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APPROACHES TO AUGMENTING GRIZZLY BEAR POPULATIONS IN THE CABINET MOUNTAINS OF MONTANA

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Abstract: The grizzly bear (*Ursus arctos horribilis*) in the Cabinet Mountains of Montana is threatened and the population may consist of as few as 15 individuals. Survival of this semi-isolated population depends on innovative habitat and population management techniques. Because potential for immigration into this population is low and the population is small, population augmentation is being considered. Possible augmentation techniques include moving animals of selected age and sex from high-density areas into the area and cross-fostering captive-born grizzly bear cubs to selected black bear (*U. americanus*) females resident in the area. Although the potential success of these efforts are not known, it is known that without such efforts, the survival of this population cannot be assured.

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The grizzly bear was once present throughout most of the western United States and south into Mexico (Storer and Tevis 1955). As the human population increased, grizzly bear populations declined in the early 20th century and became limited to remote areas of the Rocky Mountains. The result of this reduction in range was insularization of grizzly bear subpopulations; this may have contributed to the overall grizzly bear population decline in the United States. In the lower 48 states, the range of the grizzly bear is approximately 49,000 km² in 4 states (Fig. 1). This area does not include the as yet undetermined habitat in the North Cascades and Bitterroot eco-systems. Population estimates in the lower 48 states range between 700 and 1,000 bears (U.S. Dep. Int., Fish and Wildl. Serv. 1982).

The grizzly bear was declared a threatened species in the conterminous United States in 1975. Since that time, efforts have been underway to restore existing populations to levels that would not require protection under the Endangered Species Act. Recovery actions involve state, federal, and private agencies and groups and include habitat management and protection, limiting the killing of bears by people, eliminating the availability to bears of human foods and garbage, and educating the public about bears and their needs for survival.

These actions may not be sufficient to recover some small isolated populations, however, and additional actions may be necessary. One possible additional strategy is to augment existing populations with bears from other areas. Augmentation is distinguished from reintroduction in that augmentation bolsters existing small populations; reintroduction establishes grizzly bears in historic range where they do not presently exist.

Augmentation entails placing bears into areas where the population is so low that increases from natural reproduction are inadequate or not possible given the existing age and sex structure. In addition to demographic advantages of augmentation, placing bears from other populations into isolated populations can enhance the genetic diversity of the recipient population.

The 2 major augmentation methods are moving wild bears from a donor to a target area and cross-fostering captive-born grizzly bear cubs to wild black bear mothers in the target area. Other possible methods of augmentation considered but rejected at this time are embryo transplants from pregnant bears in 1 area or in captivity to females in the target area and cage release, which would require keeping donated bears in a cage at the target site to allow for possible acclimation before release. Embryo transplant was rejected because (1) most areas being con-

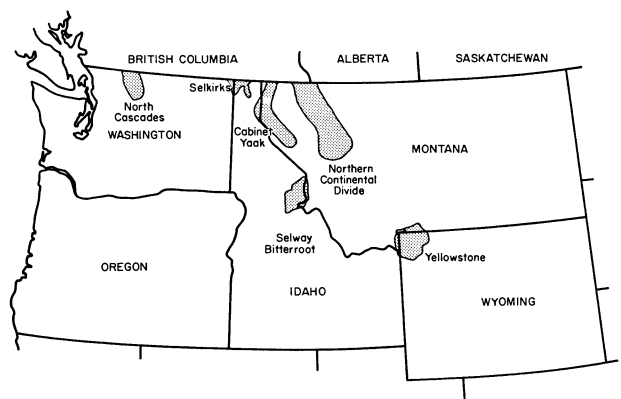


Fig. 1. Grizzly bear range in the lower 48 states is approximately 49,000 km² in 4 states.

sidered for augmentation now have few bears and trapping a resident, nonpregnant female is unlikely; (2) such an invasive technique has not been tried on bears and their delayed implantation complicates the possibility; and (3) techniques involving field surgery on wild bears, especially 1 of the few remaining adult females in a small population, are risky and should be used only as a last resort. Cage release was rejected for fear that feeding in the holding cage before release would habituate such bears to humans and human-related food.

The long-term maintenance of small grizzly bear populations as isolates has become necessary because movement corridors and adjacent contiguous habitat have been eliminated through human activity. A method is needed to maintain the historic levels of gene flow between isolated populations to prevent the loss of genetic heterozygosity and the possible detrimental effects of such a loss. Successfully augmenting the breeding population may be the only way to simulate this historic gene flow. Augmentation of grizzly bear populations has not been tested in North America, but 2 subadult brown bears (*U. a. arctos*) were released from a zoo in the Trentino area of northern Italy in the early 1970s. Both are now dead, and their release was not considered successful (H. Roth, pers. commun.).

PROPOSED STUDY AREA

The Cabinet Mountains in northwest Montana were selected for initial consideration as a test area for augmentation. There is a research project underway in the Cabinet Mountains on the small, semi-isolated resident grizzly bear population. Of the 3 bears captured since the study started in 1983, the only female is now 32 years old and has never been sighted with cubs. This bear may be the oldest grizzly bear ever captured in the wild, and her lack of cubs for 4 years is an indication that she may be past reproductive age. The connection of the Cabinet Mountains with other contiguous populations is undetermined, but it is unlikely that sufficient bears immigrate into this area naturally. The grizzly bear population in this range may be as low as 15.

METHODS OF AUGMENTATION

Augmentation with Wild Bears

Augmentation with wild bears requires taking bears carefully selected for sex, age, behavioral his-

tory with humans, and habitat use and moving them from an area of high population density to an area needing to be augmented. These bears would be carefully monitored after release into the area requiring augmentation and contingency plans would be available in the event the bears got into conflict with people or human-related activities, or left the designated area.

Criteria for Selecting Wild Donor Bears.—The efficacy of translocating grizzly bears having no history of conflict with humans to increase resident grizzly bear populations has not been tested. Mace and Haroldson (1984) reviewed available data on the success of translocating problem grizzly bears. They also examined seasonal release possibilities and speculated on the importance of habitat relationships between the home and target areas. They concluded that the animals most suited to release are subadult females because of their small home range size and reduced potential for long-range movements. They speculated that adult females have a substantial investment in establishing and maintaining a home range in their area of origin; thus the long-distance return to such a range is worth the cost if they are translocated. Adult and subadult males have larger home ranges than females and would be expected to move longer distances after translocation. Females would also be preferred as augmentation animals because of their potential reproductive contributions to the target population.

Maguire (1985) used decision theory analysis to review various grizzly bear augmentation options for the Cabinet-Yaak ecosystem. Variables considered in this decision analysis included sex, 4 age classes, and spring or late summer placement into the target area. This analysis also considered the consequences of individual grizzly bear placements according to reproductive value, conflict potential, and likelihood of remaining in the area; 16 combinations of variables were included.

Maguire's (1985) analysis showed that subadult females placed in the target area in August (when natural foods were most available) were the age and sex class with the lowest probability of leaving the target area and of having conflicts with humans. Subadult females remaining in the area would also potentially contribute the most to the population because of their long reproductive life span.

Because each bear's history of relations with humans is critical, 1 strict selection criterion is that augmentation animals have no history of positive at-

traction to humans, human-use areas, or human-related foods. In other words, they cannot be neutral or habituated (Kimmel 1973, McCullough 1982) to humans, although this characteristic may be difficult to judge in wild bears unless the animal has been previously observed or monitored. These considerations make remote areas with a moderate level of human use and little available human-related food, such as dead domestic animal disposal areas or open garbage, most appropriate sources of bears for translocation.

Criteria for Selecting Donor and Augmentation Sites.—The test of augmentation using subadult animals begins with the selection of a donor area accessible for bear capture and offering a high probability for capturing animals that meet the selection criteria. Considerations include the density and population structure of the donor population. Although ideal density levels have not been determined, areas judged by local biologists as having healthy grizzly bear populations are preferred. For success of the effort, the agency managing the donor area must be willing to donate animals that meet the selection criteria as well as allow the trapping of adequate numbers of animals.

The habitat of the donor and target areas should be topographically and vegetatively similar so that donor animals find similar food distribution and seasonal habitats in the augmentation area. This is especially important to grizzly bears that have inherited habitat use patterns tied to specific forage use patterns (Mace and Haroldson 1984). Mace and Haroldson (1984) list the following habitat features for assessing similarity between the donor and target areas:

1. Low-elevation spring and autumn range
2. Productive, fire-created shrubfields
3. Denning habitat
4. Dispersal range
5. Cover requirements.

Selection of animal placement location should be based on habitat characteristics of the donor area, existing and expected human activities, and resource management direction for the area. Recent research data should be available to assess existing grizzly and black bear densities. Existing research programs in the area, such as the ongoing study in the Cabinet-Yaak area, should allow close monitoring of the augmented animals to assure control if they leave the target area or come into conflict with people.

Capture and Movement of Donor Bears.—The animals should be captured using random methods (Aldridge foot snares or culvert traps) or direct, selective methods (free-darting from helicopters). Animals not meeting the selection criteria should be released at the capture site. Helicopters should be used to transfer selected bears to a road or to allow flights directly to the target area. Direct flight is preferred because it minimizes handling and excessive human contact after capture.

Monitoring and Evaluation.—Intensive monitoring is also necessary to evaluate the ultimate success of the augmentation effort. Monitoring should be carried out by full-time researchers in the target area. Augmented bears should be radio-collared with motion-sensitive collars to document activities, mortality, and collar loss. Aerial locations should be made at least twice weekly, depending on weather conditions, and ground locations should be obtained when the bears are near human habitations. Remote, automatic monitoring equipment should be used to determine activity patterns where feasible.

If a bear leaves the target area but is not in conflict, it should be closely monitored but not necessarily captured. The decision on capture should be based on the individual situation. Depending on the offense, animals coming into conflict with people should be captured and relocated into the target area. If a bear comes into conflict with humans for the 2nd time, the animal should not be relocated again into the target area. Such an animal may be returned to its area of origin at the discretion of local managers.

Success of the effort may be judged on several levels. Maguire (1985) judged proximate success when animals remained in the target area for 2 years with no conflicts. The long-term success of the augmentation effort requires the augmented animals to enter the population as reproducing adults. For subadult females, this may require monitoring for 3–5 years. An initial test of this augmentation method would require the animals to remain 2 years in the area without conflict to be considered successful cases. Animals remaining in the target area for that amount of time probably would not return to their original homes and would have developed sufficient habitat knowledge to allow future fidelity to the target area.

Augmentation Through Cross-fostering

Augmentation through cross-fostering involves the cross-fostering of captive-born grizzly bear cubs to

resident black bear females in the target area and thus requires the participation of zoological parks. This strategy is based on the fact that black bears and grizzly bears are sympatric throughout much of their range, and their food habits and habitat use are similar. If the cubs are accepted by a black bear female, they can learn successful feeding strategies, habitat use, and to avoid humans during the 1.5 years they remain with their foster mother.

Interspecific cross-fostering has never been tried in the wild on bears. Cross-fostering has been tried on raptors (reviewed in Fyfe et al. 1978 and Olendorff et al. 1980) with mixed success. Intraspecific cross-fostering, however, has been demonstrated successfully with black bears by placing orphaned cubs with adult females who had cubs of the same age (Clark et al. 1980, Alt and Beecham 1984). Orphaned black bear cubs were placed in natal dens before the foster mother and her natural young emerged in the spring. Orphaned cubs were also placed with drugged and undrugged lactating females after they emerged from the den. Drugged females had their sense of smell temporarily blocked, lessening their ability to discriminate between the foster cubs and their own. Of 45 post-denning black bear fosterings, 55.6% were successful. Of the 29 placements of cubs in natal dens, 79.0% were successful (Alt and Beecham 1984). In this case, success was defined as emergence and subsequent care by the foster mother.

The productivity of captive grizzly bears is such that captive-born cubs are surplus. In many zoological parks, females are prevented from breeding to prevent unwanted cubs. Thus, removing cubs from captive breeding stock minimally affects captive populations, but the potential benefits of cub augmentation to the threatened wild population are great.

Criteria for Selecting Cubs.—Selecting a male and female grizzly bear with proper genetic background is the 1st step in cross-fostering. Captive-born grizzly bear cubs should ideally be from captive parents that are not related and come from interior Rocky Mountain areas. To maintain genetic diversity in the augmented population, neither parent should be from the ecosystem to be augmented.

These animals should be bred in June or July in a facility in which the female has a maternity den where she can be observed and later (in March) easily separated from the cubs. To assure survival of the donor cubs, the female should have a history of cub production and proper maternal behavior in a captive environment.

The cubs should be female because they will make fewer demands on the foster mother during growth and will eventually produce offspring. Female cubs are also preferred because they are assumed to be less likely to imprint on black bears for breeding purposes, although no data exist on this subject for bears. The interspecific imprinting possibility, although remote, might reduce the potential for a cross-fostered male to successfully enter the grizzly bear breeding population.

Criteria for Selecting Black Bear Foster Mothers.—As part of the ongoing research project in the Cabinet Mountains, 12 adult female black bears have been radio-collared and tracked for 1–2 years. The resulting information will establish the reproductive cycles, behavior toward humans, and home range areas so that those with the optimum ranges and behaviors can be selected as foster mothers for grizzly bear cubs.

Introducing Cubs to Foster Mothers.—The field portion of the cross-fostering test should begin with the selection of 2 or 3 adult female black bears who enter their dens with a high probability of having cubs over the winter. These animals should be selected in areas where fostered grizzly bears have the least opportunity for conflict with people and where their ranges would provide considerable solitude and security from planned management actions. The den sites of these selected females should be marked, accessible in March, and large enough to be entered by the research team when the cub transfer is made. Snow conditions at the foster mother's den site should permit access to the area during the 24–48-hour transfer period.

The 2nd phase of the test should be assessing the birth of cubs in the captive grizzly bears and the wild black bears. The number and condition of the grizzly bear cubs should be monitored and the birth of cubs in the previously selected black bear females should be substantiated.

The 3rd phase of the test should be to remove the grizzly bear cubs from the captive mother and to select donor cubs of the proper sex. The selected cubs should be isolated from human contact and rushed to the foster-mother's den. Timing can be critical; the cubs should not be held for long because significant human contact may influence the cubs' future behavior toward humans in the target area. Grizzly bear cubs should not be fed during the transfer period to minimize any positive associations with people.

When the grizzly bear cubs arrive at the site, the

foster mother should be immobilized and her cubs removed and replaced with 2 female grizzly bear cubs. The displaced black bear cubs should be fostered to another black bear female. The foster mother should be treated in the same manner as those in the successful denned black bear fosterings reported by Alt and Beecham (1984). She should be carefully monitored after the transfer and upon den emergence for any sign of rejecting the grizzly bear cubs. If she successfully emerges with the grizzly bear cubs, she should be carefully monitored for several years. The fostered cubs should continue to be monitored after they leave the black bear mother to determine the ultimate success of the effort. The fostered cubs should not be radio-collared initially but should be collared as they undergo weaning from their mother.

Monitoring and Evaluating Cross-fostering.—Proximate success would be based on cubs remaining in the foster mother's home range after weaning, successful habitat use, and denning. Ultimate success would be based on the cross-fostered young becoming breeding members of the target grizzly bear population.

SUMMARY

Grizzly bear population augmentation is a long-term, intensive management effort to increase the number of grizzly bears in remote, semi-isolated areas. The testing and development of augmentation efforts is essential to recovery and to the long-term genetic maintenance of isolated populations that must

exist without natural corridors to contiguous grizzly bear populations. The potential for success of these augmentation efforts is unknown. Without such efforts, however, the survival of isolated populations like that in the Cabinet-Yaak cannot be assured.

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