USE OF PEN-REARED BLACK BEARS FOR AUGMENTATION OR REINTRODUCTIONS

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Abstract: Because bears readily breed in captivity, the use of progeny of penned animals as a source for augmentation and reintroduction has been suggested. We radiotagged 6 pen-reared black bears (*Ursus americanus*; 4 male, 2 female) that were released in the wild between 2 February 1988 and 24 May 1988. We also collected release and recovery data from 17 other pen-reared black bears (7 male, 10 female) that were eartagged and released between 25 October 1982 and 22 August 1995; 1 of these also was radiotagged. Mean age of released bears was 2.5 years. Bears fitted with radiocollars were monitored from 6 to 484 days after release. Pen-reared bears exhibited poor adaptability and survival when released into the wild. At least 5 bears (21.7%) caused nuisance problems. Six bears died and 2 others were suspected of being killed illegally. Results of these findings suggest that more research is needed on proper management of captive animals to enhance their chances of survival in the wild. Recommendations are made to improve future releases of pen-reared animals.

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Bears have been extirpated from 50 to 75% of their former range (Cowan 1972, Servheen 1990). Loss of habitat and exploitation have eliminated bears from some areas and fragmented other populations into isolated subpopulations, some of which have small breeding nuclei. Lack of viable corridors between subpopulations limits or prohibits immigration and emigration and, affects the population dynamics of bears. Illegal hunting or stochastic events may threaten the stability of small isolated populations.

The substantial decline in the overall range of bears and the vulnerability of small populations emphasize the need for more intensive management. Populations may require augmentation to promote population growth and to maintain genetic diversity (Servheen et al. 1987). Bears can be successfully reintroduced into their former range provided there is suitable habitat available (Rogers 1973, Conley 1978). Some habitats that were unfavorable for bears in the past may now be suitable, but isolated from other occupied habitats.

Augmentation of small bear populations or reintroduction into former ranges would likely be more successful using wild animals from other viable populations (Griffith et al. 1989). However, some populations may be too small to provide surplus animals. Nuisance bears might be a source for augmentation or reintroductions. There is a long history of managing nuisance bears by relocating them to new areas, often with a secondary objective of augmentation or re-establishing a population. Although there have been some successes, many of these efforts either have not been evaluated or have been unsuccessful and sometimes politically disastrous.

Because bears readily breed in captivity (Baker 1903, Crandall 1964), pen-reared bears offer another potential source of bears for augmentation or reintroductions. Little attention has been directed toward managing nuisance bears to enhance their chances of survival once relocated, much less raising captive bears for such purposes. If pen-reared bears can survive in the wild, use of these animals for such purposes would be beneficial. We report the results of releasing pen-reared black bears into habitats in the southern Appalachian mountains in Tennessee in the U.S.

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STUDY AREA

We conducted this study in Cherokee National Forest (CNF), Tennessee (Fig. 1). This area is part of the Blue Ridge Physiographic Province of the Southern Appalachian mountains (Fenneman 1938). Steep slopes with narrow valleys and ridgetops characterize the topography. The CNF supports a complex of plant communities. Forest cover consists principally of second growth mixed hardwoods and pine. Even-aged forest management is implemented on the CNF (USFS 1976). The CNF is managed for multiple-use recreation, and although bear hunting is permitted, it is prohibited in established bear sanctuaries. Releases of pen-reared bears occurred on these protected and relatively isolated sites (Fig. 1).

METHODS

The Tennessee Wildlife Resources Agency (TWRA) obtained pen-reared black bears from the Municipal Black Bear Habitat (MBBH) and Grandfather Mountain, Incorporated (GM). Both facilities are managed like a zoo, but they specialize in black bears. More concerted efforts are made at these facilities to raise bears under more natural conditions than at traditional zoos. Examples of more natural conditions practiced are: simulation of natural feeding, simulation of natural dens, limited exposure to keepers, and no feeding of bears by visitors. However, both facilities have intensive public viewing.

Bears selected for release were considered surplus. Cubs are popular for public display, and both facilities actively breed bears for this reason. However, space is limited at both facilities and overcrowding of bears frequently occurs. We selected primarily younger animals to reduce the amount of exposure to humans and also keep breeding age animals at the facilities.

Bears were immobilized for transport using a 200:100:20 mg/ml mixture of ketamine hydrochloride, xylazine hydrochloride, and mepivacaine hydrochloride (Cook 1984). Each bear was marked with eartags or corresponding lip and flank tattoos or both (Johnson and

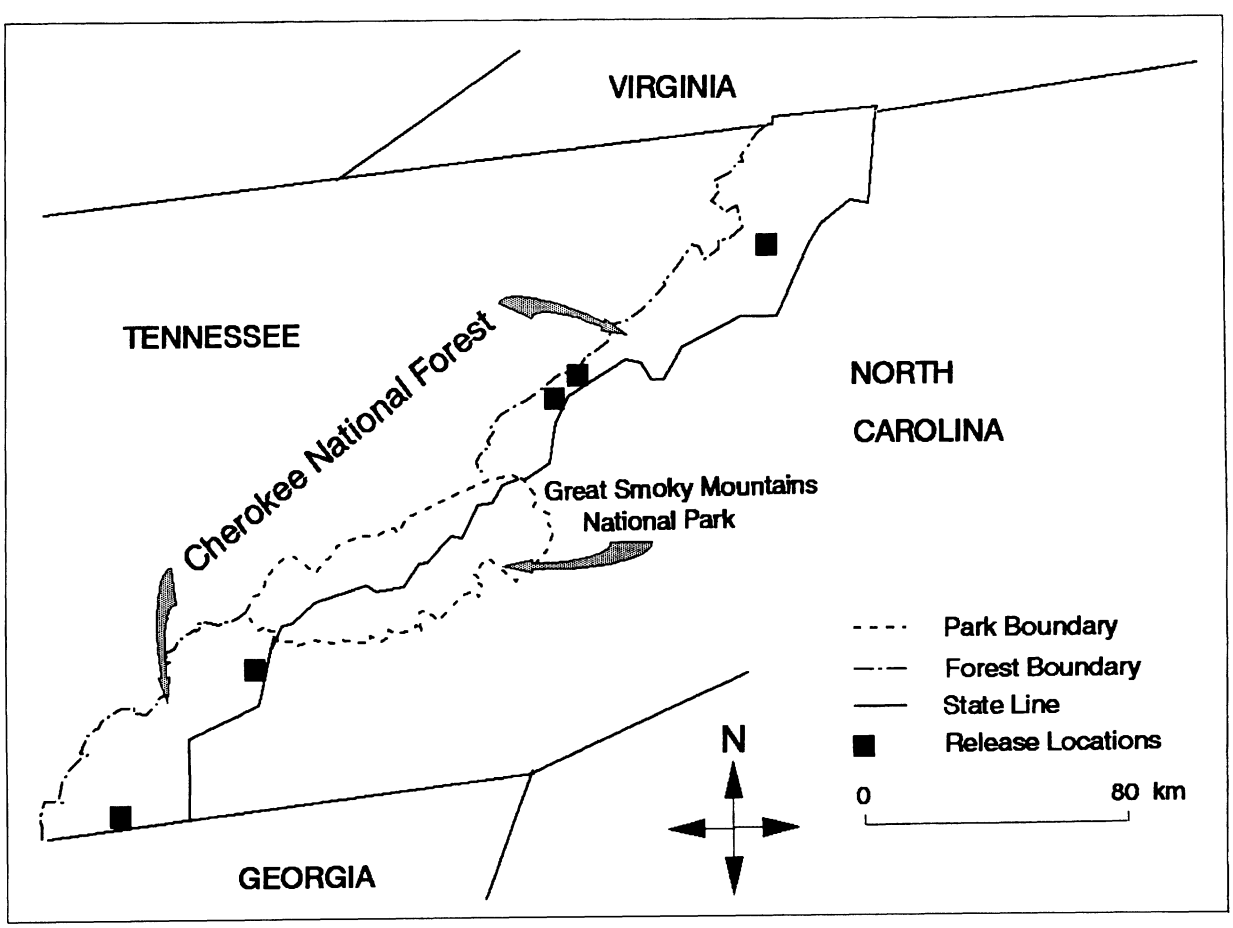

Fig. 1. Release locations of pen-reared black bears in east Tennessee, 1982–95.

Pelton 1980). Seven bears were fitted with modified Telonics breakaway radiocollars (Hellgren et al. 1988). All radiocollars were motion-sensitive (Telonics Inc., Mesa, Ariz.).

Bears released during winter (Feb) were immobilized at their release site and placed in individual wooden den boxes. Den boxes were constructed with 3/4 inch plywood and were approximately 3 feet high, 4 feet long and 3 feet wide. Straw was placed inside the boxes and the openings were blocked with bales of straw. A female bear released in May also was immobilized at her release site. Other bears were not immobilized when released.

Radiotagged bears were monitored an average of once every 18 days (SE = 3.7). We located bears using fixed wing aircraft (n = 30); triangulation (n = 5), and visual observation (n = 18). Bear locations were plotted on topographic maps. We noted the linear distance traveled from release site to death site or last location. Due to topography, distances are less than the actual minimum distance. We estimated date of death or collar drop as the median day between last active location and collar recovery.

RESULTS

Twenty-three pen-reared black bears (11 male, 12 female) were released in east Tennessee between 25 October 1982 and 22 August 1995 (Table 1). Twenty bears (10 male, 10 female) were in captivity at the MBBH and 3 bears (1 male, 2 female) were at GM. Bears had been in captivity from 1.3 to 10 years prior to their release in the wild. Mean age of released bears was 2.5 years (SE = 0.5).

Pen-reared bears were released in February (n = 8), April (n = 4), May (n = 3), June (n = 1), August (n = 6), and October (n = 1). Bears placed in wooden den boxes during winter (n = 8) emerged from their boxes within 24 hours and dispersed from their release sites. Radiotagged bears placed in wooden den boxes dispersed short distances from their boxes ($\bar{x}$ = 1.2 km, SE = 0.4, n = 3) and generally remained inactive throughout the winter; 1 of these bears denned under an overturned tree and the other 2 were observed lying on the ground.

Five pen-reared bears caused nuisance problems. Bear 880 was captured and relocated twice and finally shot by the TWRA. Bear 881 was captured at a campground 10.5 km from his release site and returned to captivity; the release of this bear was considered a failure. Bear 882 was observed feeding from a trash dumpster once, but was not captured. Bear 742 was observed feeding from a trash dumpster 3 days prior to being struck by a vehicle and subsequently euthanized by the TWRA. Bear 810 was observed feeding on garbage and bird feed and subsequently captured and relocated by the Georgia Department of Natural Resources.

We monitored radiotagged bears from 6 to 484 days (Table 1) and determined the fate of 4 of these bears. Bear 517 was shot during the hunting season in North Carolina 110 days after release. Bear 880 was shot by the TWRA because of persistent nuisance problems 92 days after release. We recovered the radiocollar and carcass of bear 917 twelve days after release but were unable to determine her cause of death; we suspect she was killed illegally. Bear 881 was captured and returned to the MBBH because the release was considered a failure. We suspect that 2 other radiotagged bears also were killed illegally and the fate of the seventh radiotagged bear was not known.

We determined the fate of 3 bears that were not radiotagged (Table 1). Bear 742 was hit by a car and subsequently euthanized by the TWRA. Bear 835 was killed illegally and bear 836 was killed during the hunting season in Tennessee.

We determined recovery or last location for 7 radiotagged bears and 4 bears that were not radiocollared; these distances ranged from 0.1 km to 25.2 km. ($\bar{x}$ = 11.4 km, SE = 2.5, n = 11).

DISCUSSION

Since most released bears were subadults and remained in the wild for a short period ($\bar{x}$ = 200 minimum days known alive, SE = 48, n = 11), it is unlikely they made any biological contribution to the local resident bear population. At least 6 bears died, 5 due to human related activities. Two other pen-reared bears were suspected of being killed illegally. We were unable to determine the fates of 14 bears (60.9%). Low recovery rates are common for bears released in this region. Nearly 60% of relocated nuisance bears in this region are never recovered (Stiver 1991). Based on records from this study and anecdotal records from the past 25 years regarding nuisance bear relocations, it is likely that other pen-reared bears released in the wild, and many relocated nuisance bears are killed soon after release (i.e., roadkills, illegal hunting, etc.).

Nuisance problems and high mortality rates of pen-reared bears appear to result from their habituation to people. Although both GM and MBBH actively manage their facilities to lessen human habituation (i.e., no feeding by visitors and simulation of natural feeding), it is obvious to us that these strategies do not work. While in

Table 1. Summary of pen-reared black bears released in east Tennessee, 1982–95.

Sex	Age[a]	Source	Release date	Days until last record	Distance (km) from release location to last location	Comments
Instrumented with radiocollars						
F	1.4	MBBH[b]	30 Jun 83	110	13.7	Hunter killed
M	2.0	MBBH	2 Feb 88	92	4.9	Shot by TWRA[c]
M	2.0	MBBH	2 Feb 88	97	10.5	Captured and returned to the MBBH
M	2.0	MBBH	2 Feb 88	155	17.7	Lost radio contact; suspected of being killed illegally
F	1.3	GM[d]	24 May 88	208	10.4	Radiocollar recovered; suspected of being killed illegally
M	1.3	GM	24 May 88	484	3.8	Radiocollar recovered; fate unknown
F	1.3	GM	24 May 88	6	0.1	Radiocollar and carcass recovered; suspected of being killed illegally
Not instrumented with radiocollars						
M	>4.8	MBBH	25 Oct 82			Fate unknown
F	2.0	MBBH	10 Feb 86			Fate unknown
F	2.0	MBBH	10 Feb 86			Fate unknown
M	2.0	MBBH	10 Feb 86	268	23.1	Hit by a vehicle and euthanized by TWRA
F	>9.0	MBBH	9 Feb 87			Fate unknown
M	>10.0	MBBH	9 Feb 87			Fate unknown
M	1.3	MBBH	17 Apr 90			Fate unknown
M	2.2	MBBH	3 Apr 92			Fate unknown
M	2.2	MBBH	3 Apr 92			Fate unknown
F	2.2	MBBH	3 Apr 92			Fate unknown
M	1.6	MBBH	24 Aug 93			Fate unknown
F	1.6	MBBH	24 Aug 93			Fate unknown
F	1.6	MBBH	24 Aug 93	273	25.2	Captured and relocated by the GDNR[e]; Fate unknown
F	1.6	MBBH	24 Aug 93			Fate unknown
F	1.6	MBBH	22 Aug 95	46	2.9	Illegal hunter kill
F	1.6	MBBH	22 Aug 95	468	13.0	Hunter killed
	$\bar{x}$ = 2.5			$\bar{x}$ = 200	$\bar{x}$ = 11.4	
	SE = 0.5			SE = 48	SE = 2.5	

[a] Age, in years, of pen-reared bears when released in the wild.
[b] Municipal Black Bear Habitat at Ober Gatlinburg, Tennessee.
[c] The Tennessee Wildlife Resources Agency.
[d] Grandfather Mountain, Incorporated, North Carolina.
[e] Georgia Department of Natural Resources.

captivity, pen-reared bears had almost daily contact with people. Likewise, nuisance bears have regular contact with humans. In either instance, bears become anthropocentric, focusing their activities near people, resulting in nuisance situations and low survival rates. It is likely that bears from more standard zoological parks would be even more conditioned to respond to humans.

A perennial problem among regional wildlife agencies is how to properly rear and release orphaned, injured, or confiscated bears. Historically, these animals have ended up in zoos. Wildlife agencies would like to place these animals back into the wild and have done so on occasion. If pen-reared bears, either orphaned cubs reared in captivity or progeny of captive stock, are to be released into the wild, we strongly urge that new and better strategies be developed for handling such animals before undertaking such endeavors. Under the present conditions it is inappropriate to release pen-reared bears into the wild.

We suggest that future experimental programs evaluate more natural enclosures, and to the extent possible, total isolation of bears from human contact. Based on our preliminary evidence, placing pen-reared bears in wooden den boxes during winter does not work. Eight bears in this study did not use wooden den boxes, and at least 1 radiotagged bear was able to locate a natural den. Jonkel et al. (1980) also reported that a pen-reared orphaned grizzly bear cub (*U. arctos*) released during winter failed to use an artificial den. We suggest placing bears in natural dens (i.e., rock crevices, blow downs, etc.) during winter releases.

We also suggest experimental programs evaluate feeding methods and foods that are as natural as possible and release strategies, such as acclimation pens in the proposed release area, sex-age of releasable individuals, season, etc. Because captivity increases a bear's habituation to people, older pen-reared bears are less likely candidates for release. Subadult pen-reared bears, particularly yearling females, may be most desirable for release since their movements will likely be more limited (Alt 1978, Rogers 1987) and they may eventually contribute reproductively to the population. Habituation to humans also may be reduced by fostering captive bred cubs with adult females that already exist in the wild (Servheen et al. 1987). However, this would require knowledge of the location and reproductive status of adult female bears within the population. Also, larger litter sizes due to fostering captive born cubs may stress foster mothers and result in low cub survival (Rogers 1976).

Pen-reared bears used to augment small populations could introduce parasitic or infectious diseases. The potential to introduce deleterious genetic material also is relevant, particularly when using captive animals with unknown breeding histories to augment small isolated populations. To prevent disease or improper genetic material entering the target population, pedigree records of pen-reared bears should be examined; animals with questionable backgrounds should not be released.

There likely are other strategies that can be developed to enhance survival of pen-reared animals in the wild such as more remote release areas to reduce potential conflicts with people (Alt and Beecham 1984). Five bears in this study caused nuisance problems because they were probably habituated to people and they had to be released relatively close to developed areas. Low to no resident bears in the proposed area may also be beneficial. Releasing new bears into habitats already occupied by a resident bear population may be a significant contributing factor to the poor success of relocation efforts. We suggest a feasibility study using habitat suitability index and geographic information system capabilities be conducted prior to releasing bears to determine potential limiting factors within the chosen area (van Manen and Pelton, 1997).

Further research and evaluation of pen-reared bears released into the wild may be warranted under conditions that do not create nuisance problems. Much can be learned with an intense and controlled monitoring program. We now have the capability of recovering experimental animals that might begin to cause problems using capture radiocollars (Mech et al. 1984). This technique has already proven successful in recent experimental releases of red wolves (*Canis rufus*) in Great Smoky Mountains National Park.

Managers must recognize that all pen-reared animals are not good candidates for release and that some releases will be unsuccessful. Positive steps toward incorporating local input into a bear management program can be permanently damaged by releasing potential nuisance animals into an area. It is usually the local people who dictate the fate of bears. Therefore, if pen-reared bears are released, it is important to define objectives of the release and develop a release plan and protocols. This plan should include management alternatives for animals that become a nuisance, including a second release area, agreements to return nuisance animals to their original facility, or humane euthanasia. One bear in this study was captured and relocated twice and finally shot by the TWRA because previous arrangements were not made. Ultimately, none of these strategies or any strategy may guarantee survival of a pen-reared bear in the wild.

The cost to properly rear and release pen-reared bears will be high and probably not easily justifiable. When augmentation or reintroduction is necessary, it might be more cost effective and successful to use wild bears (Griffith et al. 1989) under very carefully controlled and intensively monitored conditions. Considering the history of release attempts, even this strategy may prove unsuccessful without major modification to the current techniques.

CONCLUSIONS

Results of this study suggest that pen-reared black bears exhibit poor adaptability and survival when released into the wild. Pen-reared bears are especially vulnerable to human caused mortality and also may become a nuisance. Considering the large home range of bears, the limited size of release areas, the costs associated with properly rearing pen-reared bears, and the socio-political implications, releasing pen-reared black bears into the wild without proper rearing does not appear to be a viable management alternative at present.

LITERATURE CITED

ALT, G.L. 1978. Dispersal patterns of black bears in northeastern Pennsylvania—a preliminary report. Proc. East. Workshop Black Bear Manage. and Res. 4:186–199.

———, AND J.J. BEECHAM. 1984. Reintroduction of orphaned black bear cubs into the wild. Wildl. Soc. Bull. 12:169–174.

BAKER, A.B. 1903. A notable success in the breeding of black bears. Smithsonian Miscellaneous Collections. 45:175–179.

CONLEY, B.W. 1978. Status report for Arkansas. East. Workshop Black Bear Res. and Manage. 4:1–4.

COOK, W.J. 1984. Chemical immobilization of black bears in Great Smoky Mountains National Park. Proc. East. Workshop Black Bear Manage. Res. 7:79–81.

COWAN, I.M. 1972. The status and conservation of bears (*Ursidae*) of the world—1970. Int. Conf. Bear Res. and Manage. 2:343–367.

CRANDALL, L.S. 1964. The management of wild mammals in captivity. The University of Chicago Press, Chicago, Ill. 761pp.

FENNEMAN, N.M. 1938. Physiography of the eastern United States. McGraw-Hill, New York, N.Y. 714pp.

GRIFFITH, B., J.M. SCOTT, J.W. CARPENTER, AND C. REED. 1989. Translocation as a species conservation tool: Status and strategy. Science 245:477–480.

HELLGREN, E.C., D.W. CARNEY, N.P. GARNER, AND M.R. VAUGHAN. 1988. Use of breakaway cotton spacers on radio collars. Wild. Soc. Bull. 16:216–218.

JOHNSON, K.G., AND M.R. PELTON. 1980. Marking techniques for black bears. Proc. Ann. Conf. Southeast. Assoc. Fish and Wildl. Agencies. 34:557–562.

JONKEL, C., P. HUSBY, R. RUSSELL, AND J. BEECHAM. 1980. The reintroduction of orphaned grizzly bear cubs into the wild. Int. Conf. Bear Res. and Manage. 4:369–372.

MECH, L.D., R.C. CHAPMAN, W.W. COCHRAN, L. SIMMONS, AND U.S. SEAL. 1984. Radio-triggered anesthetic-dart collar for recapturing large mammals. Wildl. Soc. Bull. 12:69–74.

ROGERS, L.L. 1976. Effects of mast and berry crop failures on survival, growth, and reproductive success of black bears. Trans. North Am. Wildl. and Nat. Resour. Conf. 41:431–438.

———. 1987. Effects of food supply and kinship on social behavior, movements, and population growth of black bears in northeastern Minnesota. Wildl. Monogr. 97. 72pp.

ROGERS, M.J. 1973. Movements and reproductive success of black bears introduced into Arkansas. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies. 27:307–308.

SERVHEEN, C. 1990. The status and conservation of the bears of the world. Int. Conf. Bear Res. and Manage. Monogr. Series No. 2. 32pp.

———, W. KASWORM, AND A. CHRISTENSEN. 1987. Approaches to augmenting grizzly bear populations in the Cabinet Mountains of Montana. Int. Conf. Bear Res. and Manage. 7:363–367.

STIVER, W.H. 1991. Population dynamics and movements of problem black bears in Great Smoky Mountains National Park. M.S. Thesis, The Univ. of Tennessee, Knoxville. 134pp.

U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE. 1976. Cherokee National Forest timber management plan. Final environmental statement. U.S. Dep. Agric. FS–R8 ADM–76–16. 119pp.

VAN MANEN, F.T., AND M.R. PELTON. 1997. Procedures to enhance the success of a black bear reintroduction program. Int. Conf. Bear Res. and Manage. 9(2):67–78.