BEAR REINTRODUCTIONS: LESSONS AND CHALLENGES

INVITED PAPER

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Abstract: Reintroduction is defined as an attempt to establish a species in an area that was once part of its historical range, but from which it has been extirpated or become extinct. Historically, one of the most successful programs was the reintroduction of 254 American black bears (*Ursus americanus*) from Minnesota to the Interior Highlands of Arkansas in the 1960s; that population has grown to >2,500 today. More recent efforts have involved fewer but better monitored animals and have sometimes employed techniques to improve site fidelity and survival. In Pennsylvania, for example, pregnant female American black bears were successfully translocated from winter dens, the premise being that the adult females would be less likely to return because of the presence of young cubs. That winter-release technique was compared to summer trapping and release in Tennessee; winter releases resulted in greater survival and reduced post-release movements. Homing has not been a problem for small numbers of brown bears (*Ursus arctos*) reintroduced to the Cabinet-Yaak ecosystem in Montana and Idaho and to the mountains of Austria and France. Reintroduction success appears to be correlated with translocation distance and is greater for subadults and females. As with any small population, reintroduced bear populations are susceptible to environmental variation and stochastic demographic and genetic processes. Although managers have focused on these biological barriers, sociopolitical impediments to bear reintroduction are more difficult to overcome. Poor public acceptance and understanding of bears are the main reasons some reintroduction programs have been derailed. Consequently, the public should be involved in the reintroduction process from the outset; overcoming negative public perceptions about bear reintroduction will be our greatest challenge.

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Terms to describe animal translocations are often confused. The International Union for the Conservation of Nature (IUCN) Reintroduction Specialist Group defines *reintroduction* as an attempt to establish a species (or lower taxonomic unit) in an area that was once part of its historical range, but from which it has been extirpated or become extinct (IUCN 1998). Reintroduction is sometimes called *repatriation* (Reinert 1991). When native conspecifics already are present, reintroductions are referred to as *supplementations* or *augmentations* (IUCN 1998). Reintroduction differs conceptually from the related methods of *nuisance translocations*, *fostering*, and *rehabilitation* because the primary objectives of those techniques usually are not population reestablishment. Although the latter methods have been well documented (e.g., Boyer and Brown 1988, Linnell et al. 1997, Stiver et al. 1997, Clark 1999), we discuss those methods only to the extent that they relate to reintroduction as the IUCN defines it.

Reintroduction of bears has been the subject of much renewed interest. The distribution and numbers of most bear species have been dramatically reduced and fragmented because of habitat loss, overexploitation, or some combination of both (Servheen 1990). Yet, in many cases the causes of historical population declines have been rectified; habitats have recovered in many areas and laws are in place to prevent overexploitation.

In the case of population fragmentation, long-term persistence depends on recolonization of vacant habitat patches following periodic local extinctions (Levins 1970, Hanski 1996). Bears, however, may not be well adapted to exploit such habitats. Although the considerable dispersal capabilities of male black and brown bears have been well documented (Kemp 1976, Young and Ruff 1982, Schwartz and Franzmann 1992, Blanchard and Knight 1995, Stratman et al. 2001), that behavior is not typical of all age and sex classes, and rate of population spread correlates only weakly with mobility (Caughley 1977:69). Females of at least some bear species typically do not disperse and, thus, reside within a portion of their mother's home range (Schwartz and Franzmann 1992). Also, bears have relatively low reproductive rates (Bunnell and Tait 1981), a characteristic which limits population growth and natural colonization ability (Hanski 1991, Hastings 1991). Consequently, bears should probably be considered poor colonizers and reintroduction may be necessary to expedite this otherwise slow recolonization process.

Reintroduction is a costly and time-consuming enterprise, with only about 11% of all species reintroductions resulting in viable populations (Beck et al. [1994] from Earnhardt [1999]). In general, reintroduction success is enhanced in instances when there are a large number of founders, low environmental variation, and access to refugia, and for species with high genetic variability, a high rate of population increase with low variance and low intraspecific competition (Griffith et al. 1989). Unfortunately, bears exhibit low population growth with high variance, are subject to high environmental variation (e.g.,

annual fluctuations in food production), and have low genetic variability relative to their population size (Manlove et al. 1980, Wathen et al. 1985). Furthermore, bears have a strong homing instinct and often travel great distances (Beeman and Pelton 1976, Miller and Ballard 1982, Rogers 1987) and experience increased mortality following translocation (Rogers 1986, Fies et al. 1987, Stiver 1991, Comly 1993, Riley et al. 1994, Blanchard and Knight 1995). Thus, reintroduction in general, and bear reintroduction specifically, presents many challenges. Our goals for this paper are to provide an overview of bear reintroduction efforts worldwide, summarize the findings, and offer guidance for the future.

HISTORICAL PROGRAMS

Few bear reintroduction efforts have occurred, fewer have been successful, and fewer still have been adequately documented. Perhaps the earliest program was a 1933 California effort, where about 30 American black bears were translocated from Yosemite National Park to the Angeles National Forest (D. Updike, California Department of Fish and Game, Sacramento, California, USA, personal communication, 2002; Table 1). Managers used a *hard release*, whereby animals were captured, transported, and released without an acclimation period. Grizzly bears had been extirpated in 1922 from the area where the black bears were reintroduced. Although the Ameri-

Table 1. Characteristics of bear reintroduction programs and eventual outcomes. Abbreviations: NP = National Park, NF = National Forest, Am. = American, NWR = National Wildlife Refuge.

Source	Release area	Distance from capture site (km)	Number released	Date	Species and reintroduction method	Outcome
Yosemite NP, Calif., USA[a]	Angeles NF, Calif. USA	350	~30	1930s	Am. black bears, hard release	Success
Cook County, Minn., USA[b]	Interior Highlands, Ark., USA	1,570	254	1958–68	Am. black bears, hard release	Success
Cook County, Minn., USA[c]	Northern La., USA	2,030	161	Mid-1960s	Am. black bears, hard release	Unknown
Byelorussia[d]	Bialowieza, Poland	300	≥11	1938	Brown bears, soft release of captive bears	Failure
Vienna, Austria (zoo)[e]	Trentino, Italy	–	2	1959	Brown bears, soft release of captive bears	Failure
Zurich, Switzerland (zoo) and Este Castle, Italy (zoo)[e]	Trentino, Italy	–	4	1969, 1974	Brown bears, hard release of captive bears	Failure
Northeast Penn., USA[f]	Southeast Penn., USA	440	22	1977–84	Am. black bears, soft release with winter-den technique	Success
Shenandoah NP, Virginia, USA[g]	Southeast Va., USA	298	43	1991	Am. black bears, hard release of nuisance bears	Unknown
Croatia, Slovenia[h]	Austria	>400	3	1989–93	Brown bears, hard release	Success
Northern Montana, USA[i]	Cabinet Mountains, Mont., USA	20–40	4	1990–94	Brown bears, hard release	Pending
Great Smoky Mountains NP, Tenn., USA[j]	Big South Fork, Tenn., USA	160	14	1996–97	Am. black bears, soft release with winter den technique and summer acclimation pens	Pending
Slovenia[h]	Central Pyrenees, France	1600	3	1996–97	Brown bears, hard release	Pending
Northern and southern La., USA[k]	Central La., USA	50–180	6	1998–01	Am. black bears, soft release with winter den technique	Pending
Slovenia[l]	Alps, Italy	~400	7	1999–01	Brown bears, hard release	Pending
White River NWR, Ark., USA[m]	Felsenthal NWR, Ark., USA	160	10	2000–01	Am. black bears, soft release with winter den technique	Pending

[a] D. Updike, California Department of Fish and Game, Sacramento, California, USA, personal communication, 2002
[b] Smith and Clark 1994
[c] Taylor 1971
[d] Buchalczyk 1980
[e] Osti 1999
[f] Alt 1995
[g] Comly 1993
[h] D. Huber, University of Zagreb, Zagreb, Croatia,, unpublished data
[i] Servheen et al. 1995
[j] Eastridge and Clark 2001
[k] D. Anderson, U.S. Fish and Wildlife Service, Tallulah, Louisiana, personal communication, 1999
[l] P. Genovesi, Instituto Nazionale per la Fauna Selvatica, Ozzano Emilia, Italy, personal communication, 2001
[m] B. Wear, University of Tennessee, Knoxville, Tennessee, USA, personal communication, 2001

can black bear population size today is unknown, the expansion of the population into unoccupied grizzly range is mostly due to that reintroduction effort (D. Updike, personal communication, 2002).

Another early program released 254 American black bears from Minnesota and Manitoba, Canada, in Arkansas from 1958 through 1968 (Rogers 1973). Animals were captured in culvert traps during summer and translocated to 3 locations in the Interior Highlands of northwest Arkansas. Subsequent movements were extensive with some animals traveling up to 435 km from their release sites (Rogers 1973, Smith et al. 1990). Reintroductions at all 3 locations were successful, with the resulting population increasing to >2,500 animals in 20-years (Smith and Clark 1994). Numerically, this may be the most successful reintroduction of any large carnivore anywhere in the world.

In the mid-1960s, Louisiana officials attempted to augment dwindling American black bear populations in the Tensas River area and the Atchafalaya River Basin by capturing 161 bears from Minnesota and hard releasing them 2,030 km away (Taylor 1971). Bears are now present at both locations in Louisiana, but it is unclear to what extent they are the result of the releases (Pelton 1991). As in Arkansas, post-release movements were extensive and mortality was high (Taylor 1971).

In an early European effort, brown bears were reintroduced to Bialowieza in northeastern Poland where the original population was extirpated in the late 1800s (Buchalczyk 1980). Seven were hand-raised cubs brought from neighboring Byelorussia (now Belarus) and reintroduced in 1938. All 7 bears were soon killed by poachers or were recaptured after they came into conflict with the local human inhabitants. In another release, a pregnant female from Poznan Zoo was placed in a cage in the forest where she gave birth to 2 cubs in January 1938 (Buchalczyk 1980). The spacing of the bars of the cage permitted the cubs to leave and return at will. Access to the cage was blocked in the fall and the cubs spent the winter in the wild, returning only sporadically the next spring. During the Second World War and German occupation of the area, the caged adult female and another captive bear were released. These bears subsequently killed 2 or 3 people and injured another and were then shot. At the end of the Second World War there were probably 4 bears in Bialowieza but none were known to have survived after 1947 (Buchalczyk 1980).

Some 20 years later in the Trentino area of the Italian Alps, 3 historical brown bear reintroduction efforts involved ≥6 bears (Osti 1999; P. Genovesi, Instituto Nazionale per la Fauna Selvatica, Ozzano Emilia, Italy, personal communication, 2001). The first was of 2 young Carpathian brown bears in 1959–60, born in captivity in a Vienna zoo. Attempts to rehabilitate the bears by holding them in semi-natural conditions failed and they were returned to captivity. In 1969, another 2 Carpathian brown bears from a zoo in Zürich were reintroduced. Both were habituated to people. During an attempted recapture, the female was seriously injured and had to be killed. The male was sent to a zoo in Verona. The last known attempt to reintroduce captive bears in the Trentino area was in 1974 using 2 males from a private enclosure at Este Castle. One bear was apparently illegally shot in 1976. The other was captured, fitted with a radiocollar, and radiotracked until it died in an avalanche in 1978.

RECENT EFFORTS

American Black Bears

From 1977 to 1984, 22 adult female black bears were translocated 440 km from northeastern Pennsylvania to augment a sparse population in the southwestern portion of the state (Alt 1995; G. Alt and M. Ternent, Pennsylvania Game Commission, Harrisburg, Pennsylvania, USA, personal communication, 2001). In that effort, some female bears that had just given birth to cubs or were suspected to be pregnant at the time of relocation were radiotracked to their winter dens in the source area, removed, and placed in den sites at the release area. At the release site, these bears were placed in known den sites or in wooden crates lined with straw. The premise of this winter-den method was that the combination of hibernation, parturition, and cub rearing would keep the adult females in the reintroduction area, thus increasing site fidelity. Although some native bears were present, the augmentation effort, along with harvest restrictions, was thought to have greatly increased population growth. Prior to augmentation, harvests for the area averaged 4 bears/year, whereas the recent hunter-kill increased to an average of 111 bears/year (M. Ternent, personal communication, 2001). This winter-den technique is considered a *soft-release* method because release was preceded by an acclimation period (Griffith et al. 1989). In a Virginia program, 43 nuisance American black bears were hard released in the southwest portion of the state (Comly 1993). Mortality was high, with annual survival rates averaging 0.37 for females and 0.12 for males. Homing behavior also was evident, with 32 of the 43 bears leaving the release areas. Although 11 bears remained in the areas of release, females did not reproduce the first year and the population was projected to decline.

To attempt to reduce the homing observed in Virginia, 2 soft-release techniques were compared for reintroducing black bears from Great Smoky Mountains National Park in Tennessee to the Big South Fork National River and Recreation Area in Tennessee and Kentucky, some

160 km to the northwest (Eastridge and Clark 2001). The winter-den technique was used to reintroduce 8 adult females with cubs. The second method involved reintroducing 6 adult and subadult female bears, not accompanied by cubs, to the release area during summer and holding them in pens for a 2-week acclimation period. After release, total distance moved from the release sites, net distance moved, mean daily distance moved, and circuity for winter-released bears were significantly less than for summer-released bears. Also, survival of winter-released bears (0.88) was greater than summer-released bears (0.20). Reproduction among reintroduced bears was documented; sires were thought to be transient adults or progeny of the reintroduced bears.

Also using the winter-den technique, a female with 2 cubs were reintroduced from Madison Parish, Louisiana, and placed in a denning box on the southern portion of Tensas River National Wildlife Refuge, Louisiana, in March 1998 (D. Anderson, U.S. Fish and Wildlife Service, Tallulah, Louisiana, USA, personal communication, 1999). In late February 1999, another female and her cub were taken to the Buckhorn Wildlife Management Area in Tensas Parish and placed in a den. Both females stayed in the reintroduction area the next year and at least 1 of the 3 cubs survived. In 2001, 4 females with 9 cubs were similarly reintroduced. Although 1 female abandoned her cubs, all adults remained in the release areas.

Finally, the winter-den technique was used in 2000 to translocate 6 females with 12 cubs from eastern Arkansas to Felsenthal National Wildlife Refuge in southern Arkansas (B. Wear, University of Tennessee, Knoxville, Tennessee, USA, personal communication, 2001). One of the 6 females died following reintroduction, the fate of 1 was unknown, and the other 4 survived and remained near the release area. Of the 15 cubs reintroduced with their mothers, 5 were known to have survived ≥1 year after release. In 2001, 4 more adult females with 10 cubs were reintroduced to Felsenthal.

Brown Bears

From 1989 to 1993, 2 females and 1 male brown bears were translocated to lower Austria and Styria and hard released (D. Huber, unpublished data). The area was thought to be inhabited by a male (Rauer 1997). One female was 3.5 years of age when transplanted; she established a home range of >115 km^2. She gave birth to 3 cubs in 1991 and had a second litter of 3 cubs in 1993 but died in September of that year in an unexplained accident. The other transplanted female was 6 years old and established a home range of >4,730 km^2 (Gerstl and Rauer 1999). She also gave birth in 1993 to 2 cubs before the radiosignal was lost. The bear population in Austria was estimated to be 20 to 25 in 2001.

In France, bears were extirpated from the Central Pyrenees by 1990 (Parde 1997). Two females in 1996 and 1 male in 1997 were reintroduced from Slovenia, a distance of 1,600 km (D. Huber, unpublished data). Both females were pregnant at time of capture and had litters of 2 and 3 cubs in 1997. A hunter killed the second female in fall 1997. One of her cubs and both cubs of the other female appeared to have survived (P. Quenette, Life Project, Saint-Gaudens, France, personal communication, 2001).

In the Italian Alps, 2 male and 3 female bears from Slovenia were hard released in 1999 and 2000, respectively, to augment a wild population estimated to contain only 2–4 bears. Two additional females were released in 2001 (P. Genovesi, personal communication, 2001).

Lastly, 4 subadult female brown bears were released to augment the existing small population in the Cabinet Mountains in northwestern Montana between 1990 and 1994 (Servheen et al. 1995). The bears were released in spring and summer, the time of maximum food availability in the area. One of the bears emerged with a cub the following spring but died of unknown causes approximately 50 weeks after release. Her offspring disappeared. The other 3 bears eventually dropped their radiocollars and have not been recaptured. As of 2001, there was evidence that at least 1 of the 3 bears survived and may have reproduced, but without recapture and monitoring, this cannot be verified.

WHAT HAVE WE LEARNED?

Homing and Survival

One of the obstacles to bear reintroduction has been homing behavior. Translocated American black bears have returned hundreds of kilometers to their capture sites (Beeman and Pelton 1976, McArthur 1981, Fies et al. 1987, Rogers 1988). Factors that may influence homing include age, sex, the presence of cubs, food availability, translocation distance, and geographic barriers. Hard releases of subadult American black bears have been more successful than hard releases of adults (Rogers 1988, Eastridge 2000), and subadult brown bears have demonstrated fewer propensities for homing than adults (Miller and Ballard 1982, Brannon 1987, Servheen et al. 1995). Additionally, females may be better candidates for reintroduction because their home ranges are relatively small (Rogers 1973, Wilson and Gipson 1975, Clark 1985). The winter-release technique first developed in Pennsylvania for American black bears holds much promise to reduce homing (Eastridge and Clark 2001).

Conversely, homing has not been a problem in brown bear reintroduction programs, even for males. Brown bear

reintroductions have primarily taken place in spring or early summer, when food is relatively abundant. In Austria, bears used roe deer (*Capreolus capreolus*) feeding stations extensively (Rauer 1997); thus, artificial food sources may help minimize homing. Ironically, man-made obstacles such as roads and developments that are barriers to natural immigration of bears also may have prevented homing. Finally, translocation distances have been relatively large (400–1,600 km). A number of other studies also identified an inverse relationship between the distance American black bears were translocated and the probability of return (Beeman and Pelton 1976, Singer and Bratton 1980, McArthur 1981, Rogers 1986, Fies et al. 1987).

Vehicle-related mortalities are often associated with homing and can be expected to be higher for reintroduced bears the year after release (G.L. Alt, 1995, Black bear population establishment in Southwestern Pennsylvania, Pennsylvania Game Commission, Harrisburg, Pennsylvania, USA; Comly 1993, Eastridge 2000). Similarly, Massopust and Anderson (1984) found that survival was lower for translocated American black bears (0.56) than for non-translocated bears (0.72) in Wisconsin, and survival of translocated bears in Maine (Hugie 1982) and Tennessee (Stiver 1991) was lowest during the first several months after release. Although hard releases of American black bears such as occurred in the Interior Highlands of Arkansas clearly can be successful, the number of animals released must be larger because of higher dispersal and increased mortality. Bears generate much interest today, however, and the public may not tolerate excessive numbers of transient or road-killed bears associated with such hard releases.

Population Demographics

Demographics of the founders can have a marked effect on resultant population growth and chance of successful reestablishment (Saltz 1996). One reason for the success of the bear reintroduction program in Arkansas was a relatively large founder population, which included many adult females and excluded many older males (Smith and Clark 1994).

Although a large number of founders increase the chances of successful reestablishment and rate of population growth, bear reintroduction is expensive, particularly using labor-intensive soft-release methods. Also, the source population may be in short supply, particularly if certain age or sex groups are targeted or if the source consists of endangered stock. Therefore, it is important to know when returns in population growth on the initial investment of bears decline. For that purpose, a few reintroduction programs have attempted to predict population growth and the time to population establishment (Comly 1993, Boyce and Waller 2000). Eastridge and Clark (2001) demonstrated how extinction probabilities in Tennessee and Kentucky could be greatly diminished and the time to population reestablishment greatly reduced with additional releases of bears. Releases beyond 3–5 years had less effect on population growth and, with 7 releases, the change in growth was much less discernible. Similarly, Griffith et al. (1989) demonstrated that, after a point, releasing a large number of animals does little to improve reintroduction success.

To reduce costs, it may be tempting for wildlife agencies to release bears without subsequent monitoring. However, growth projections cannot be made if released bears are not monitored to determine dispersal, survival, and reproductive rates. As a result, more bears may be stocked than needed or, conversely, the number released may be insufficient. Most principles of small population management apply to reintroduced bear populations and, as such, they are vulnerable to demographic and environmental stochasticity. Therefore, population growth projections should account for such potential variation (Saltz 1996, Eastridge and Clark 2001).

Genetics

Griffiths et al. (1996) warned that species reintroduction without genetic profiling of native stock risks what they termed genetic genocide. For example, it remains unclear whether bears that exist in northern Louisiana today, now listed as threatened under provisions of the U.S. Endangered Species Act of 1973 (16 U.S.C. 1531–1544), are descendents of native stock (*U. a. luteolus*) or bears reintroduced from Minnesota (*U. a. americanus*; Pelton 1991, Miller et al. 1998, Warrillow et al. 2001). The same subspecies (IUCN 1998) or suitable substitutes (Seddon and Soorae 1999) should be used whenever possible. Using modern techniques of molecular genetics, it is now possible to compare the genes of extinct populations, even by use of museum samples, with potential source populations.

If a small number of individuals are used for population reestablishment, founder effects or genetic drift can occur. For example, bears that were moved from Minnesota to the Interior Highlands of Arkansas were released in 2 regions, the Ouachita Mountains and the Ozark Mountains. About 20% of black bears in northern mid-western states where the translocated bears originated are brown in color (Rounds 1987), as are 22% of Ozark bears (Smith and Clark 1994). Presumably, few founders of the Ouachita Mountains population carried this trait, because few if any bears with brown coat color are known in the Ouachita Mountains (Smith and Clark 1994). Other less-discernible genetic differences between the 2 populations probably exist as well and could, in theory, affect popula-

tion fitness.

Habitat

Little is gained by releasing animals in areas where habitat is unsuitable; thus bear reintroductions have often been preceded by habitat evaluations (van Manen 1990, Boyce and Waller 2000, Hogg et al. 2000). In addition to food production, other factors such as roads and human developments have been assessed. Central to an evaluation of habitat at the release site is an understanding of the initial cause of the decline. For example, flooding regimes coupled with timber harvesting may affect American black bear denning habitat (White et al. 2001) and may have contributed to the decline of some bear populations in the lower Mississippi Alluvial Valley (A. Edwards, University of Tennessee, Knoxville, Tennessee, USA, unpublished data). Additionally, in some parts of Asia, problems resulting from habitat loss and poaching have not been remedied. Thus, it may not be appropriate to release additional bears into areas where such obstacles have not been overcome.

Behavior

It is of the utmost importance that reintroduced bears behave as normal wild individuals. Any alterations of their behavior that make them more dependent on anthropogenic food sources or more exposed to humans will likely result in reduced survival. Perhaps more importantly, the release of habituated bears can result in nonacceptance by the local human population and the rejection of the entire reintroduction project.

Rehabilitation is a complex effort to prepare captive-born or hand-raised bears for release in the wild. Rehabilitation and release of orphaned American black bear cubs has been attempted with some success (Stiver et al. 1997, Clark 1999). The release of cubs that have already become habituated to humans is much more difficult. In 2000, 3 sun bear (*Helarctos malayanus*) cubs, confiscated by local authorities in East Kalimantan, Indonesia, were trained for release (G. Fredriksson, University of Amsterdam/Tropenbos-Kalimantan Project, Kalimantan Timur, Indonesia, personal communication, 2001). From the time they arrived (3–7 months old) at the holding facility, the bears' handlers walked them through the forest during the day and kept them in cages at night, where they received additional food. After 6–9 months, 2 of the 3 bears would spend nights in the forest but would come back to camp in the evening to obtain food. Within 6 months the 2 bears were consuming many of the same foods eaten by their conspecifics in the area and appeared to have similar home range sizes. Encounters between the released and wild sun bears have been observed. Unfortunately, the third bear, which had been confiscated as a newborn, did not rehabilitate well and was eventually killed by local human inhabitants.

Though results are encouraging in this case, samples sizes were small and over a relatively short time. Many more attempts to rehabilitate habituated bears have failed. Generally, rehabilitation is costly and labor intensive and there may be more efficient ways to obtain source animals, even for endangered species. Also, rehabilitation may not be possible for potentially aggressive bear species because the consequences of personal injury by rehabilitated bears could undermine overall conservation efforts for the species. In Poland, for example, captive brown bears released in the 1940s killed at least 2 people; resentment and negative attitudes toward bear reintroduction by the public persists today. It seems clear that further attempts to rehabilitate brown bears should not occur. Because of the difficulties, expense, and potential for negative encounters with the public, we view rehabilitation as a technique primarily for coping with individual bears rather than reintroduction.

WHAT ARE THE CHALLENGES?

Although the biological issues are complex, it appears that they can be overcome for most bear species. Perhaps more daunting are the social and political aspects of bear reintroduction. Reading and Kellert (1993) observed that many species reintroductions have failed because the socioeconomic and political aspects were not adequately addressed. Although the historic American black bear reintroduction program in Arkansas was designed to generate as little publicity as possible, it was eventually terminated because of public opposition (Smith and Clark 1994).

Conversely, the U.S. Fish and Wildlife Service proposed to reintroduce grizzly bears into the Bitterroot Ecosystem of east central Idaho and western Montana starting in 2002 to facilitate recovery of the species in the lower 48 United States (Boyce et al. 2001). The proposal recommended reintroduction of ≥25 bears over 5 years, with a goal of eventually reaching >280 bears. That effort was marked by a 5-year public process which sought ideas from the public, solicited documents for review and comment, held public meetings and hearings, and provided multiple opportunities for the public and political interests to get involved. Additionally, an Environmental Impact Statement would have designated reintroduced bears as an "experimental, nonessential" population managed by a citizen–scientist committee (U.S. Fish and Wildlife Service 2000). That designation allows more management flexibility under the U.S. Endangered Species Act, especially for large carnivores that need management rather than strict protection. More than 24,000 comments were received

and there were 7 formal public hearings. Even after all that, the future of this project is doubtful; local public and political pressure forced the U.S. Fish and Wildlife Service to reverse an earlier decision to go forward with the reintroduction (Doddridge 2001). The process cost >$700,000 without a single bear being moved.

Nevertheless, it is critical that public support, particularly local support, for reintroduction programs be garnered from the outset. As charismatic megafauna it is easier to gain support for bears because of their high public appeal compared with other species (Eckholm [1978] and Westman [1990] from Reading and Kellert [1993]). Most people identify with bears and have a positive view of them because they are aesthetically appealing, are intelligent, are of large size, have the capacity to stand erect, and have an omnivorous diet (Kellert 1994). In a national study of Americans, a significant majority was willing to set aside millions of hectares of national forest land for grizzly bear conservation, despite the potential loss of jobs and a reduction in timber harvest (Kellert 1985). The North American attitude toward bears is highly positive, yet wildlife managers may be far too conservative in acknowledging this public viewpoint toward bears and their population enhancement and recovery (Kellert 1994).

Despite positive overall attitudes toward bears, attitudes toward bear reintroduction are more negative. These negative attitudes are partially associated with the perception that reintroduction will result in land-use restrictions. Rural, property-owning, and resource-dependent groups tend to be more utilitarian and dominionistic in their values toward wildlife (Kellert 1994). For example, fear of restrictions and strong libertarian attitudes have played major roles in the opposition to black-footed ferret (*Mustela nigripes*) reintroductions (Reading and Kellert 1993); this probably also is true for bears, particularly the endangered species. Such restrictions could affect hunting, mineral extraction, grazing, logging, and access to public lands, although historically, they rarely have. With bears, as with other carnivores, there seem to be differences between urban and rural attitudes toward reintroduction. For example, a 1995 Tennessee survey found that 61% of local residents were in favor of an American black bear reintroduction compared to 81% for non-locals (Peine et al. 1995). This is noteworthy because rural attitudes probably best reflect those most likely to be affected by the reintroduction program.

Other negative attitudes are linked to the potential danger to humans and the destruction of livestock and crops. In Arkansas, landowner attitudes toward bears were greatly influenced by previous experiences with bear damages (Clark et al. 1991). In Europe, most opposition to brown bear reintroduction was from fear of livestock losses (P. Quenette, personal communication, 2001). This is partially because the livestock guarding tradition among herdsmen has been lost in the absence of large predators, and now that the predators have returned, herdsmen have been slow to readopt those husbandry practices. Similarly, proposed brown bear reintroductions in the western U.S. have been opposed mostly by ranchers.

Although public relations and education programs have been successful in developing support for some reintroduction programs (Kleiman et al. 1990), traditional education programs are often woefully inadequate. Such programs tend to simply provide information about a species with the assumption that such knowledge will result in a shift in attitudinal values (Reading and Kellert 1993). This is rarely successful if beliefs are strongly held (Rokeach [1979] and Chaiken and Stangor [1987] from Reading and Kellert [1993]) because knowledge is only one of several factors influencing attitude (Kellert 1994). Changing long-held beliefs, particularly for species that evoke as much emotion as do bears, will not be easy. Addressing such opposition will be one of the greatest challenges facing the field of conservation biology (Reading and Kellert 1993). Failure to do so will rarely result in long-term success of reintroduction programs.

RECOMMENDATIONS

Because females typically do not disperse widely, bears are extremely susceptible to habitat fragmentation and are poor recolonizers of vacated habitats. Yet, given adequate habitat and a sufficient number of founders, some past reintroduction programs have shown remarkable success. We expect human-assisted reintroduction to be an increasingly valuable tool for augmenting or reestablishing bear populations in the future.

Homing behavior and associated low survival rates of reintroduced bears have been major impediments to successful bear population reestablishment, especially for American black bears. Factors that may improve survival and decrease homing include a lengthy translocation distance, natural or man-made barriers to bear dispersal from the release area, abundant food at the release site, and the use of subadults. Translocation of hibernating female American black bears with cubs has been successful and may hold promise for other bear species.

Central to the evaluation of habitat at the reintroduction site is the identification of the initial cause of population decline; this is often overlooked in reintroduction programs. Total potential range should be estimated so long-term population goals can be set; population–area relationships for bears may be similar to those of other large carnivores (Schoenwald-Cox et al. 1988). Multivariate assessments of past reintroductions have identified factors contributing to the success or failure of red

wolf (*Canis rufus*) releases (van Manen et al. 2000) and may be worthwhile for bears. Additionally, a recent analysis suggests that American black bear absence or presence in the southern Appalachian mountains in the eastern U.S. can be explained by simple landscape metrics such as patch size and distribution (Murrow 2001). The analysis identified certain habitat fragments that could serve as lynchpins for surrounding patches if restocked with bears (Murrow 2001). Such metapopulation approaches could greatly increase the efficiency of bear reintroduction programs.

Although the population consequences of inbreeding in bears have not been documented as well as with some other carnivores (O'Brien et al. 1985, 1990), genetic issues should not be overlooked. Soulé et al. (1986) recommend a 90% gene retention level from the source population to avoid demographic consequences of a loss of genetic diversity, but this may be difficult to achieve for some endangered species (Earnhardt 1999). Bear populations on peninsular fringes of their range have been shown to have significantly reduced genetic variation compared to more centralized populations (Waits et al. 1999), an important consideration when choosing a source. Tests to determine founder genome equivalents, mean kinship, or other measures of the relatedness of the founding individuals to the source population should be routinely performed (Earnhardt 1999).

Finally, too little emphasis has been placed on the sociopolitical aspects of bear reintroduction. The public has an overall positive perception of bears, but conservationists often fail to take advantage of this. However, the negative aspects of bears (e.g., personal injury, property damage) are often inflated or given improper perspective. Opinion surveys and conservation education through the mass media and at local levels should be a cornerstone of any reintroduction program (Kleiman 1989). Care should be taken so that such opinion surveys are an accurate gauge of public sentiment, however, because a few vocal individuals can dominate public meetings and have undue influence on the process. A procedure incorporating decision analysis, expert opinion, and tradeoff analysis was used in the grizzly bear reintroduction program in the Cabinet Mountains in Montana to reconcile the biological needs of the reintroduced bears with the socioeconomic needs of the local human residents (Maguire and Servheen 1992). That sophisticated approach could serve as a model for other programs.

Reading and Kellert (1993) describe 3 basic methods for reducing opposition and developing support for reintroduction programs: pressure, purchase, and persuasion. They suggest that power and authority in the form of law enforcement to control access and use of resources can be used to apply pressure. The U.S. Endangered Species Act of 1973 (16 U.S. Code 1531–1544), for example, represents a potentially powerful use of authority. Next, reintroduction programs can purchase support through financial incentives for conservation. Gray wolf (*Canis lupus*) reintroductions in the western U.S., for example, are accompanied by an indemnity fund for livestock depredation losses. Finally, public relations programs should attempt to persuade people to support the reintroduction program, or at least, not actively oppose it. Enlisting the help of people with similar cultural and socioeconomic backgrounds can be effective. A committee of community leaders was established in Montana to work with managers to answer questions and concerns about a grizzly bear augmentation program in the Cabinet Mountains (Servheen et al. 1995). As demonstrated by the Bitterroot reintroduction effort, that task will not be trivial. Nevertheless, we suggest that conservationists should be more active in developing programs to purchase, pressure, and persuade public support for bear reintroduction efforts.

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