

TRANSLOCATION OF NUISANCE GRIZZLY BEARS IN NORTHWESTERN MONTANA

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Abstract: We examined 7 variables from 103 translocations of nuisance grizzly bears (*Ursus arctos*) to (1) describe the type of bears involved in conflicts, (2) determine factors affecting translocation success, and (3) test the hypothesis that translocation is a feasible method to control mortality of grizzly bears. Males comprised 58% of all translocated bears. The median age of all bears was 3.5 years, and the modal age was 2.5 years. Subadults comprised a significantly greater proportion of the nuisance bear population than the wild population. Residential, livestock, garbage, and apiary oriented offenses represented 46%, 30%, 20%, and 4% of the total, respectively. The success rate of bears > 1.5 years was 44% for first time translocations prior to 1990, and 15% for bears moved > 1 time. Sex was the only variable that significantly predicted success. Females were more likely to be successfully translocated than males except for bears associated with livestock damage. Thirty-eight percent of the translocated bears died within 2 years of translocation. The average cost of a capture and translocation was \$1,038.00, not including personnel salaries and administrative costs. An aggressive program focused on preventive action is recommended.

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Translocation has been an important tool for wildlife managers (Griffith et al. 1989). Traditionally, a translocation has been defined as an intentional release of an animal to establish, reestablish, or augment a free-ranging, wild population (IUCN 1987). Translocation has been used for both population augmentation (Servheen et al. 1987) and reduction (Miller and Ballard 1982) in grizzly bear management. However, translocation has been used most commonly in resolution of grizzly-human conflicts (Meagher and Phillips 1983), as an alternative to immediate destruction of nuisance bears (Craighead and Craighead 1972), and to minimize mortality in grizzly bear populations (Dood et al. 1986).

As high-profile management actions, translocations have inherently high costs both financially and in terms of maintaining the credibility of management programs. Documenting the success of grizzly bear translocation programs is crucial to responsibly attaining recovery of the species (Cowan 1972). Most evaluations of ursid translocations have concentrated on black bears (*U. americanus*) (Alt et al. 1977, Rutherglen and Herbison 1977, McArthur 1981, Rogers 1986) or were conducted in and adjacent to national parks (Cole 1972, Mundy and Flook 1973, Meagher and Phillips 1983, Brannon 1987). Miller and Ballard (1982) reported on the rate and frequency of return from non-nuisance, translocated brown bears in Alaska. However, there has not been a thorough examination of a translocation program in a nonpark setting, where many of the conflicts are related to grizzlies living in close proximity to people, property, and domestic livestock.

We report the characteristics of nuisance grizzlies, the results of 15 years of translocation efforts, the factors contributing to success of a translocation, and some of the costs associated with translocations. We also test the hypothesis that translocation is a feasible way to minimize bear mortality.

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STUDY AREA

The geologic history, climate, vegetation, land use and human demography of the 1,400,000 ha. Northern Continental Divide Ecosystem (NCDE) was thoroughly described by Dood et al. (1986:16-65). Specific portions of the area have been described in further detail by Aune and Kasworm (1989), Servheen (1981), McLellan and Shackleton (1988), and Mace et al. (1994). The NCDE is bounded on the north by the United States-Canada boundary, on the south by Montana Highway 200, on the west by U.S. Highway 93, and on the east by U.S. Highway 287. The widest portion of the NCDE, from the Mission Valley to the east front of the Rockies, is 126 km. The narrowest width of the ecosystem, between Columbia Falls and the east front west of Browning, is only 88 km.

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METHODS

We examined game damage reports and translocation records from 1975 to 1991 of 103 nuisance grizzly bear translocations. Of the 103 records, 80 were from bears handled for the first time. We only evaluated first-time offenses and the characteristics of bears associated with particular offenses.

Offenses were classified into 4 types. Livestock related offenses included bears attacking or killing domestic animals, including cattle, sheep, horses, pigs, and poultry. Bears moved because of their close proximity to people, or because they were causing physical damage to structures were classified as residential offenses. Garbage related offenses included bears removed from dumps and other solid waste facilities, as well as those residential offenses where garbage was the primary attractant to the bear. Beehive related offenses involved bears causing actual damage to apiary facilities.

In some cases, investigators did not record specific offenses, and only gave a general description of the situation that required bears to be translocated. Beehives were considered livestock under Montana law. Therefore, some beehive-related offenses were probably recorded as livestock by investigators. Some bias in the analysis may have resulted from this suspected inaccurate reporting of investigations, but the authors feel that this bias is minimal.

Bear ages were determined by cementum analysis. Ages, however, were estimated for cubs, yearlings, 61% of the 2-year-olds, and 28% of the bears ≥ 2.5 years. Ages were therefore combined into the following age classes: cub, yearling, subadult (2.5-4.5 yrs), and adult (5.5+ yrs). Standing age structures of nuisance bears were compared to age structures of bears captured during research efforts in the Northern Continental Divide Ecosystem. An assumption was made that research bears reflected an expected population (Mace et al. 1987).

All bears were individually marked with numbered ear tags and lip tattoos, and after 1983 all were equipped with radio collars.

Translocations occurred during 1 of 3 seasons: spring (den emergence-30 Jun), summer (1 Jul-15 Sep), and fall (16 Sep-denning). Offenses were delineated by origin to either east (ES) or west (WS) of the continental divide.

A successfully translocated bear did not resume conflict activities that required recapture within 2 years of its initial translocation. Translocations were also considered successful if the bear died from legal or natural causes within 2 years, and unsuccessful if the

bear died from illegal or management-caused actions. To determine factors that may predict success, we analyzed 7 variables including age, sex, offense type, season, origin of offense (ES or WS), airline distance moved, and the number of times an animal was translocated.

We used Chi-square analysis, Mann-Whitney 2-tailed tests, and Student's *t*-tests to determine differences between proportions, medians, and means, respectively. Yates correction factors for Chi-square analysis (Zar 1984:42) were used for small sample sizes or when there were only 2 categories. Statistical significance was accepted at $P = 0.10$.

RESULTS

Eighty grizzly bears were translocated for the first time from 1975 to 1991 (Fig. 1). Forty-three (54%) and 37 (46%) translocations originated on the ES and WS, respectively. Within-year sample sizes varied from 1 in 1976, 1982, and 1988 to 14 in 1989. There were 46 (58%) males and 34 (42%) females. No difference ($P = 0.900$) was detected between sex ratios observed on the ES and WS. Modal age for both ES and WS nuisance bears was 2.5 years. Median age of the total sample was 3.5 years (range = 0.5-20.5) for both sexes, 2.5 years (range = 0.5-16.5) for males, and 4.5 years (range = 0.5-20.5) for females. There was no difference ($P = 0.777$) between median ages of bears involved in the different types of offenses. However, with cubs and yearlings excluded from the sample, the median age of 5.5 years observed for bears involved with residential offenses was greater ($P = 0.051$) than the median of 3.5 years observed for bears involved with livestock.

West-side nuisance bears (median age = 5.5 years, range = 0.5-16.5) were older ($P = 0.048$) than bears from the ES (median = 3.5 yr, range = 1.5-20.5). Nuisance grizzlies from the ES had a higher proportion of subadult research bears (Aune and Kasworm 1989) in the same area (Fig. 2). The WS nuisance bears had a lower proportion of cubs and a greater proportion of subadults than research bears (R. Mace, Mont. Dep. Fish, Wildl. and Parks, unpubl. data) in the same population.

Livestock, residential, garbage, and beehive offenses totaled 24, 37, 16, and 3, respectively. A greater proportion ($P < 0.001$, $\chi^2 = 10.07$, $df = 3$) of the livestock offenses (79%) occurred on the ES while a greater proportion of the residential offenses (62%) occurred on the WS. Eight garbage related offenses occurred on both the ES and WS.

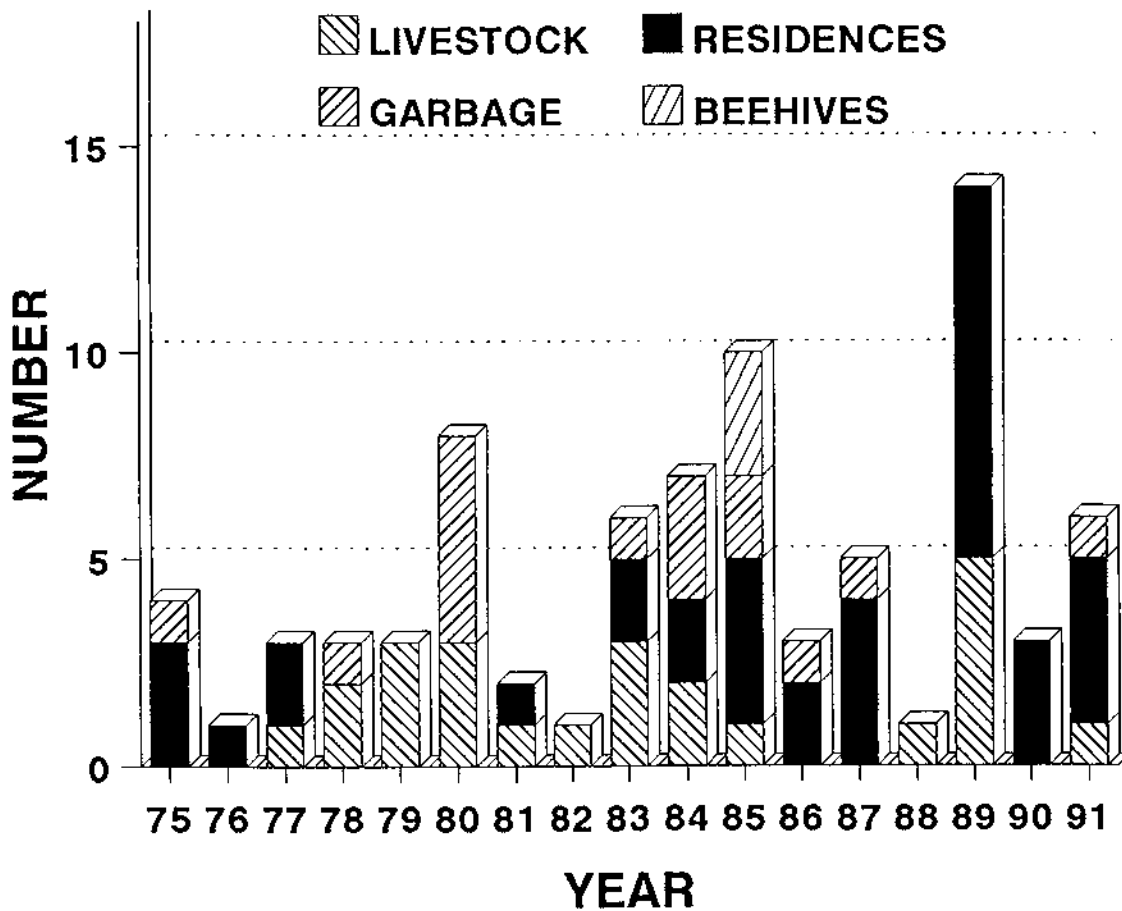


Fig. 1. Sample of translocated nuisance grizzly bears, categorized by offense type, in the Northern Continental Divide Ecosystem, Montana, 1975-91.

More translocations occurred during fall (50%) than spring (30%) or summer (20%). There was no significant difference between ES and WS relative to seasonality of offenses. Thirty-five percent, 16%, and 49% of the ES offenses occurred during spring, summer, and fall, respectively. Twenty-five percent, 25%, and 50% of the WS offenses occurred during those same seasons. Males comprised 58%, 75%, and 49% of the spring, summer, and fall translocations. Fifty-eight percent of all females translocated were moved in fall while 31%, 27%, and 42% of all translocated males were moved during spring, summer, and fall.

Seasonality of offenses was significantly different ($P = 0.012$, $\chi^2 = 21.09$, $df = 9$) between offense types. Fourteen of 16 (88%) garbage offenses occurred during fall, and all 3 beehive incidents occurred during spring. Livestock and residential offenses were evenly distributed among the 3 seasons. Thirty-five percent,

26%, and 39% of the livestock offenses occurred during spring, summer, and fall, respectively. Thirty-five percent, 26%, and 43% of the residential offenses occurred during those same seasons.

The mean airline distance of all translocations was 93.7 ± 7.7 km (SE). Bears involved with livestock were moved farther than any other offense class ($P = 0.057$, $\bar{x} = 106.9 \pm 13.6$ km, range = 26-256). Bears causing residential offenses were moved an average of 81.1 ± 6.0 km (range = 26-160). Bears involved with garbage were translocated an average of 105.1 ± 21.1 km (range = 16-272). Males and females were translocated an average of 92.2 ± 8.23 and 96.7 ± 10.7 km, respectively.

The success rate for all translocations, of bears >1.5 years, made prior to 1990 was 44% (Table 1). Success of cub and yearling translocations appeared to be dictated by the behavior of their mothers. To reduce this apparent bias, we report the fate of cubs and

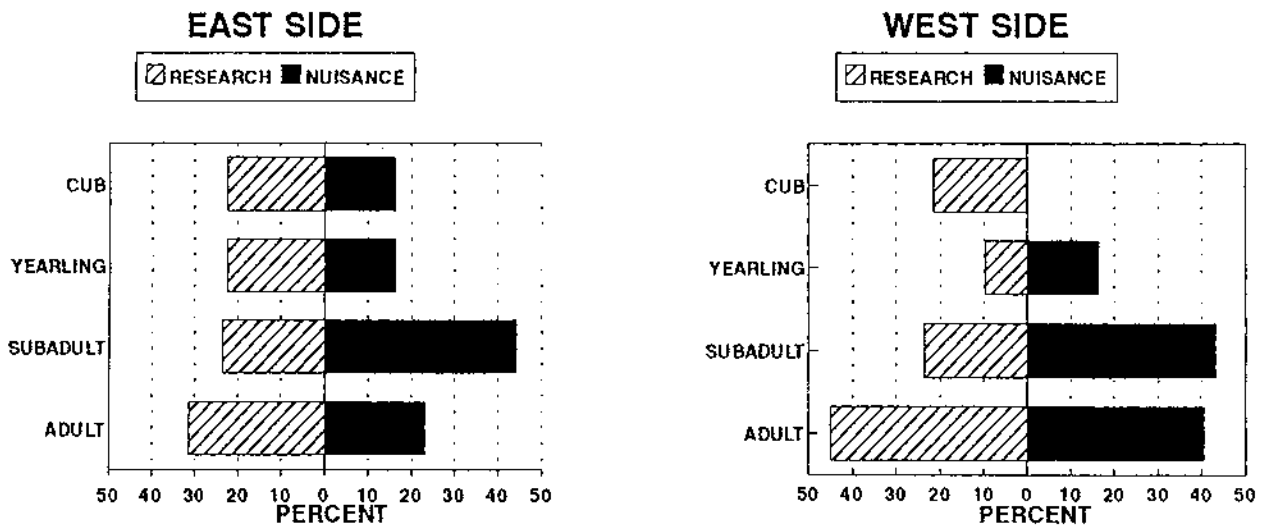


Fig. 2. A comparison of the relative standing age structure of nuisance grizzly bears and bears captured during research on the east and west sides of the Northern Continental Divide Ecosystem, Montana, 1975-1991.

yearlings ($n = 20$) separately; and they are not considered in the general analysis.

The remaining sample ($n = 51$) of subadults and adults was comprised of 47% females and 53% males, with a median age of 4.5 years. Twenty-six bears (54% M) originated on the ES and 25 (52% M) originated on the WS.

Sex was the only variable found to predict success of a translocation. Overall, females were more than twice as likely (65% versus 32%) to be successfully translocated than males ($P = 0.038$, $\chi^2 = 4.30$, $df = 1$). This relationship was only significant, however, for the WS ($P = 0.073$, $\chi^2 = 3.21$, $df = 1$) where 67% of the females, but only 23% of the males were successfully translocated. For translocations originating on the ES, 58% of the females and 36% of the males were successfully translocated.

Other than differences detected in the likelihood of success between sexes on the WS, no single category of translocation could be predicted to be any more or less successful than another. Bears originating on the ES had a success rate of 48% compared with 52% for bears originating from the WS. Forty-six percent of the subadults and 43% of the adults were successfully translocated. Median age was 4.5 for both successful and unsuccessful bears. The mean airline distance was 110.9 ± 9.5 km and 85.2 ± 9.5 km for successful and unsuccessful translocations, respectively. Forty-two percent, 36%, and 52% of the spring, summer, and fall translocations were successful. Grizzlies translocated for livestock, residential, and garbage related offenses

had success rates of 37%, 41%, and 64%, respectively.

Two (1 M, 1 F) of 7 cubs (3 M, 4 F) were successfully translocated. Both cubs were from the ES; 1 was involved with residences and the other was involved with garbage. All cubs were translocated with their mothers, and their fates mirrored that of the females.

Thirteen yearlings (10 M, 3 F) were translocated. One, 10, and 2 yearlings were involved in livestock, residential, and beehive offenses, respectively. Sixty-two percent of the yearling translocations were in the spring, 15% in summer, and 23% in the fall. Whereas all 4 yearlings that originated on the WS (2 M, 2 F) were successful translocations, only 2 (both male) of the 9 from the ES were successful. There was no apparent relationship between season and success.

Thirteen bears older than 1.5 years were translocated twice (4 M, 9 F). Ten (4 M, 6 F) were moved prior to 1989. Two of these second time translocations were successful. Both were adult females from the WS. One bear was translocated because of a residential offense and the other caused damage to beehives. One of 3 of bears moved 3 times was a successful translocation. That bear was a 10.5-year-old female moved 212 km on 3 October 1989 because of a livestock related incident.

Thirty-eight percent of all bears translocated were dead within 2 years of their first translocation, including 19 males and 9 females. Of the 51 bears older than 1.5 years and translocated between 1975 and 1989, 20 (39%) were dead within 2 years. Four of

Table 1. Successful, unsuccessful, and total first time translocations of nuisance grizzly bears, by sex and age class, in the Northern Continental Divide Ecosystem, Montana, 1975-89.

Offense type	Age class	Males		Females		Sexes combined	
		S ^a	U	S	U	S	U
Livestock	0.5		2		1		3
	1.5		1				1
	2.5-4.5	4	5	1	3	5	8
	5.5+	1	2	1	2	2	4
	Total	5	10	2	6	7	16
Residences	0.5			1	2	1	2
	1.5	4	4	2		6	4
	2.5-4.5	1	4	2		3	4
	5.5+	1	4	3	2	4	6
	Total	6	12	8	4	14	14
Garbage	0.5		1				
	1.5						
	2.5-4.5	1	2	4	1	5	3
	5.5+	0	2	4		4	2
	Total	2	4	8	1	10	5
Beehives	0.5				1		1
	1.5		1				1
	2.5-4.5						
	5.5+				2		3
	Total		1		2		3
Total	0.5	1	2	1	4	2	6
	1.5	4	6	2		6	6
	2.5-4.5	6	11	7	4	13	15
	5.5+	2	8	8	5	10	13
	Total	13	27	18	13	31	40

^a S = Successful, U = Unsuccessful.

those mortalities were natural or legal, and 16 were illegal or control actions. An additional 8 (62%) of the 13 yearlings were dead within 2 years of their first translocation. Seven of the mortalities were illegal or control actions and 1 was natural. One (14%) cub died within the 2 years after translocation.

An average ground capture and translocation was determined to cost \$1,038.00 in 1991. This cost estimate included 1,050 km at \$0.186/km, 4.5 days of per diem at \$15.00/day, \$50.00 for drugs and

miscellaneous tagging equipment, \$325.00 for a radio collar, and \$400.00 for 2 follow-up flights to locate the animal. The cost estimate is conservative because it did not include such variable factors as salaries, administrative time for coordinating the translocation among 3-4 agencies, or the administrative costs and telemetry to document and coordinate the fates of translocated animals.

DISCUSSION

The NCDE may not be geographically large enough to translocate a grizzly bear far enough so that it does not return or have further opportunity to conflict with humans. Distance moved was not a dependable factor for determining success in the NCDE as reported by authors studying black bears (Alt et al. 1977, McArthur 1981, Rogers 1986, Fies et al. 1987). Miller and Ballard (1982) reported that the average distance translocated was 198 km and 233 km for unsuccessful and successful translocations of Alaskan brown bears. In most places, the NCDE is less than 125 km wide, and the farthest point away from permanent human habitation is only 48 km. A similar geographical paradox was reported for the Greater Yellowstone Ecosystem (Brannon 1987).

Grizzly bears in the NCDE have ready access to domestic livestock, beehives, and human residences. Mace et al. (1987) found areas with the greatest human land-use development (particularly residences and livestock operations) had the highest level of conflict with research bears. Both the east and west sides of the NCDE have considerable human development. This human interface is within the home ranges of a significant portion of the male grizzly bears that occupy the NCDE (Aune and Kasworm 1989; R. Mace, Mont. Dep. Fish, Wildl. and Parks, unpubl. data). If failures in natural bear foods occur, it is probable that many grizzlies will occupy lowland areas with anthropogenic bear attractants, especially during the spring and fall (Aune and Kasworm 1989:229).

Two-year-old bears were the modal category translocated from 1975 to 1991, and this phenomenon can be expected to increase with increased population density. If population density increases under conservation measures taken to recover the grizzly bear, density-dependent social intolerance can be expected to produce more dispersal of young bears into marginal habitats and into close proximity with humans (Stokes 1970).

The need for an aggressive, proactive management program aimed at the prevention of nuisance grizzlies

is imperative. Translocations are expensive, costing agencies human resources and money that could be spent on habitat conservation measures or elimination of attractants. In addition, the relatively poor success of translocation programs may erode credibility of an entire management program. High mortality experienced by translocated bears may be unacceptable in situations where populations are declining or population viability is a concern.

With the exception of livestock related offenses, sex of a bear appears to be the best predictor of outcome for a translocation in the NCDE. There are several plausible reasons for this phenomenon. Adult females, if they did not resume immediate conflict, may have had cubs the following year. Females with cubs were significantly underrepresented in the sample. This suggested that females with cubs avoided areas where conflicts with humans were likely or the relatively small home ranges (Aune and Kasworm 1989) of adult females precluded them from coming into contact with humans. Nutritional stress associated with raising cubs may have caused more females than males to be attracted to garbage. During fall, a bear removed from an attractant may resume feeding on natural foods in preparation for denning. Some auto-correlation of events may have occurred that blurred interpretation of results (most garbage-bears were female and most garbage offenses occurred in the fall—the season with the highest proportion of successful translocations).

It is common belief among bear managers that stock-killing grizzly bears are the least likely to be successfully translocated. Our data suggested that this class of bear is as likely to be successfully translocated as a bear involved with human residences. The severity of the offense and the political profile of livestock killing bears has probably enhanced their poor reputation.

Our observed 44% success rate for all translocations was 23% and 19% lower than that reported in the Greater Yellowstone Ecosystem by Brannon (1987) and Meagher and Phillips (1983). Those authors, working on overlapping data sets, defined a translocation as successful if the bear did not resume nuisance behavior within 1 year. A longer time period may have resulted in poorer success rates. In addition, bears in the Yellowstone vicinity were translocated primarily because of garbage and dump related offenses. The 64% success rate for translocations due to garbage offenses in the NCDE was very similar to the Yellowstone findings.

The 20% annual mortality rate observed in translocated grizzly bears suggested that translocation is

only moderately successful at minimizing mortality. The mortality rate among translocated bears is higher than that of the entire population (Aune and Kasworm 1989; R. Mace, Mont. Dep. Fish, Wildl. and Parks, unpubl. data) or that recommended for conservation of the species (Peek et al. 1987, Miller 1990).

Habituated and food-conditioned bears are the most dangerous to humans (Herrero 1985, Herrero and Fleck 1990). This type of bear, involved with anthropogenic foods, is also the one most likely to require translocation. Managers should exercise caution in deciding whether to translocate food-conditioned bears. If they are translocated, remote, nonwilderness sites should be selected. The type and level of recreational activity in administrative wilderness areas (Cole 1983) make those areas a poor choice for habituated or food-conditioned bears. Most wilderness users (Stankey and Schreyer 1987) occupy facilities that provide little protection from bears. Bears translocated into wilderness areas should be moved prior to peak times of human use.

MANAGEMENT IMPLICATIONS

Translocation, as a tool to minimize bear mortality or to prevent individual bears from conflicting with humans, has had limited success. Aggressive programs should be implemented to eliminate factors that predispose bears to conflict with humans. Translocations may provide time to eliminate an attractant, but should not be used as substitute for preventive action. However, the 44% overall success rate justifies translocations where population viability is a concern.

Decisions made to translocate grizzlies in the NCDE should be based on a review of the past successes and failures, and not upon popular beliefs about what type of bear will likely result in a successful translocation. Caution should be exercised in deciding whether to translocate food-conditioned bears.

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