killed defense of life or property 8/87.
[l] Offspring of No. 60.

Table 3. Summary and status of brown bears captured on Northeast Chichagof Island, autumn 1989 through 30 June 1991.

Bear No.	Location	Sex	Capture (recapture) Age[a]	Weight (kg)[b]	Date	Capture Techniques[c]	Current status (30 June 1991)
101	Mt. head Seal Ck.	F	6	159[d]	10/13/89	H	transmitting
102	Repeater Mountain	M	13	345[d]	6/12/90	H	--
102	Hoonah Dump	M	13	374	(7/28/90)	S	lost radio 8/90
102	Hoonah Dump	M	13	374	(8/14/90)	S	Hoonah dump 10/90
103	Mt. S False Bay	M	2	170	10/13/89	H	transmitting
104	Mt. head Seal Ck.	F	(3)	113[d]	10/13/89	H	lost radio
105	Repeater Mountain	F	13	127	6/12/90	H	transmitting
106	Den Mountain	F	8	172	6/13/90	H	transmitting
107	Den Mountain	F	8	154[d]	6/13/90	H	transmitting
108	3 foot Mountain	M	11	318[d]	6/13/90	H	transmitting ?
109	Den Mountain	F	4	91	6/13/90	H	transmitting
110	Repeater Mountain	F	(3)	73	6/19/90	H	lost radio 4/91
110	Repeater Mountain	F	(3)	73	(6/26/91)	H	transmitting
111	Repeater Mountain	M	(3)	82	6/19/90	H	transmitting
112	Mt.N Fk.Freshwater	M	4	136	6/19/90	H	transmitting
113	Mts.E Indian River	F	10	172	6/19/90	H	transmitting
114	Mt.N Fk.Freshwater	F	(3)	73	6/21/90	H	transmitting
115	Mts.E Salt Lake Bay	F	24	127	6/21/90	H	transmitting
116	Mt.S of 3 Foot Mt.	F	6	136	6/21/90	H	lost radio
117	Repeater Mountain	F	9	159	6/21/90	H	lost radio
118	Repeater Mountain	F	(3)	64	6/21/90	H	transmitting
119	Mts.E Indian River	F	(3)	68	6/22/90	H	lost radio ?
120	Mts.E Indian River	F	12	163	6/22/90	H	lost radio ?
121	Mts.E Indian River	M	4	170	6/22/90	H	transmitting
122	Mts.E Indian River	M	11	295	6/22/90	H	transmitting
123	Tenakee Mts. mile 20	M	(18)	249	6/22/90	H	transmitting
124	S Fk.Freshwater Ck.	M	8	267	6/22/90	H	transmitting
125	Tenakee Mts. mile 20	M	(8)	193	6/25/90	H	Lost radio
126	Mts.E of Narrows	F	16	159	6/25/90	H	lost radio
127	Mts.E of Narrows	F	26	204	6/25/90	H	lost radio 8/90
128	Mt. South Den Mt.	F	9	136	6/26/90	H	lost radio 4/91
129	Tenakee Mts. mile 20	M	21	295[d]	6/26/90	H	DLP 10/90 Hoonah[e]

(continued)

Table 3. Continued.

Bear No.	Location	Sex	Capture (recapture) Age[a]	Weight (kg)[b]	Date	Capture Techniques[c]	Current status (30 June 1991)
130	Tenakee Mts. mile 20	F	(3)	73	6/26/90	H	transmitting
131	Mt. S of 3 Foot Mt.	F	23	147	6/26/90	H	transmitting
132	Den Mountain	F	12	159	6/26/90	H	transmitting
133	Tenakee Mts. mile 20	F	11	147	6/28/90	H	transmitting
134	Den Mountain	F	8	170	6/28/90	H	transmitting
135	Den Mountain	F	16	143	6/28/90	H	transmitting
136	Mts. E of Narrows	F	(3)	68	6/28/90	H	transmitting
137	Spasski Creek	M	4	136	7/17/90	S	lost radio
138	Spasski Creek	M	(20)	227	7/17/90	S	lost radio 6/91
139[f]	Spasski Creek	M	(1)	27	7/20/90	S	transmitting
140	Spasski Creek	M	4	136	7/25/90	D	sport harvest 5/91
141	Spasski Creek	F	5	147	7/26/90	S	transmitting
142	Hoonah Dump	M	4	170	7/27/90	D	not transmitting 5/91
142	Hoonah Dump	M	(6)	170	(8/10/90)	D	Hoonah Dump 6/91
143	Hoonah Dump	M	8	306	7/27/90	S	Hoonah Dump 10/90
143	Hoonah Dump	M	8	306	(8/14/90)	S	Hoonah Dump 10/90
144	Game Creek	M	(5)	159	8/13/90	S	unknown
145	Game Creek	F	(7)	159	8/13/90	S	transmitting
146	Hoonah Dump	M	(8)	272	8/13/90	S	transmitting
147	Hoonah Dump	M	(20)	340	8/14/90	S	Hoonah Dump 10/90
148	Game Creek	F	6	147	8/14/90	S	transmitting
149	Repeater Mountain	F	(12)	136	6/26/91	H	transmitting
150	Repeater Mountain	F	(7)	147	6/26/91	H	transmitting
151	Mts.E Indian River	M	(4)	125	6/26/91	H	transmitting

[a] Age determined by tooth sectioning or (estimated).
[b] Weight estimated.
[c] S = Snare; H = helicopter; D = darted, free ranging.
[d] Actual weight.
[e] DLP = Defense of life and property.
[f] A male Coy, no sow observed, family status unknown.

Table 4. Reproductive history of radio-collared female brown bears on Northeast Chichagof Island, autumn 1989 through 30 June 1991.

Bear No.	Age at capture (yrs)	Offspring[a] by year		
		1989	1990	1991
101	6	0	0	no
104	(3)	0	0	no
105	13	--	0	no
106	8	--	0	no
107	8	--	0	no
109	4	--	0	0
110	(3)	--	0	0
113	10	--	0	no
114	(3)	--	0	no
115	24	--	0	no
116	6	--	0	no
117	9	--	1 Coy	no
118	(3)	--	0	no
119	(3)	--	0	no
120	12	--	0	no
126	16	--	0	no
127	26	--	0	no
128	9	--	0	no
130	(3)	--	0	no
131	23	--	1 1-yr	no
132	12	--	1 1-yr	no
133	11	--	0	no
134	8	--	0	no
135	16	--	3 Coy	1 Coy[b]
136	(3)	--	0	no
139[c]	Coy[c]	--	1 Coy[d]	1 Coy[d]
141	5	--	1 Coy[e]	no
145	(7)	--	0[e]	0
148	6	--	0[e]	no
149	(12)	--	--	2 1-yr
150	(7)	--	--	0

[a] Coy = cub of year
1-yr = yearling
2-yr = 2-year-old
0 = no cubs observed.
no = no observation of marked bear.

[b] Aerial observation, poor visibility because of vegetation.

[c] A male Coy, no sow observed, family status unknown.

[d] Telemetry location, no sighting.

[e] Snared along salmon stream, limited visibility. If cubs present may not be visible.

APPENDIX A. Titus, K. 1991. Southeast Alaska brown bear (*Ursus arctos*) conservation plan and viability analysis. *in* L. H. Suring and L. C. Shea, eds. Conservation of old growth forest wildlife in southeast Alaska. Draft Administrative document. USDA Forest Service.

SUMMARY

The brown/grizzly bear has a high potential for population viability problems given the history of its extirpation from many regions of North America. Resource managers in southeast Alaska should learn from historic and current pressures on brown bears so that viable, well-distributed and preferably useable populations remain into the future. The brown bear is a management indicator species (MIS) for the National Forest lands in Alaska. The Tongass Land Management Plan (TLMP) Revision Draft Environmental Impact Statement (DEIS) identified eight geographic units to maintain viable and well-distributed brown bear populations. Minimum viable population sizes varied from 125 to 250 individuals (TLMPR-DEIS, p. 3-553; and USFS Technical AMS, R10-MB-89, pp. 568-773). There are problems with the 'well-distributed' portion of the minimum viable population analysis in that resource extraction activities could result in the extirpation of the brown bear from portions of their range. This problem exists because brown bears require large tracts of undisturbed landscapes. A series of Monte Carlo simulations demonstrated that a population of 250 bears would be extirpated given continued high man-induced mortality rates that occurred on northeast Chichagof Island. Old growth standards and guidelines and general forest-wide standards and guidelines should maintain intact watershed-like areas so that brown bears remain well-distributed over the Forest. The units to maintain viable and well-distributed brown bear populations in the present TLMP DEIS are too large. I suggest that the appropriate planning size combine multiple watersheds and that within these brown bear planning units some areas be maintained as a sanctuary where landscape features associated with brown bear habitat use are available. These attributes include the maintenance of undisturbed, high volume old growth, access to salmon streams that have forest buffers, few roads and/or difficult human access, and limited access to remote and varied denning habitat. Resource management standards and guidelines should include-

1) planning guidelines that include habitat capability modeling and cumulative impacts assessments for site-specific plans,
2) the maintenance of undisturbed, difficult to access landscapes juxtapositioned near intensively managed habitat conservation areas,
3) undeveloped areas adjacent to important salmon streams,
4) the maintenance of 100 meter forest buffers along important bear-fishing streams,
5) the continued development of solid waste management programs and firearms policies in industrial camps,
6) a progressive, a priori, road closure program, and

7) a program of limited access to cutting units and roads except for the ongoing timber extraction activities.

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