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

by
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We conducted a series of brown bear mark-resight survey flights to estimate density on the northeast portion of Chichagof Island. Preliminary analyses indicated a density of 330 bears/1,000 km^2.

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SUMMARY

Long-term brown bear monitoring continued in association with the Greens Creek Mine, Admiralty Island, Alaska during this report period. Eighty brown bears were radio-collared from 1981 through 30 June 1992 and during summer 1992, 22 active radio-collars were on bears and being monitored. We noted no major population changes or shifts in spatial use patterns during this time period. Two radio-collared sows were sport-harvested and mine personnel experienced their first instances of chronic, bear-human encounters, that resulted in the death of one brown bear.

Brown bear population ecology studies continued on the 1,112 km^2 northeast portion of Chichagof Island. Thirty-two brown bears were captured and radio-collared this report period, six of which were recaptures. As of June 1992, 46 active radio-collars were affixed to bears. From October 1989 through August 1992, 79 individual brown bears were captured 100 times.

Two radio-collared brown bears were shot legally during the spring 1992 hunting season, and two radio-collared sows were found dead from unknown causes.

We evaluated brown bear movements associated with roadbuilding and logging activity and found that at least three female brown bears moved away from the immediate area of roadbuilding activity. We also evaluated brown bear telemetry locations in conjunction with some of the interagency brown bear habitat capability model's roadbuilding any human access parameters during late summer. Brown bear telemetry locations were farther ($P < 0.05$) away from salmon streams in a timber harvested watershed that had incomplete streamside forest buffers than in an uncut watershed during late summer. Brown bears were found in close association with secondary and blocked roads indicating that they do not avoid these areas and have a high probability of encountering humans. These initial findings were in agreement with the brown bear habitat capability model.

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BACKGROUND

Studies of brown/grizzly bears (*Ursus arctos*) in areas where resource development is planned or is occurring are important towards understanding a species that has been extirpated from much of its historic range. The maintenance of healthy brown bear populations for more than 50 years amidst resource development activities requires knowledge of the regional bear population and an understanding of those development attributes that will affect the population. Through this knowledge, planning for brown bears can take place and their special requirements can be integrated into land use planning and multiple use requirements that allow for a variety of land management options.

Brown/grizzly bears have been studied in a variety of North American locations relative to resource development (e.g., Archibald et al. 1987, Ballard et al. 1990, McLellan 1990, Schoen and Beier 1990, Titus and Beier 1992). Most of these studies were conducted on lower density bear populations, or they were of short duration. The high density brown bear populations of southeast Alaska are dependent on spawning salmon as a part of their annual nutritional pattern (McCarthy 1989). This pattern concentrates brown bears in low elevation riparian forests (Schoen and Beier 1990) and increases the probability of bear-human encounters. The combination of high-density brown bear populations, intensive forest management that created an easily accessed public road system and long-term changes in forest cover are unique aspects of our study.

Another unique aspect of this study during this report period and into future years relates to the Tongass Timber Reform Act's (Public Law 1990) streamside buffers. Timber harvest began in a watershed that contains major salmon spawning streams and very high late summer bear densities. Timber harvest in this watershed was subject to 100+ foot streamside buffers where no timber harvest would take place. We have the opportunity to evaluate the use of these buffers by radio-collared brown bears and monitor their effectiveness in the coming years.

During this reporting period we estimated brown bear density on the northeast portion of Chichagof Island using aerial mark-resight methods (e.g., Miller and Sellers 1992). The density estimate is a basis for meeting other study objectives such as validation of the brown bear habitat capability model, population projection modeling, and a baseline upon which future population changes can be monitored. The density estimate also provides a basis for re-evaluating the current brown bear hunting restrictions on the northeast portion of Chichagof Island.

OBJECTIVES

The scope of our project remained similar to that of the previous report period (Titus and Beier 1992). The main emphasis was to evaluate and predict short- and long-term changes in brown bear populations as influenced by man-induced changes to their habitat and demography. Specific objectives include -

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 344 km^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). During this reporting period bear tagging and telemetry flights focused on Greens Creek watershed, Robert Baron Mountain, Wheeler Mountain, and Admiralty Creek.

The northeast Chichagof Island study area is a 1,112 km^2 island-like area north of Tenakee Inlet and east of Port Frederick. A complete description of the study area is found in (Titus and Beier 1992). We focused our research activities in portions of the study area during this report period. We targeted the Game and Seagull creeks watersheds (229 km^2) for study because of their high bear density and the roadbuilding and logging activity that took place this report period.

METHODS

Bear capture, aerial telemetry, and data collection methods followed those of Schoen and Beier (1990) and Titus and Beier (1992). Methods specific to this report period follow.

Evaluation of brown bear habitat capability model. The interagency brown bear habitat capability model (Schoen et al. 1989, Schoen et al. in press) considered a variety of habitat and human access attributes to predict the changes in bear populations over time as associated with different forest management scenarios. Road access was considered detrimental to bear populations in this model and some habitat capability indices required professional judgement for determining their value. We used data collected during the first two field seasons from northeast Chichagof Island to evaluate the association of brown bears to roads and salmon streams during the summer months. We tested whether radio-collared brown bear telemetry locations exhibited any pattern associated with distance from primary roads, secondary roads, and salmon streams. To make this evaluation, we chose a subset of 58 radio-collared brown bears captured from 1989 to 1991. Aerial telemetry locations were selected from 15 July to 15 September to coincide with the late summer season of the habitat capability model. Two adjacent, uncut, and largely unroaded watersheds that effectively form one watershed (total = 185 km^2) were chosen to compare with a watershed that has undergone the most extensive clearcut logging on the 1,112 km^2 study area. Each watershed had a single, major salmon spawning stream flowing much of its length. Chum (*Onchorhynchus keta*) and pink (*O. gorbuscha*) salmon were the most important salmon species for brown bears. Of 26 anadramous fish streams on the study area, these two streams had the highest and fourth highest numbers of spawning pink and chum salmon.

Mark-resight density estimate. The brown bear mark-resight density estimation technique followed methods developed by S. Miller (e.g., Miller and Sellers 1992) that use a modified Lincoln-Peterson estimate (Seber 1982, Pollock et al. 1990). Unlike other regions where bear mark-resight density estimates were made (e.g., Ballard et al. 1990, Miller and Sellers 1992) our study area was largely forested resulting in a limited search area. We relied on the annual pattern of brown bear movements in southeast Alaska in which a large number of bears spend 2-5 weeks in alpine habitats during the early summer where they can be observed from an airplane.

All brown bears were marked (radio-collared) before the resight flights. We conducted survey flights over prescribed routes to cover subalpine and alpine habitats. Logging roads and clearcut habitats were not targeted for observation. To meet the assumptions of the mark-resight technique (Pollock et al. 1990), we conducted aerial telemetry flights to assure population closure, and determine if any bears had lost their radio collars.

We estimated bear density for all bears that included sows with cubs, and for independent bears that eliminated sows and their dependent offspring from the calculation of bear density (Miller and Sellers 1992).

RESULTS AND DISCUSSION

Admiralty Island/Hawk Inlet Study Area

Greens Creek Mine - Admiralty Island Study. We captured and radio-collared 14 brown/grizzly bears as part of the long-term study on northern Admiralty Island associated with the Greens Creek Mine. Six of these bears were recaptures of previously marked individuals, including some females first captured and radio-tagged in the mid-1980s. As of 30 June 1992, 80 individual brown bears were radio-collared on this study area beginning in 1981. We monitored 22 active radio-collars during summer 1992 for their location in association with the Greens Creek Mine and a control site on Robert Baron Mountain. Spatial patterns were similar to previous years with the exception of one radio-collared sow that moved away from a traditionally used portion of her home range where mine exploration activities occurred. No changes in cub production were noted during this time period.

Greens Creek Mine experienced human-bear encounters and associated problems during this report period. Some of these bear-human problems were with research bears and one brown bear broke into a building and obtained human food. Two radio-collared females that had 3.5 year-old cubs earlier in the season were shot legally in Hawk Inlet during spring hunting season. Both of these sows were partially habituated to humans.

Northeast Chichagof Island Study Area

Bears captured and radio-collared. We captured and radio-collared 32 brown bears this report period. Six of these brown bears were recaptures of previously marked bears and 3 occurred at the Hoonah dump. Of the 32 brown bear captures, 4 were snared, 1 was free-ranged, and 27 were captured by helicopter darting in alpine and subalpine habitats.

From October 1989 through August 1992, 79 individual brown bears were captured 100 times. No capture related mortalities occurred during this study. Male bear #102 that broke free with a snare attached to his front paw was recaptured in October 1991 and was in excellent condition, though he was missing a front paw. Through August 1991, he continues to be the dominant bear at the Hoonah dump.

Forty-six active radio-collars were affixed to bears as of June 1992. This sample was composed of 12 males and 34 females. This lack of equality differs from the previous report period. The disparity in the sexes of radio-collared bears was because of high collar loss by males and male bears being largely absent from alpine habitats during summer 1992 helicopter tagging operations. We cannot account for eight of 79 radio-collars on the study area and consider them to be missing.

Mortality patterns. Two radio-collared bears were shot legally during the spring hunting season and the remains of two radio-collared bears were examined in the field during this report period. The remains of sow #115 were found 400 m from the beach in the forest and the remains of sow #149 were found in an uncut leave strip of trees surrounded by large clearcuts. Causes of death remain unknown. In addition to the mortality of radio-collared bears, one male bear was killed and discovered in a clearcut with his claws and one paw cut-off, and a sow was shot in defense-of-life-and-property with the shooter receiving a citation for failing to report the shooting.

Six brown bears were harvested during the spring 1992 hunting season within the study area. This harvest rate combined with the increased knowledge of the illegal killing of brown bears leads us to the conclusion that the motorized vehicle restrictions and the closure of the autumn hunting season were prudent brown bear management measures during this report period.

Population Isolation. One of ~60 brown bears for which we have home range data has moved out of the study area and established a home range south of Tenakee Inlet. The status of ~10 radio collars was not determined. We conclude that brown bears on the northeast portion of Chichagof Island are more isolated than initially expected.

Short- and long-term home range changes relative to roadbuilding and logging. Preliminary analysis indicates that at least three female brown bears moved away from the immediate area of roadbuilding activity during the report period. These individuals moved to higher elevations and/or had movements outside their established home range. Major short-term movements were not noted for other radio-collared bears within the Game Creek watershed during intensive logging and roadbuilding. No brown bear telemetry locations (n = 40) were recorded in any of the Game Creek clearcuts during summer 1992 even though these clearcut areas had telemetry locations in previous years.

During the summers of 1990 and 1991, home range data were collected on at least 12 brown bears whose home ranges were influenced by roadbuilding and logging during spring and summer 1992.

Evaluation of brown bear habitat capability model relative to roadbuilding and salmon streams. After data screening, 58 aerial telemetry location estimates were available for analysis from 29 brown bears. Mean distance from a brown bear telemetry point to primary roads did not differ between the uncut and roaded watersheds (Table 1) because of a primary road oriented near the uncut watershed. Brown bears were much closer to secondary and blocked roads in the roaded watershed as opposed to the uncut and unroaded watershed indicating that they do not avoid these locations. This attribute results in more frequent bear-human encounters (McLellan 1990).

The most important result was that brown bear locations were much farther away from the salmon stream in the highly roaded and clearcut watershed than in the uncut pristine watershed (Table 1). We believe that a lack of cover and forested stream buffers contributed to this result. This pattern fits the professional judgment within the capability model where capability is reduced in clearcut habitat and adjacent salmon spawning streams.

<u>Brown bear density estimate</u>. We report the results here even though they transcend two report periods. Twenty-two additional brown bears were radio-collared in June 1992 to supplement those previously marked from 1989-1991. We used aerial telemetry flights immediately before and after the mark-resight surveys to determine population closure and the number of active collars on bears during the mark-resight surveys. Forty-six active radio-collars were on brown bears during the mark-resight survey period. Including cubs with their marked mothers, 73 marked bears were present. The study area is almost insular and surrounded by water and bears did not routinely move to and from the study area so the assumption of closure was met.

We conducted seven mark-resight alpine surveys during the evenings from July 1-18, 1992. All surveys were conducted with one fixed-wing aircraft by K. Titus or L. Beier along with a pilot. One survey was hampered by low cloud ceilings and rain. The mark-resight density estimates were conducted with and without this partial survey.

Sightability of marked brown bears ranged from 9-11% (Table 2). For the all bears estimate, all cubs accompanied by marked sows were also considered marked. Excluding the partial survey, we saw five to 12 marked bears on survey flights and the total number of all bears observed ranged from 33 to 53. For the independent bears estimate, only radio collared individuals were considered marked. Excluding the partial survey, we saw from two to eight marked bears on survey flights and the total number of independent bears observed ranged from 23 to 35.

Using mark-resight methods and all seven survey flights, we estimated that 367 brown bears of all ages were present on the 1,112 km^2 the northeast portion of Chichagof Island during July 1992 (Table 2). The density estimate was 35 bears higher if the incomplete survey of July 8 was eliminated (Table 2). Mean brown bear density for the northeast portion of Chichagof Island was lower than that for northern Admiralty Island (Schoen and Beier 1990), but the confidence intervals overlapped, so there was no significant difference between the two estimates.

The brown bear density estimate based on the habitat capability model for the Tongass Land Management Plan Revision was 324 bears for the national forest lands on northeast Chichagof (USDA Forest Service 1991) for the year 1990. This value would be ~10-15% higher if all lands were included in the habitat capability model, because of the large tracts of private lands in two watersheds. The Tongass Land Management Plan Revision model includes only effects of vegetation changes over time, with no long-term reductions in habitat capability attributable to human access (Schoen et al. in press). We conclude that the brown bear habitat capability model agrees with our independent density estimate over the short term. Our patterns of bear mortality associated with increased access after roadbuilding indicate that the long-term reductions in capability because of both human access and vegetation changes need to be incorporated into the model for planning purposes.

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Table 1. Mean distances (in km, ± SD) from brown bear telemetry locations to primary roads, secondary roads, blocked roads, and salmon spawning streams in an uncut and largely unroaded watershed versus a roaded and highly clearcut watershed during late summer, Chichagof Island, Alaska.

	Watershed type		
	Uncut	Clearcut	P^a
Primary road	3.0 ± 1.8	2.7 ± 2.6	0.082
Secondary road	7.8 ± 2.0	2.4 ± 1.7	<0.001
Blocked road	2.7 ± 2.1	0.9 ± 1.5	0.001
Salmon spawning stream	0.5 ± 1.0	1.2 ± 1.2	0.025

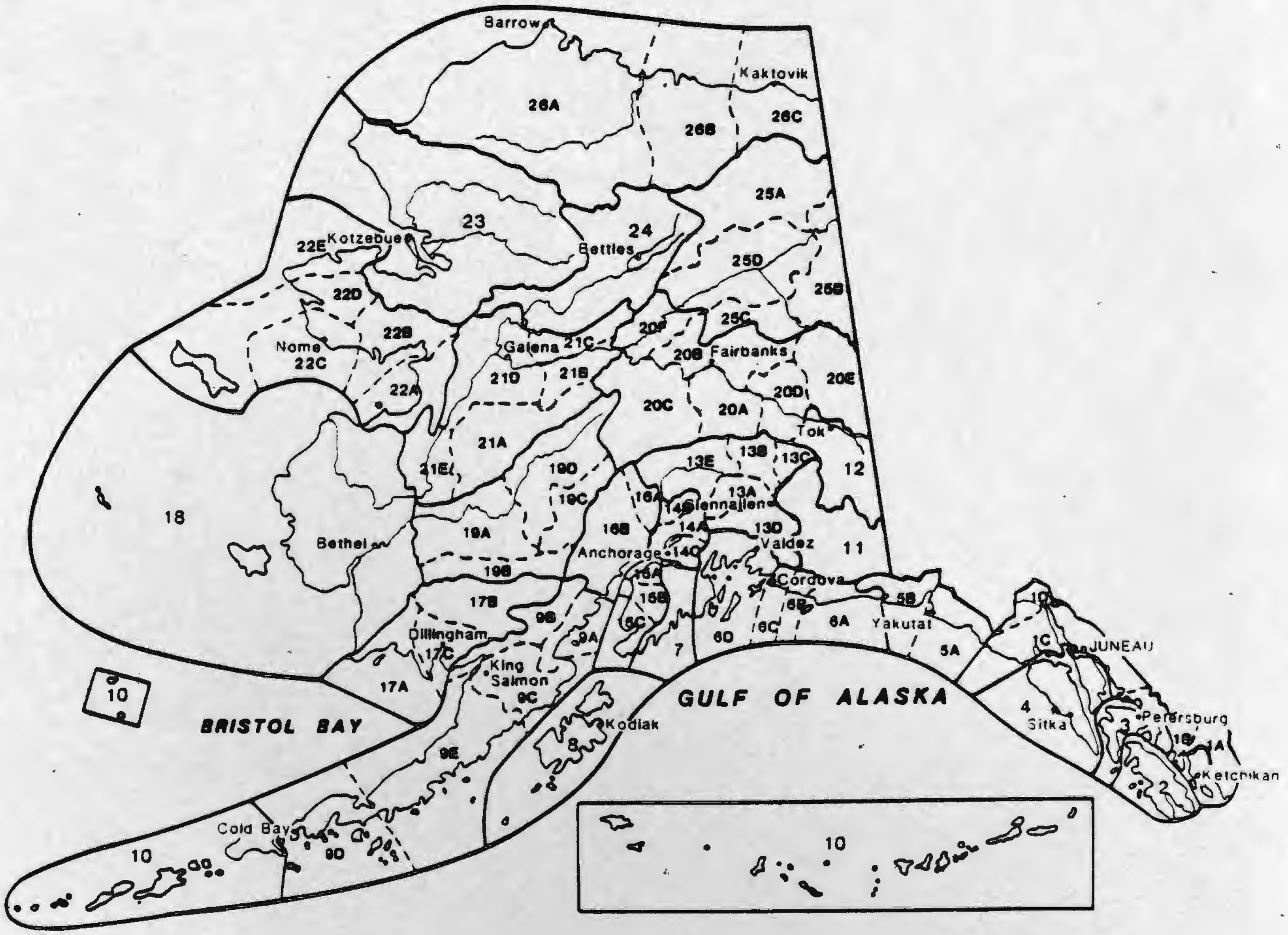
[a] Based on equal variance t-tests.

Table 2. Brown bear density estimates for the 1,112 km^2 northeast portion of Chichagof Island, Alaska, 1992, based on mark-resight methods.

	Marks present	Mean daily Lincoln-Peterson estimate	Sight-ability (%)	Density No./1000 km^2	95% CI No./1000 km^2	Density No./1 mi.^{2}
Bears of all ages						
All survey flights[a]	73	367.8	10.9	330.5	175-485	0.856
Eliminating partial survey flight[a]	73	402.6	11.2	361.7	226-496	0.936
Independent bears only, dependent young not included in estimate						
All survey flights[a]	46	245.5	9.3	220.6	149-294	0.571
Eliminating partial survey flight[a]	46	260.4	10.1	234.0	170-299	0.606

[a] Estimates were made using seven and six survey flights, respectively, with one partial survey being eliminated.

Alaska's Game Management Units



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