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Biological Conservation 71 (1995) 261–268
Elsevier Science Limited
Printed in Great Britain
0006-3207/95/$09.50+.00

0006-3207(94)00035-2

TRANSPLANTING GRIZZLY BEARS *Ursus arctos horribilis* AS A MANAGEMENT TOOL — RESULTS FROM THE CABINET MOUNTAINS, MONTANA, USA

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(Received 4 January 1993; revised version received 24 November 1993; accepted 15 December 1993)

Abstract

A study of grizzly bears Ursus arctos horribilis *in the Cabinet Mountains, Montana indicated that the future of the population was in jeopardy, and population augmentation was recommended. The US Fish and Wildlife Service (USFWS) issued an augmentation plan in 1987. The first of four projected transplants was completed in July 1990. The first transplanted grizzly bear was a 5-year-old female that weighed 71 kg. The first bear remained in the Cabinet Mountains following release and was monitored for 13 months before the radio collar was lost. This bear was visually located in the target area on 15 May 1992 approximately 19 km from the release site. Her home range from July 1990 through May 1992 encompassed 555 km^2. Data regarding movements and habitat use were analysed and compared with native grizzly bears in the Cabinet Mountains. Trapping efforts in southeast British Columbia for additional bears to transplant were again conducted in 1991 and 1992. The effort resulted in the capture of eight different grizzly bears in 1991, but none met the sex and age criteria of 2–6-year-old females. Efforts in 1992 resulted in the capture of a second 71 kg 6-year-old female (bear 258) which was released at the same location as the first bear exactly 2 years later on 22 July 1992. Movements of bear 258 from July through November 1992 encompassed 388 km^2 in the target release area. This second bear emerged with a single cub in May 1993 and was radio-monitored until July 1993 when it was found dead in the target release area. No trace of the cub was found although it had been seen with its mother in late June. The cause of death is as yet unknown pending completion of toxicology reports. A third subadult female bear (286) was captured in July 1993 and released in the target area where she has remained through October 1993. Transplanting of bears can be a valuable tool in the conservation of small bear populations worldwide.*

Keywords: grizzly bear, bear, management, Montana, transplant, *Ursus arctos*.

INTRODUCTION

In 1975, the grizzly bear *Ursus arctos horribilis* was listed as a threatened species in the 48 adjacent states under the provisions of the US Endangered Species Act. Six ecosystems were identified as supporting self-perpetuating or remnant grizzly populations (USFWS, 1982, 1993). The Cabinet/Yaak Ecosystem (CYE) was one of three ecosystems designated by the recovery plan for concentrated recovery efforts to restore viable populations of grizzly bears. The hunting of grizzly bears in the area had been suspended by the State of Montana in 1974.

Grizzly bear ecological research was conducted in the Cabinet Mountains from 1983 to 1988 (Kasworm & Manley, 1988) to determine habitat use and the status of the existing population. The study concluded that the continued existence of the population in the Cabinet Mountains was in serious doubt, and that the probability of the extinction of this population in the next few decades was high. This conclusion was based on the capture of only three grizzly bears despite an extensive trapping effort, the advanced age of the individuals captured, few additional sightings, only one observation of a female with young, and high mortality rates of marked bears.

The placement of grizzly bears into the Cabinet Mountains was proposed as a conservation effort in order to maintain this population. Two approaches for augmenting grizzly bears were proposed (USFWS, 1987). The first involved transplanting adults or subadults from higher density populations in other areas of similar habitat into the Cabinet Mountains. Transplants would involve bears from remote areas that would have no history of conflict with humans. The use of subadult females was recommended because they were thought most likely to remain in the target area rather than returning to the site of origin because of their smaller home ranges and potential reproductive contribution (Maguire & Servheen 1992). The second proposed approach relied on the cross-fostering of grizzly bear cubs to wild black bear (*Ursus americanus*) females currently resident in the target area. Under this approach, grizzly bear cubs from zoos would replace black bear cubs in the maternal dens of black bear females during March or April. The fostering of orphaned black bear cubs to surrogate black bear females has been used successfully in several areas (Alt, 1984; Alt & Beecham, 1984). This approach was initially considered but was rejected due to lack of public support.

The objective of the study was to test grizzly bear transplant techniques in the Cabinet Mountains to determine if transplanted bears would remain in the area of release and ultimately contribute to the population through reproduction.

STUDY AREA

The Cabinet Mountains (48° N, 116° W) constitute the southern portion of the CYE (Fig. 1). Approximately 90% of the study area is on public land administered by the Kootenai, Lolo and Panhandle National Forests.

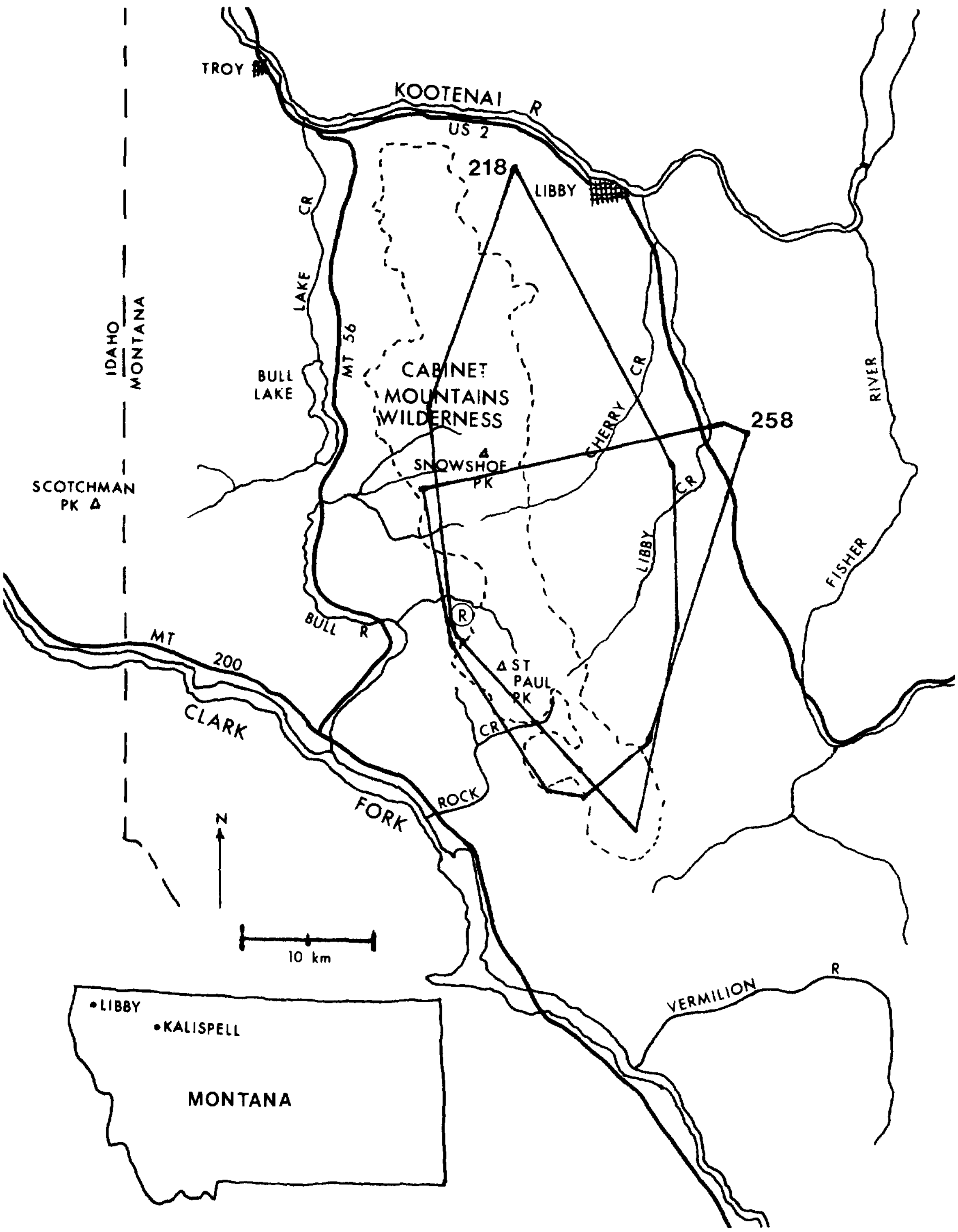

Fig. 1. Composite home ranges of grizzly bears 218 and 258 in the Cabinet Mountains, 1990–92 (R, release site).

Plum Creek Timber Company Inc. and Champion International are the main corporations holding significant amounts of land in the area. Individual ownership exists primarily along the major rivers and valley bottoms, and there are numerous patented mining claims along the Cabinet Mountains Wilderness boundary which encompasses 381 km^2 of the higher elevations of our study area in the East Cabinet Mountains.

The entire CYE encompasses 5,360 km^2 and is located in northwest Montana and northern Idaho. The Cabinet Mountains portion of the ecosystem is 3,960 km^2 and lies south of the Kootenai River, while the Yaak area borders Canadian grizzly populations to the north. Two 12-km-wide areas link the Yaak with the Cabinet Mountains.

Elevations in the Cabinet Mountains range from 610 m along the Kootenai River to 2,664 m at Snowshoe Peak. The study area has a Pacific maritime climate characterized by short, warm summers and heavy, wet winter snowfalls. The lower, drier elevations support stands of ponderosa pine *Pinus ponderosa* and Douglas-fir *Pseudotsuga menziesii*, whereas grand fir *Abies grandis*, western red cedar *Thuja plicata*, and western hemlock *Tsuga heterophylla* dominate the lower elevation moist sites. Mixed stands of subalpine fir *Abies lasiocarpa*, spruce *Picea engelmannii*, and mountain hemlock *Tsuga mertensiana* predominate between 1,500 m and the timberline. Mixed stands of coniferous and deciduous trees are interspersed with riparian shrubfields and wet meadows along the major rivers. Huckleberry *Vaccinium* spp. and mixed shrubfields are largely a result of the wildfires that occurred in 1910 and 1929. Effective fire suppression since then has virtually eliminated wildfire as a natural force in creating and maintaining berry-producing shrubfields.

Contemporary resource use by humans in the area includes mineral exploration and extraction, timber harvest, and recreation. ASARCO operated the Troy mine complex 20 km south of Troy from 1979 to 1992. Silver and copper were the primary minerals extracted. Mineral exploration activity currently centers on the southwestern portion of the Cabinet Mountains Wilderness Area. Noranda Minerals Corporation began construction of a similar facility in Libby Creek during 1990, and ASARCO has proposed a second mine near the community of Noxon.

Timber harvest is the principal land management activity over most of the CYE. A total timber volume of 935,856 m^3 was harvested on the Kootenai National Forest from 1988 to 1991. Additional timber was harvested from private lands in the area.

Various forms of recreational use occur in the Cabinet Mountains. Summer recreation consists primarily of day hikes, overnight backpack trips, and fishing. Recreational and commercial huckleberry picking occurs during the fall and primarily outside the Wilderness. The West Cabinets (Scotchman Peak) and areas adjoining the Cabinet Wilderness are under consideration as additions to the wilderness system. Big-game hunting and fishing provide seasonal recreation and are an important part of the local economy.

Trapping for this study in 1990 to 1993 was conducted in the upper North Fork of the Flathead River drainage and the Wigwam River drainage in British Columbia, approximately 20–40 km north and 15 km to the south of the US border. Subalpine fir was the indicated climax species throughout most of the area, with lodgepole pine *Pinus contorta* the most prevalent. Recent wildfires in the upper elevations have had more of an influence on habitat than in the CYE. An outbreak of pine bark beetles *Dendroctonus ponderosae* resulted in the logging of large areas at lower elevations during the 1980s. Large portions of the upper elevations had been logged earlier in response to a spruce bark beetle *Dendroctonus obesus* epidemic. Although roads were relatively common in the area trapped, very little public use was observed. Grizzly bears are considered an important game animal in this portion of British Columbia and are hunted under a system of limited entry.

METHODS

Bears were captured with foot snares (Aldrich Snare Company, Clallam Bay, Washington) (the use of trade names does not imply endorsement of such products by the US Fish and Wildlife Service) placed in and near wooden cubbies baited with road-killed deer and miscellaneous meat scraps (Johnson & Pelton, 1980). Scraps of bait were dragged along roads and trails to produce scent trails to attract bears to the trap sites. Human scent on the snares was reduced by boiling them for several hours with bark, needles, leaves, and paraffin, and then handling only with gloves. Signs were posted to warn humans of the snare sets. Snares were checked daily.

Captured grizzly bears were immobilized with tiletamine hydrochloride and zolazepam hydrochloride (Telazol), administered at a dose of 8 mg per kg of body weight. Captured black bears were immobilized with a mixture of ketamine hydrochloride (Ketaset or Vetalar) and xylazine hydrochloride (Rompun), administered at 4·4 mg per kg of ketamine and 2·2 mg per kg of xylazine. Drugs were delivered with either a Palmer Cap-Chur gun or jab stick. Dosages were based on estimated weights of bears by experienced personnel.

Rubberized button ear tags were used to mark captured bears. One numbered tag was placed in each ear. Colored streamers were attached to the ear tags of grizzly bears transplanted to the CYE. Physical measurements and estimates of body condition were recorded at each capture. The first premolar was extracted and used to determine the age of the individual by counting cementum annuli (Stoneberg & Jonkel, 1966).

Only independent unmarked female grizzly bears < 7 years and > 35 kg were deemed suitable for transplanting to the CYE. All other captured grizzly bears were released on-site. Females > 2 years old were fitted with radio collars (Telonics, Mesa, Arizona) prior to release, in agreement with the British Columbia Fish and Wildlife Branch, to aid an ongoing grizzly bear study. All radio collars were attached with a canvas spacer to allow collar separation in 2–3 years (Hellgren *et al.*, 1988). Male grizzly bears were ear tagged but not collared.

Habitat values and bear food habits were carefully compared between the origin area and the target area to assure that the trophic resources available were similar in type and availability. This was done to assure that released bears would not have to learn new food sources in the target area. Timing of release was set for July, the time when food availability in the target area was highest, with shrub fruits, the major food source in the area, ripe and available for bears. Before July, shrub fruits were not ripe, and after July, the possibility of capture in the origin area dropped as bears moved into shrubfield areas and fed on shrub fruits almost exclusively.

Captured bears were immobilized at the capture site and fitted with radio collars and ear tags. They were then placed inside aluminum culvert traps for transport and release. Transplanted bears were moved to the release site during darkness to avoid the daytime heat. This method required only a single immobilization of each transplanted bear. Bears were released at the target area 24–28 h after capture at the origin site. They were given water in the holding cage but were not fed.

Monitoring of each bear was conducted from the air and ground beginning immediately after release. Locations were plotted on 1:24,000 US Geological Survey topographic maps by Universal Transverse Mercator (UTM) coordinates. Minimum convex polygons (Mohr, 1947) were calculated using a computer program (McPAAL; Smithsonian Institution). Radio locations were also classified by grizzly bear habitat component (Madel, 1982), US Forest Service management area (USFS, 1987), and elevation. Distance measurements from roads and trails to radio locations were used to examine their relationships to bear distribution (Kasworm & Manley, 1990). Closed roads were considered to be trails for analysis. If open roads were closer to locations than the nearest trail, the distance to the road was also entered as the measurement for the nearest trail. A random point sample was used to delineate distance-to-road categories (DRC) and distance-to-trail categories (DTC) in the area used by native grizzly bears (Kasworm & Manley, 1990). Twenty percentiles of randomly located points produced five DRCs: (1) 0–274 m; (2) 275–914 m; (3) 915–1,859 m; (4) 1,860–3,322 m; and (5) >3,322 m. Similarly, 20 percentiles of randomly located points produced five DTCs (1) 0–122 m; (2) 123–305 m; (3) 306–610 m; (4) 611–1,128 m; and (5) >1,128 m. Statistical analyses were performed through the use of the computer packages MSUSTAT (Lund, 1983) and SPSS/PC+ (SPSS Inc., 1988).

THE PUBLIC INVOLVEMENT PROCESS

Because the augmentation of the Cabinet Mountains grizzly bear population was a project that had an effect on the environment, the project was subject to an environmental assessment under the US National Environmental Policy Act (NEPA). This process involved a series of public meetings to ask which type of augmentation procedure the public preferred and to be sure that public concerns about augmentation were addressed. During this review, many concerns were expressed which included human safety, conflicts with other land-uses, the effects on existing wildlife populations, and long-term grizzly bear population goals.

A citizens' involvement committee was formed to aid in information exchange between the public and the agencies, by asking the community to appoint 10–15 community leaders who represented a cross-section of local opinion ranging from those against bear conservation to those strongly in favor of conservation. This group was asked to work closely with the management agencies in developing a plan to answer the questions and concerns of the local public about the augmentation and to provide direct input to agencies on how to improve conservation efforts. Representatives of several local organizations donated their time to further this purpose.

The first product of this citizens' group was a question and answer brochure regarding grizzly bear conservation in the Cabinet/Yaak Ecosystem, mailed to every person in Lincoln and Sanders counties, Montana, some 14,000 mail box holders. In response to concerns expressed by the citizens' group, the augmentation proposal was modified to eliminate cross-fostering and to reduce total numbers of transplanted bears to four individuals over 5 years. The initiation of transplanting was also postponed for 1 year to allow for additional public information and education programs regarding the proposal.

An approach to the integration of general public knowledge into the augmentation process was described by Maguire and Servheen (1992). This method utilized decision analysis to select the best course of action when the best information was a combination of subjective and objective information. The result was the selection of the best possible alternatives given the level of uncertainty in such a management action like augmentation of a grizzly bear population.

RESULTS AND DISCUSSION

Trapping

In July 1990, a 5-year-old 71 kg female grizzly bear (bear 218) was captured and moved to the Cabinet Mountains as part of the augmentation effort. Bear 218 was trapped in the North Fork of the Flathead River approximately 15 km north of the international boundary on 21 July 1990 and released in Lost Girl Creek on the west side of the Cabinet Mountains wilderness on 22 July 1990. A total of four different grizzly bears were captured before the selected bear.

Trapping for candidate grizzly bears in British Columbia in 1991 began on 9 July and continued for 26 days ending on 7 August. Ten captures of eight individual

Table 1. Capture effort and trap success for grizzly bears in southeast British Columbia during July 1990, 1991 and 1992

Year	Trap nights	Grizzly bears captured	Trap nights/ grizzly bear
1990	240	5	48·0
1991	310	8	38·8
1992[a]	212	5	42·4
1993	73	2	36·5

[a]1992 data include some trapping effort in northwest Montana in addition to British Columbia data.

grizzly bears occurred during the 310 trap nights (Table 1). None of the captured grizzly bears met the criteria for bears to be transplanted. All captured bears were released at the capture site. These included one adult male, three subadult males, three adult females, and one 1-year-old female (Table 1). The adult females were radio collared for research monitoring by Canadian biologists. The yearling female was judged too small to be a good candidate for transplanting. Twenty-one black bears were captured, ear tagged, and released.

Trapping activities began on 7 July 1992 in the North Fork of the Flathead River, both north of the border in British Columbia and south of the border in the US. Trapping concluded on 22 July in British Columbia and on 28 July in the US. Three grizzly bears were captured in British Columbia and two grizzly bears were captured in the US (Table 1). Four of the five grizzly bears captured in 1992 were subadults. The other individual was an adult female with yearlings. One of the subadult females, a 6-year-old 71 kg animal (bear 258), was trapped on 21 July 1992 and transferred to the Lost Girl Creek release site in the Cabinet Mountains.

Trapping activities began on 9 July 1993 in the North Fork of the Flathead River and concluded on 15 July. Two grizzly bears and five black bears were captured. A 2-year-old female grizzly bear (bear 286) was transferred to the Lost Girl Creek release site on 16 July 1993.

Monitoring

Radio location flights and ground monitoring of bear 218 were conducted from release in July 1990 to late August 1991 when the radio collar came off the animal. Forty-five specific radio locations were obtained during 1991. Forty-one of these were aerial and four were ground. Several additional general ground locations were obtained.

Movements of bear 218 as a 5-year-old during 1991 in the Cabinet Mountains encompassed 439 km^2, and its composite home range during 1990–92 was 555 km^2 (Fig. 1). This compared with a 1990 home range of 191 km^2. The home range size of bear 258 from 22 July to 30 September 1992 was 388 km^2 (Fig. 1).

Bear 218 emerged from her den during mid-April 1991. In late July she began using lower elevations on the east side of the Cabinet Mountains where huckleberries and serviceberries *Amelanchier alnifolia* were abundant. She stayed in this area until the first week of August at which time she moved south where the huckleberry crop also appeared good.

Table 2. Mean distance (m) and confidence interval between successive radio locations of grizzly bear 218 in the Cabinet Mountains, 1990–91

Time	Mean period	n	$\bar{x}$ (m)	95% CI (m)
22–28 July	Weekly	5	1,176	671–1,682
29 July–4 August	Weekly	7	3,647	1,060–6,288
5–11 August	Weekly	8	5,811	2,378–9,244
12–18 August	Weekly	7	3,629	1,215–6,043
19–31 August	Monthly	7	4,870	0–9,818
1–30 September	Monthly	14	2,491	760–4,222
1–31 October	Monthly	6	4,803	1,144–8,462
15–30 April	Monthly	2	4,243	0–51,675
1–31 May	Monthly	10	3,571	1,552–5,589
1–30 June	Monthly	8	5,569	193–10,944
1–31 July	Monthly	11	7,556	2,823–12,289
1–31 August	Monthly	14	3,846	2,004–5,688

Distances between successive locations for bear 218 were analysed to quantify movements following release. During the first four weeks following release, daily aerial radio locations were attempted. Mean daily movements were calculated by weekly intervals and compared (Table 2). Mean daily movements were lowest during week 1 (1,176 m) and highest during week 3 (5,811 m), though none of the four weekly means were significantly different ($F = 2·47$; $p = 0·087$). Following week 4, monitoring frequency dropped to an average of three flight locations per week. Mean movements between successive locations were then computed on a monthly basis and compared (Table 2). Mean distance between successive locations was least during September and greatest during July for the period 19 August 1990–1 September 1991, though none of the eight monthly means were significantly different ($F = 1·24$; $p = 0·297$).

Bear 218 appeared to develop a geographical memory of specific sites. The vicinity of the release site was revisited during middle and late August 1990 and again in late June 1991. Several other small drainages or basins were used repeatedly during the 13 months she was monitored. Bear 218 was visually located on 15 May 1992 approximately 19 km from her release site.

Bear 218 was 5 years-old during the breeding season of 1991 and may have been reproductively fit. Although she was observed three times from the air during the May and June breeding period, no other bears were observed with her. Throughout the entire 1990–91 monitoring period, she was observed a total of 30 times during aerial monitoring flights. At no time were other grizzly bears observed accompanying her. During the 13 months of monitoring, she remained within the intended area of the transplant and had little reported contact with people. Her movement patterns and home range appear similar to native grizzly bears monitored from 1983 to 1989.

Radio location flights and ground monitoring of bear 258 were conducted from release on 22 July 1992 to den entry in early November. Thirty-nine aerial radio locations were obtained during 1992. This bear used a portion of the Cabinet Mountains south of the area used by bear 218 while she was monitored. Bear 258 denned in the Rock Creek drainage during early November 1992 at about 1850 m. She emerged in May 1993 with a single cub. Since she was captured in July and the breeding season is normally in late May and June, she likely bred in 1992 in Canada before capture. Her movements in 1993 were localized in high-elevation areas within 8 km of her den site prior to her death in July. This bear remained in the release area for 12 months during which time she was radio monitored and all movements and behaviors appeared to be normal. The cause of death is a mystery as her fat level and body condition appeared to be normal. No sign of acute injury was evident. The body was helicoptered out and examined at a veterinary pathology lab. Toxicology tests for arsenic, cyanide, and strychnine were negative. Additional toxicology tests are ongoing.

The production of a cub in 1993 indicated that this bear was not unusually stressed by the transplant and found sufficient food to complete her pregnancy. Nothing in the data available to date indicates that the transplant had a direct relationship to her death.

Habitat use characteristics

Habitat information from 131 specific aerial radio locations from bears 218 and 258 was summarized and compared with 233 specific aerial locations obtained from native grizzly bears in the Cabinet Mountains during 1983–88 (Kasworm & Manley, 1988).

Monthly mean elevations of radio locations from transplanted bears varied from a low of 1,327 m during May to a high of 1,839 m during September and ranged from a minimum of 853 m to a maximum of 2134 m (Fig. 2) The mean elevation of all radio locations from transplanted bears (1,664 m) during 1990–92 was greater than the mean elevation of all radio locations of native grizzly bears (1,591 m) during 1983–89 ($t = 2{\cdot}47$, $p = 0{\cdot}014$). This difference in elevational use may be related to spring sample size differences, the annual variation of food production and resultant habitat use that occurred during 1990–92, or it may reflect a greater avoidance of low-elevation areas used by people for transplanted bears as compared with native bears.

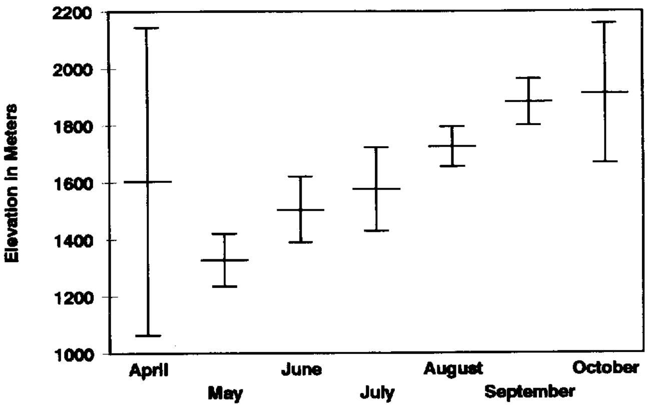

Fig. 2. Monthly mean elevation of grizzly bear radio locations in the Cabinet Mountains, 1990–92, for transplanted grizzly bears 218 and 258 at 95% confidence intervals. April, $n = 2$; May $n = 10$; June $n = 8$; July $n = 29$; August, $n = 58$, September, $n = 23$; October $n = 5$.

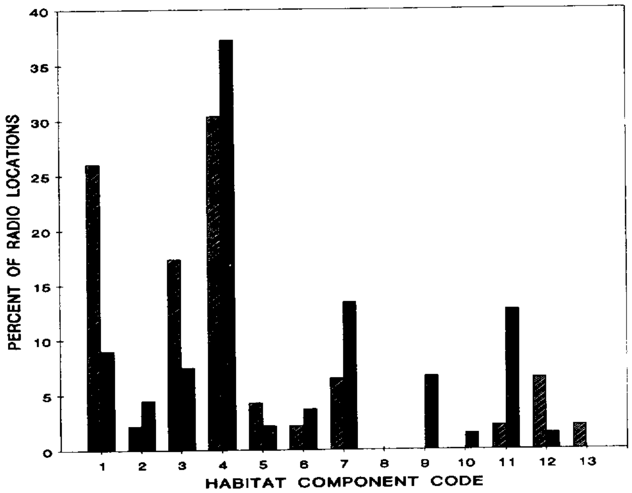

Fig. 3. Early-season habitat component use by transplanted grizzly bears during 1990–92 and native grizzly bears in the Cabinet Mountains, 1983–88. Shaded bars, transplant; solid bars, native. Transplant, $n = 46$; Native, $n = 134$. Habitat component key: 1, closed timber, 2, open timber; 3, timbered shrubfield; 4, shrubfield snowchutes; 5, shrubfield cutting units; 6, shrubfield burn; 7, alder shrubfield; 8, huckleberry shrubfield; 9, riparian; 10, drainage forbfield; 11, graminoid sidehill park; 12, beargrass sidehill park; 13, slabrock.

Two seasons were defined on the basis of bear food habits, an early season from den exit to 31 July, when bears are largely dependent on green vegetation other than berries, and a late season from 1 August to den entry when they are feeding heavily on berries. Grizzly bear radio locations were classified by habitat component (Madel, 1982) based on existing vegetation structure and composition.

Seventy-four percent of transplanted bear radio locations occurred in the closed timber, timbered shrubfield, and mixed shrub/snowchute habitat components during the early season (Fig. 3). Native grizzly bears monitored in the Cabinet Mountains from 1983 to 1989 had 54% of their radio locations in the same three habitat components and made greater use of alder *Alnus sinuata* shrubfields and graminoid sidehill parks than transplanted bears during the periods studied.

Seventy percent of transplanted bear radio locations occurred in timbered shrubfield, mixed shrub/snowchute, huckleberry shrubfield, and beargrass *Xerophyllum tenax* sidehill park habitat components during the late season (Fig. 4). Fifty-four percent of radio locations from native grizzly bears occurred in the same components. Transplanted bears made greater use of huckleberry shrubfields and beargrass sidehill parks than native bears, likely related to the distribution of

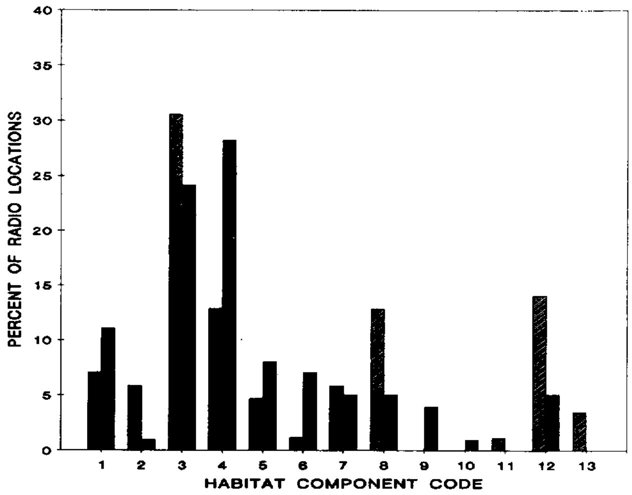

Fig. 4. Late-season habitat component use by transplanted grizzly bears during 1990–92 and native grizzly bears in the Cabinet Mountains, 1983–88. Shaded bars, transplant; solid bars, native. Transplant, n = 85; native, n = 99. See Fig. 3 for habitat component key.

huckleberries during the years monitored. Native bears made greater use of mixed shrubfield snowchutes and mixed shrubfield burns. Production of huckleberries in beargrass sidehill park components may be more variable than other components because these sites lack timber cover which may protect plants from frost damage. Likewise, a partial timbered overstory may provide shading to huckleberry bushes during dry conditions. Good production on these sites may be indicative of good overall production.

Relations to human activity

Ninety-eight percent of aerial radio locations obtained from transplanted bears were on US Forest Service administered lands. Classification of radio locations by US Forest Service management area indicated that 83% of use by transplanted bears occurred in wilderness, proposed wilderness, or non-motorized recreational lands. Ninety-one percent of native bear locations occurred on US Forest Service administered lands and 85% of use occurred in either wilderness, proposed wilderness, or non-motorized recreational lands.

Aerial radio locations of transplanted bears were analysed to determine their relationship to open roads and trails (including closed roads). Use of five distance to open road categories (DRC) by transplanted grizzly bears was compared with use by native bears (Kasworm & Manley, 1990). Native grizzly bear use of the five DRCs was different from expected based on availability (χ^2 = 132·51, p < 0·001). Native grizzly bears used DRCs 1 and 2 less than expected (p < 0·05) and DRCs 4 and 5 more than expected (Table 3). Use of DRC 3 was not different from expected. Native grizzly bear use of DRCs 1 and 2 combined was 20% of expected.

Transplanted grizzly bear use of the five DRCs was different from expected based on availability (χ^2 = 58·88, p < 0·001). Transplanted bears used DRCs 1 and 2 less than expected and used DRCs 4 and 5 more than expected (Table 3). Use of DRC 3 was not different from expected. Combined use of DRCs 1 and 2 by transplanted grizzly bears was 26% of expected. Use of these DRCs by transplanted and native bears was identical.

Native grizzly bear use of the five distance to trail categories (DTC) was significantly different from expected based on availability (χ^2 = 70·56, p < 0·001). They used DTCs 1 and 3 less, and DTC 5 more, than expected (Table 4). All other DTCs received use as expected.

Transplanted grizzly bears' use of the five DTCs was different from expected based on availability (χ^2 = 36·54, p < 0·001). They used DTC 1 less, and DTC 5 more, than expected (Table 4). Use of DTCs 2, 3 and 4 was not different from expected, and DTC 1 36% of expected. Use of these DTCs by transplanted bears was thus similar to native bears.

Table 3. Proportional use (U) and availability (A) of distance to open road categories (DRC) for native and transplanted grizzly bears in the Cabinet Mountains, 1983–1992

Group	n	DRC 1 0–274 m U p^a A	DRC 2 275–914 m U p A	DRC 3 915–1,859 m U p A	DRC 4 1,860–3,322 m U p A	DRC 5 > 3,322 m U p A
Native	233	0·009 < 0·205	0·073 < 0·201	0·202 = 0·198	0·296 > 0·198	0·421 > 0·198
Transplant	133	0·023 < 0·205	0·083 < 0·201	0·211 = 0·198	0·338 > 0·198	0·346 > 0·198

[a]Significant differences (p < 0·05): < less than, > greater than, = no difference.

Table 4. Proportional use (U) and availability (A) of distance to trail categories (DTC) for native and transplanted grizzly bears in the Cabinet Mountains, 1983–1992

Group	n	DTC 1 0–122 m U p^a A	DTC 2 123–305 m U p A	DTC 3 306–610 m U p A	DTC 4 611–1,128 m U p A	DTC 5 > 1,128 m U p A
Native	215	0.098 < 0.234	0.172 = 0.166	0.144 < 0.213	0.177 = 0.189	0.409 > 0.198
Transplant	119	0.084 < 0.234	0.143 = 0.166	0.168 = 0.213	0.210 = 0.189	0.395 > 0.198

[a]Significant differences (p < 0·05): < less than, > greater than, = no difference.

CONCLUSION

Trapping for other candidate bears for transplant will continue. Additional locations for trapping will be examined. There are no plans to alter the sex and age criteria for candidate bears or time for release into the Cabinet Mountains.

Relocation of 2–6-year-old female grizzly bears has thus far proven to be a useful tool to increase the number of reproductively capable animals in a small population where reproduction and numbers are critically low. Important factors to the success of the effort include age, sex, and human-related history of the released animals, the timing of release, and the similarity of food resources between the origin and release sites. Public support is critical and to date has proved to be the main factor limiting the use of this technique. Significant efforts must be initiated to develop and maintain public understanding and support for bear conservation as part of any transplant effort. Continued success of the effort must be monitored with ultimate success being reproduction of the transplanted bears.

The future of many bear populations worldwide is precarious due in large part to habitat loss and fragmentation that produces small isolated populations (Servheen, 1990). The management of such populations isolates requires active, intrusive operations if they are to survive increasing human pressures. Many areas of potential bear habitat are currently unoccupied due to historical excessive human-caused mortality. Such areas have the potential again to have bear populations with the use of the technique described in this paper. Human actions such as transplanting bears will be required if bear populations are to be re-established and small populations are to survive.

ACKNOWLEDGEMENTS

Numerous individuals and agencies have contributed to the success of the Cabinet Mountains grizzly bear augmentation and transplant program. M. Burcham, C. Bechtold, H. Carriles, P. Feinberg, G. Miller, R. Pisciotta, T. Radandt, D. Reiner and K. Roy were field assistants. K. Kinden and B. Groom provided exceptional services as pilots. M. Stangl and B. Coleman provided administrative assistance. B. McLellan (British Columbia Ministry of Forests), F. Hovey (Simon Fraser University), R. Demarchi, and A. Wolterson (British Columbia Fish and Wildlife Branch) provided invaluable assistance in planning, trapping, and transport aspects of this project. Numerous individuals from the US Forest Service (USFS) have provided agency support and assistance. These include B. Summerfield, B. Haflich, J. Mershon C. Brooks and R. Schrenk. Funding to make this project possible was received from the US Fish and Wildlife Service, US Forest Service, the National Fish and Wildlife Foundation, and E. O. Smith. We wish to extend a special thanks to the citizens of the province of British Columbia for allowing us to remove some of their grizzly bears to augment the population in the Cabinet Mountains. The paper is dedicated to the memory of Kevin Roy who worked on this project and died in a plane crash while radio-tracking grizzly bears.

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