EFFECTS OF CAPTURE PROCEDURES ON BLACK BEAR ACTIVITY AT AN ALASKAN SALMON STREAM

DANIELLE K. CHI, Department of Fisheries and Wildlife, Utah State University, Logan, UT 83422-5255, USA, email: slglx@cc.usu.edu
DENNIS CHESTER,[1] Wrangell Ranger District, U.S. Forest Service, P.O. Box 51, Wrangell, AK 99929, USA
BARRIE K. GILBERT, Department of Fisheries and Wildlife, Utah State University, Logan, UT 84322-5255, USA, email: BGilbert@cc.usu.edu

Abstract: We examined the effects of capture and handling on fishing activity of black bears (*Ursus americanus*) at Anan Creek in Southeast Alaska. The bears had no previous experience with capture procedures. One female brown bear, 9 male black bears, and 4 female black bears were captured (trapped or darted), collared, and ear-tagged by Alaska Department of Fish and Game personnel between 24 July and 1 August 1993. Observational data on bear behavior were collected before and after capture procedures from 16 July–4 September 1993 (296 observation hours) and from 3 July–27 August 1994 (258 observation hours). We observed a significant decline in the number of different individuals on the river following the week of capture and handling in 1993. In addition, approximately 46% of the collared bears were not seen again at Anan Creek throughout the remainder of the 1993 season. This percent declined to <30% by 16 August 1993. The next year, when no bears were captured and handled, these patterns were not observed. Furthermore, we found little evidence to suggest that bears abandoned Anan Creek immediately following capture and handling because of other ecological factors (i.e., brown bear activity [*Ursus arctos*], pink salmon [*Oncorhynchus gorbuscha*] inaccessibility, berry availability and productivity). Although many black bears at Anan Creek tolerated recreational viewing by humans, disappearance of bears from the capture site suggests that they were displaced by capture and handling activities.

***Ursus* 10:563–569**

Key words: bear behavior, black bear, brown bear, capture effects, Southeast Alaska, *Ursus americanus*, *Ursus arctos*.

Studies of human effects on bears are becoming increasingly important as human–bear interactions become more numerous. Biologists have attempted to examine human effects on bears at both the population (Elgmork 1978, McLellan and Shackleton 1989) and individual scales (Archibald et al. 1987, McCutchen 1990, Olson 1993). Such research often requires capture and handling of bears to fit them with radiocollars and identification tags and to collect demographic information. Researchers typically assume that these procedures have minimal effect on the subjects and do not bias study results (Laurenson and Caro 1994). While some biologists have attempted to validate this assumption by examining both short-term and long-term physiological and mortality effects of trapping and handling (Ramsay and Stirling 1986, Beck 1991, Gibeau and Paquet 1991), only a few studies have investigated the immediate behavioral responses to these procedures (Amstrup and Beecham 1976, Taylor 1986).

In 1993, we initiated a behavioral study on the influence of people on black bears at Anan Creek in the Tongass National Forest. Visitation to Anan Creek had escalated rapidly since 1989 (U.S. Dep. of Agric. For. Serv. [USFS] 1990). Our objectives were to investigate potential human effects on individual black bears fishing at Anan Creek and to identify other ecological factors that influence their distribution and activity patterns. Black bears were captured (trapped or darted), radiocollared, and ear-tagged to identify individuals and obtain home range data. Because black bears have been reported to exhibit initial avoidance of people immediately after being captured and handled (Amstrup and Beecham 1976), we questioned whether these activities might introduce bias into the behavioral data subsequently collected on marked animals. The capture operation also placed people in new areas, presenting an opportunity to observe the responses of bears to these activities. As a substudy, we examined the short-term effects of capture and handling procedures on the distribution and activity of black bears fishing on Anan Creek in Southeast Alaska, while monitoring other possible influences (e.g., brown bear activity, salmon availability, etc.). Because Anan bears had no prior experience with capture procedures or human presence in the areas where the bears were captured, we hypothesized that the capture operation would function as a short-term disturbance. While most bears at Anan tolerate people at a bear-viewing observatory, we predicted that some would be temporarily displaced from the disturbed site.

This research was funded by the United States Department of Agriculture, Forest Service, Wrangell Ranger District with cooperation from the Alaska Department of Fish and Game (ADF&G). Travel funds were provided by the Utah State University Ecology Center and the Berryman Institute. We especially thank L. Beier and K. Titus (ADF&G) for bear capture and collaring and for

[1]Present address: P.O. Box 7, Blairsden, CA 96103, USA.

comments on an earlier draft of the manuscript. Interpretation and conclusions are the responsibility of the authors and do not necessarily reflect the views of ADF&G. For assistance in 1993–94 data collection, we thank G. Holser, J. Stoneman, R. Reed, D. Staab, and C. Mellison. Additional thanks go to S. Gilbert, J. Stoneman, and R. Reed for their help in building observation platforms in 1993 and to 2 anonymous reviewers for comments which greatly improved the manuscript.

STUDY AREA

Anan Creek is located approximately 30 miles southeast of Wrangell on the Tongass National Forest (Fig. 1) and is accessible only by float-plane or boat. The region is characterized by coastal forests of Sitka spruce (*Picea sitchensis*) and western hemlock (*Tsuga heterophylla*) interspersed with alder (*Alnus* spp.) and black cottonwood (*Populus trichocarpa*) along riparian zones. The left fork of Anan Creek is wide and flat providing suitable spawning habitat for pink salmon. Both black bears and brown bears come to Anan Creek to feed on abundant salmon from early July to mid-September. Two sets of falls impede movement of salmon, making them particularly vulnerable to capture by bears. The lower falls, accessible by a boardwalk and trail, is located about 0.5 miles from the trailhead at Anan Bay. A bear-viewing observatory was constructed on a cliff approximately 12 meters above the lower falls for public use. The upper falls area, 0.25 miles from the lower falls, has been closed to the public since 1992.

METHODS

Bears were captured by Alaska Department of Fish and Game (ADF&G) personnel, 23–31 July 1993. Snares were set at both the upper and lower falls, but capture efforts were concentrated on the south side of the upper falls because of exceptionally high bear activity. Capture activities took place between 0600 and 2100 hours. Bears were captured in leg snares or by free-range darting and immobilization with Telazol® (A.H. Robins Co., Richmond, Va.). Once anesthetized, bears were fitted with radiocollars, ear-tagged with multi-colored Floy tags (Floy Tag, Inc., Seattle, Wash.) and lip-tattooed. For each bear, an ear plug was collected, upper or lower (or both) pre-molar extracted, and information recorded on sex, estimated weight and age, reproductive condition, and distinguishing physical characteristics (scars, pelage color, chest patch, etc.).

We observed black bear behavior from the public observatory at the lower falls and from a tree platform constructed above the north bank of the creek at the upper falls. A blind was constructed around the tree platform in 1994 to conceal the observer and contain human odor as much as possible. In early July, observations were made between 0600 and 2200 hours when light was sufficient for sampling. Each day was divided into eight 2-hour periods. In mid-July, the last session was dropped as decreasing light made observations difficult and return from sites hazardous. For logistic simplicity, we assigned sampling sessions systematically each day to assure complete coverage of all periods at both sites within a week.

We used binoculars and spotting scopes to help identify bears. Photographs of bears (front view and profiles) were taken and distinguishing physical characteristics were sketched to help identify both unmarked individuals and individuals whose ear-tags had been lost. The sex of individuals was determined from observation of genitals, urination posture, or the presence of cubs.

We quantitatively estimated fish abundance during the 1993 field season based on density categories of salmon (percent coverage) across the mainstream and sidepools of the creek. Categories included the following: 0 = none to few fish, 1 = <10%, 2 = 10–50%, 3 = 51–90%, and 4 = >90%. We compared this estimate to fish capture rates to assess its validity in predicting fish accessibility for black bears.

Prior to beginning each observation, we recorded the date, time, site, observer identification, weather conditions (visibility and wind velocity), fish accessibility category, water level, number of bears present upon arrival, identification or description of individuals present, and initial response of individuals present to the arrival of researchers. We used a form of continuous recording (Altmann 1974) to collect data on black bear activity and fishing success. During observations we recorded species, sex–age class and individual identification number, side of river of bear appearance, arrival and departure time (to nearest second), number of fishing attempts, number of fish caught, and eating location for each fish caught or scavenged for all bears we observed. From these data, we determined the number of different individuals that frequented the site during any given observation session. Fishing success was calculated from the number of fish caught/individual for an observation session. We used instantaneous scan sampling at 10-minute intervals (Altmann 1974) to obtain relative measures of visitor and bear activity.

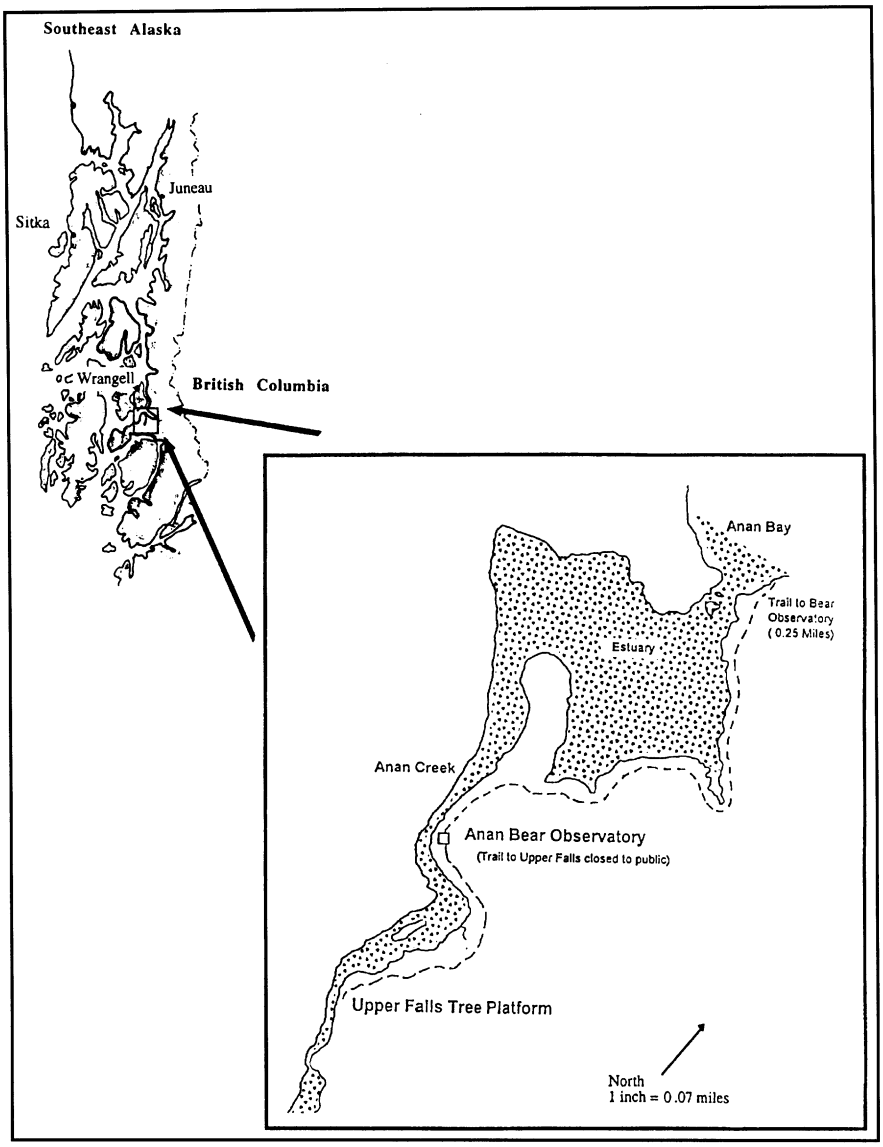

Fig. 1. Map of the Anan Creek drainage in Tongass National Forest, Alaska 1993–94.

Seasonal patterns of fish accessibility, black bear activity, and visitor use were summarized using six 9-day sample blocks to ensure that all times were represented from both sites in each block. Means were calculated using 2-hour observation sessions as the sampling unit. To test for differences between overall black bear activity before and after the trapping exercises in 1993, we pooled the bear activity from the 2 blocks prior to and 2 blocks following trapping to form pre- and post-trapping periods. These periods were then compared statistically. Data collected in 1994 served as a control. Non-normally distributed data was analyzed using nonparametric statistical procedures (Zar 1984).

RESULTS

Thirteen black bears and 1 brown bear were captured and marked between 24–31 July 1993 (Table 1). Two subjects, a large adult male and small adult female, sustained slight injuries to front paws while in the snares. The large male was observed fishing at the upper falls immediately following the capture operation and throughout the remainder of the 1993 season; the female was not re-sighted until 1994. Sampling at the lower and upper falls included 168 and 128 observation hours between 16 July and 4 September 1993, respectively. In 1994, 148 and 110 hours of data were collected between 3 July and 27 August at the lower and upper falls, respectively.

Table 1. Capture information for black bears at Anan Creek, Alaska, 1993.

Date of capture	Capture technique	Capture site[a]	Sex[b]	Estimated weight (kg)	Estimated age
25 Jul	Dart	U. falls S. side	M	113	10 yrs
25 Jul	Snare	U. falls S. side	M	82	5 yrs
26 Jul	Snare	U. falls S. side	M	147	15 yrs
26 Jul	Dart	U. falls S. side	M	154	15 yrs
27 Jul	Dart	U. falls S. side	M	136	14 yrs
27 Jul	Dart	U. falls S. side	M	73	5 yrs
27 Jul	Dart	U. falls S. side	M	124	7 yrs
28 Jul	Snare	U. falls S. side	F	77	11 yrs
29 Jul	Snare	U. falls S. side	M	136	17 yrs
30 Jul	Dart	U. falls S. side	M	147	21 yrs
30 Jul	Dart	L. falls N. side	F & 2 COY	77	8 yrs
30 Jul	Dart	L. falls N. side	F & 2 COY	91	10 yrs
31 Jul	Snare	L. falls S. side	F & 2 COY	73	20 yrs

[a] U. = Upper, S. = South, L. = Lower, N. = North
[b] M = male, F = female, COY = cubs-of-the-year

Overall Black Bear Activity

Data on black bear activity were not normally distributed, necessitating nonparametric statistical approaches. In 1993, the number of different individuals observed fishing on the creek decreased significantly at both sites following capture activities (lower falls: Mann-Whitney $U = 467.5$, $P = 0.0017$; upper falls: $U = 321$, $P = 0.0006$; Figs. 2, 3). We found no significant differences between overall black bear activity (bears/10 minute scan) prior to and following the capture exercises at the lower falls ($U = 307.5$, $P = 0.1142$) and upper falls ($U = 248$, $P = 0.1045$) in 1993. In 1994 (Figs. 2, 3), there were no significant differences in either overall black bear activity or number of individuals observed at the upper falls between periods that were comparable to pre- and post-capture periods of 1993. At the lower falls in 1994, there were significant drops in both overall black bear activity ($U = 339.5$, $P = 0.0009$) and the number of individuals observed at this site post-capture ($U = 351.5$, $P = 0.0003$).

Responses of Trapped Bears

Of 13 black bears collared between 23–31 July 1993, only 7 were re-sighted in 1993 at Anan Creek (Table 2). The number of individuals seen declined through the rest of the summer. After 10 August, 2 collared males accounted for approximately 90% of the bear activity observed at the upper falls. In 1994, 11 of the 13 original bears were observed from 14–22 July. Decline in the number of collared individuals sighted during observation sessions was much later in 1994 than in 1993, with over half of the collared bears still fishing at the falls between 19–27 August.

Brown Bear Activity

Brown bear activity at the upper and lower falls of Anan Creek ceased after 13 July in 1993 (Fig. 4). In 1994, brown bears were observed until 27 August.

Fish Accessibility

Friedman's test, a nonparametric equivalent of a randomized block analysis of variance (Zar 1984), was used

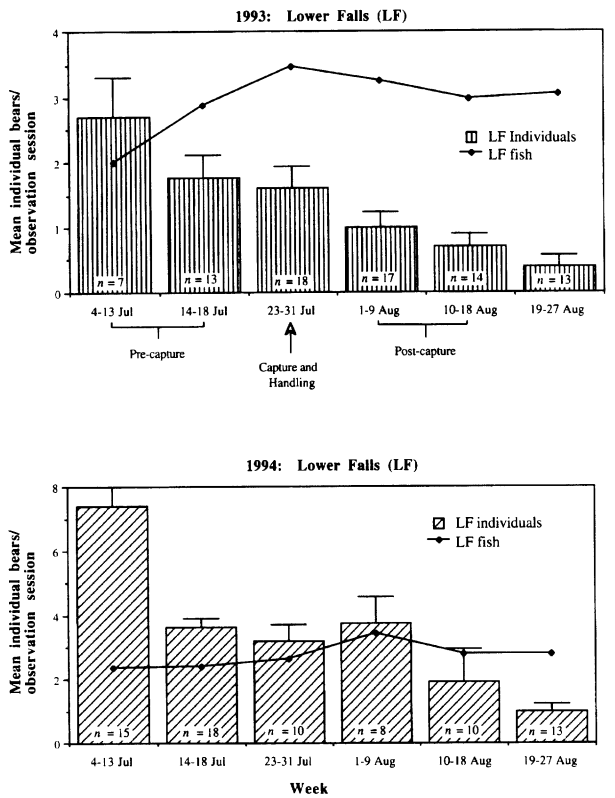

Fig. 2. Mean number of individuals observed fishing and fish accessibility at the lower falls Anan Creek, Alaska, 1993 and 1994. *N* refers to the number of 2-hour observation sessions.

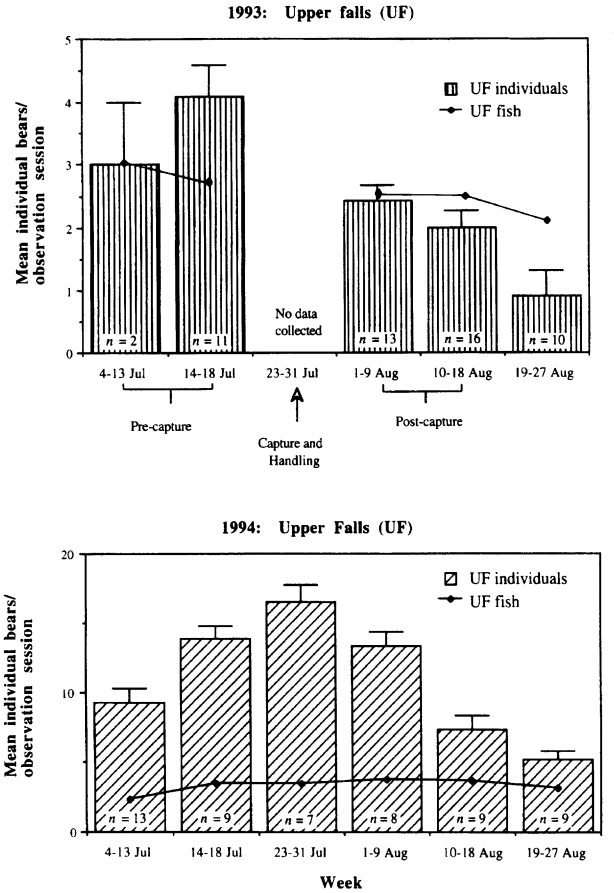

Fig. 3. Mean number of individuals observed fishing and fish accessibility at the upper falls, Anan Creek, Alaska, 1993 and 1994.

to test for significant differences between fish capture rates of individual bears (n = 15) under 3 categories of fish accessibility (10–50% coverage, 51–90% coverage, >90% coverage) in 1994. Since bears rarely caught fish in the 2 lowest categories, we eliminated none to few and <10% coverage from the analysis. Fish capture rates of individual bears increased as fish coverage in the sidepools of the creek increased (Friedman's χ^2 = 7.6, 2df , P = 0.0224). These results suggested that this index was a valid measure of fish accessibility to black

Table 2. Sightings of individual radiocollared black bears during systematic sampling throughout July and August, 1993–94 at Anan Creek in Alaska.

	Week					
	4–13 Jul	14–22 Jul	23–31[a] Jul	1–9 Aug	10–18 Aug	19-27 Aug
1993						
Males			9	5	3	2
Females			4	2	2	1
1994						
Males	8	8	8	8	7	5
Females	3	3	3	3	2	2

[a] Week of capture and handling.

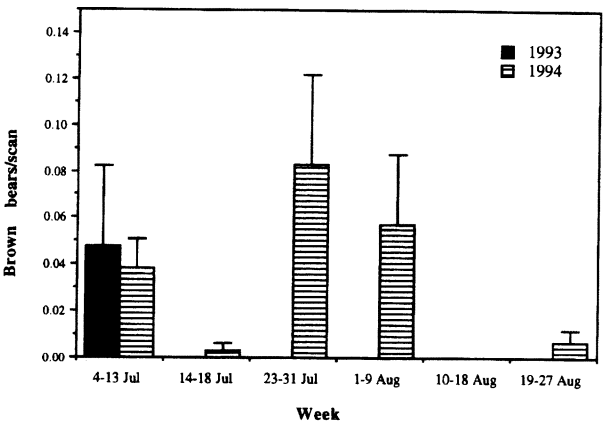

Fig. 4. Brown bear activity at Anan Creek. Alaska for 1993 and 1994 with error bars.

bears. Therefore, we used it to summarize seasonal trends of fish accessibility for 1993 and 1994. Fish accessibility peaked at the lower falls (Fig. 2) between 23 July–6 August 1993, but remained relatively constant at the upper falls throughout the season (Fig. 3). In 1994, these patterns were similar, although fish accessibility at the upper falls increased earlier in the season and remained relatively high until 18 August (Figs. 2, 3).

DISCUSSION

Our results suggest that capture and handling exercises conducted at Anan Creek between 24–31 July 1993 contributed to displacement of some bears for the remainder of the season. The number of individuals observed fishing significantly declined at the upper falls following the week of capturing at that site in 1993, but remained constant for the same period in 1994. As we did not observe a significant decrease in overall black bear activity, the remaining bears probably increased the time they spent on the creek. In addition, of the 13 bears that were trapped, 6 were not re-sighted again in 1993. In 1994, 11 of the marked individuals were re-sighted and over half remained through 27 August.

There are 2 mechanisms that could explain the abrupt decline in individuals observed fishing after trapping in 1993. First, most of the trapping took place on the south side of the upper falls, a location where people are not typically seen. Rogers and Wilker (1990) found that researcher-habituated black bears exhibited initial wariness and avoided the research crew for as long as 100 hours following encounters in new areas. In our study, the novelty of human presence on the south side of the upper falls might have been sufficient to provoke bears into temporarily or permanently abandoning this site regardless of whether they had been captured. Second, due to other ecological factors, black bear activity was exceptionally low in 1993 as compared to 1992 (USFS 1992) or 1994 (Chi and Gilbert 1995). Therefore, it is possible that most of the bears that were present that year were captured. We know that 6 marked individuals were not re-sighted in 1993 after the week of capture and handling. If most bears at Anan Creek in 1993 were captured, the decline in the number of individuals following capturing may be a direct consequence of abandonment by these 6 bears.

These 2 mechanisms may have functioned independently or in concert to produce this apparent capture effect. By comparing the responses of the bears that were captured to those that were not, we might be able to determine which explanation is more plausible. However, because we could not reliably identify individuals prior to capture and marking in 1993, we were unable to determine whether captured bears were differentially affected by these activities.

Several factors may have contributed to an increased sensitivity of bears at Anan Creek to capture and handling. First, the bears had no prior experience with being leg-snared or darted. In addition, we suspect that the bears captured on the south side of the upper falls were there, in part, to avoid fishing near people at the lower falls. Some biologists speculate that more wary bears may respond more negatively to capture and handling than habituated or food-conditioned bears (Gilbert 1989). Lastly, being leg-snared in an area frequented by brown bears may have intensified the aversiveness of the experience.

A variety of other ecological factors have been implicated in the distribution and habitat use of black bears. The location and temporal availability of highly concentrated food sources such as salmon (Glenn and Miller 1980, Schoen et al. 1986, Barnes 1990) and berries (Schoen et al. 1986, Rogers 1989) have been shown to influence bear movement patterns. We found little evidence to suggest that seasonal changes in salmon accessibility at Anan Creek were responsible for the apparent abandonment of the area in August of 1993 by some bears, although there did appear to be differences in berry availability and productivity between 1993 and 1994 (pers. obs.). Spring 1993 was unusually warm which may have resulted in an earlier, more prolific berry crop in June, July, and August (Martin 1983). While we speculate that these annual differences may have contributed to exceptionally low black bear activity at Anan Creek in 1993 in comparison to 1992 (USFS 1992) and 1994 (Chi and Gilbert 1995), they do not adequately

explain the abrupt decline in individual black bears observed immediately following capture and handling procedures.

Limited research conducted on interspecific interactions between black bears and brown bears suggests that the former typically avoid areas frequented by the latter (Miller 1985, Reinhart and Mattson 1990). At Anan Creek, we observed black bears actively avoiding approaching brown bears on numerous occasions. However, no brown bears were sighted during systematic sampling after 13 July 1993, suggesting that the precipitous decline in the number of different individual black bears observed in early August of 1993 was not a result of interspecific avoidance.

Although the long-term effects of capture and handling on subjects appeared to be minimal in most cases (Amstrup and Beecham 1976, Ramsay and Stirling 1986, Laurenson and Caro 1994), bears may show more immediate behavioral responses (Taylor 1986). However, these short-term effects may not be easily detected due to small sample sizes, an inability to directly observe some subjects or difficulty in obtaining comparable data on individuals that were not handled (Laurenson and Caro 1994). While it is impossible to eliminate all aversive effects related to capture and handling of wildlife, biologists should evaluate short-term effects when analyzing and interpreting their data.

LITERATURE CITED

ALTMANN, J. 1974. Observational study of behavior: sampling methods. Behaviour 49:227–267.

AMSTRUP, S.C., AND J. BEECHAM. 1976. Activity patterns of radio-collared black bears in Idaho. J. Wildl. Manage. 40:340–348.

ARCHIBALD, W.R., R. ELLIS, AND A.N. HAMILTON. 1987. Responses of grizzly bears to logging truck traffic in the Kimsquit River Valley, British Columbia. Int. Conf. Bear Res. and Manage. 7:251–257.

BARNES, V.G., JR. 1990. The influence of salmon availability on movements and range of brown bears on southwest Kodiak Island. Int. Conf. Bear Res. and Manage. 8:305–314.

BECK, T.D. 1991. Black bears of West-Central Colorado. Colo. Div. Wildl., Tech. Publ No. 39. 86pp.

CHI, D.K., AND B.K. GILBERT. 1995. The plasticity of black bear behavior in response to people and their activities at Anan Creek Wildlife Viewing Area. U.S. Dep. Agric., For. Serv., Wrangell Ranger Dist., Wrangell, Alas. 25pp.

ELGMORK, K. 1978. Human impact on a brown bear population (*Ursus arctos* L.). Biol. Conserv. 13:81–103.

GIBEAU, M.L., AND P.C. PAQUET. 1991. Evaluation of Telazol® for immobilization of black bears. Wildl. Soc. Bull. 19:400–402.

GILBERT, B.K. 1989. Behavioural plasticity and bear–human conflicts. Pages 1–8 *in* M. Bromley, ed. Bear–people conflicts: proceedings of a symposium on management strategies. Northwest Territ., Dep. Renewable Resour., Yellowknife, Can.

GLENN, L.P., AND L.H. MILLER. 1980. Seasonal movement of an Alaskan Peninsula brown bear population. Int. Conf. Bear Res. and Manage. 4:307–312.

LAURENSON, M.K. AND T.M. CARO. 1994. Monitoring the effects of non-trivial handling in free-living cheetahs. Anim. Behav. 47:547–557.

MARTIN, P. 1983. Factors influencing globe huckleberry fruit production in northwest Montana. Int. Conf. Bear Res. and Manage. 5:159–165.

MCCUTCHEN, H.E. 1990. Cryptic behavior of black bears (*Ursus americanus*) in Rocky Mountain National Park, Colorado. Int. Conf. Bear Res. and Manage. 8:65–72.

MCLELLAN, B.N., AND D.M. SHACKLETON. 1989. Immediate reactions of grizzly bears to human activities. Wildl. Soc. Bull. 17:269–274.

MILLER, S.D. 1985. An observation of inter- and intra-specific aggression involving brown bear, black bear, and moose in Southcentral Alaska. J. Mamm. 66:805–806.

OLSON, T.L. 1993. Resource partitioning among brown bears at Brooks River in Katmai National Park and Preserve, Alaska. M.S. Thesis, Utah State University, Utah, Logan. 147pp.

RAMSAY, M.A., AND I. STIRLING. 1986. Long-term effects of drugging and handling free-ranging polar bears. J. Wildl. Manage. 50:619–626.

REINHART, D.P., AND D.J. MATTSON. 1990. Bear use of cutthroat trout spawning streams in Yellowstone National Park. Int. Conf. Bear Res. and Manage. 8:343–350.

ROGERS, L.L. 1989. Black bears, people, and garbage dumps in Minnesota. Pages 43–46 *in* M. Bromley, ed. Bear–people conflicts: proceedings of a symposium on management strategies. Northwest Territ., Dep. Renewable Resour., Yellowknife, Can.

———, AND G.W. WILKER. 1990. How to obtain behavioral and ecological data from free-ranging, researcher-habituated black bears. Int. Conf. Bear Res. and Manage. 8:321–328.

SCHOEN, J.W., J.W. LENTFER, AND L. BEIER. 1986. Differential distribution of brown bears on Admiralty Island, Southeast Alaska: a preliminary assessment. Int. Conf. Bear Res. and Manage. 6:1–6.

TAYLOR, M.K. 1986. The effect of radio transmitter harnesses on free-ranging polar bears. Int. Conf. Bear Res. and Manage. 6:219–221.

U.S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE. 1990. Human–bear interaction at Anan Creek: 1990 Progress Report. U.S. Dep Agric., For. Serv., Wrangell Ranger Dist., Wrangell, Alas. 10pp.

———. 1992. Human–bear interactions at Anan Creek: 1992 Progress Report. U.S. Dep. Agric., For. Serv., Wrangell Ranger Dis., Wrangell, Alas. 15pp.

ZAR, J.H. 1984. Biostatistical analysis. Second ed. Prentice-Hall, Inc., Englewood Cliffs, N.J. 718pp.