MOVEMENTS AND RATES OF RETURN OF TRANSLOCATED BLACK BEARS IN VIRGINIA

MICHAEL L. FIES, Virginia Commission of Game and Inland Fisheries, Route 6, Box 484-A, Staunton, VA 24401
DENNIS D. MARTIN, Virginia Commission of Game and Inland Fisheries, Route 6, Box 484-A, Staunton, VA 24401
GERALD T. BLANK, Jr., Virginia Commission of Game and Inland Fisheries, Route 6, Box 484-A, Staunton, VA 24401

Abstract: From 1970 to 1984, 540 black bears (*Ursus americanus*) were trapped and released. Of the 540 bears captured, 240 were released at the trap site and 300 were translocated to different areas. A total of 186 bears were recovered, most of them legally harvested by hunters. Trap, release, and recovery sites were plotted on topographic maps and a computer program was used to calculate distances between map coordinates. Nonrelocated bears were recovered an average of 19.6 km from the area where they were trapped. Large males (> 136 kg) were recovered significantly farther from their capture locations ($\bar{x}$ = 38.6 km, $P < 0.05$) than other nonrelocated bears. Among translocated bears, females were recovered significantly farther ($P < 0.05$) from their capture site than were males. Translocated bears were recovered an average of 58.2 km from original capture site and 27.7 km from their release location. Bears translocated more than 80 km were recovered significantly farther from their capture site ($\bar{x}$ = 100.8 km, $P < 0.05$) than all other bears. Approximately 23% of the translocated bears were recovered within an angle defining the home direction. Twelve bears reached home before being recovered. All bears that returned home were males. Results of this study suggest that relocation distances of less than 80 km are effective for relocating Virginia black bears.

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Translocation of nuisance black bears is a management practice used by many wildlife agencies. Problem bears are captured and transported to areas where they are less likely to engage in further nuisance activity. As a result, landowners destroy fewer nuisance animals, and areas where bear populations are low can be restocked. Public support for such programs is generally high, despite the high cost of capture and relocation.

Although the fate of many translocated black bears remains unknown, researchers in other states report varying degrees of transplant success. Distance translocated (Alt et al. 1977) and physiographic barriers (McArthur 1981) appear to be important factors affecting frequency of return. Rogers (1986) found that 81% of black bears that were translocated less than 64 km returned home. As bears were moved farther than 64 km, return rates decreased steadily. Our objective in this study was to examine the relationship between translocation and transplant success in Virginia.

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STUDY AREA

This study was conducted in the Blue Ridge and Allegheny mountains of western Virginia (Fig. 1). The Shenandoah National Park (SNP), managed by the U.S. Dep. Int., Natl. Park Serv., dominates the higher elevations of the Blue Ridge Mountains. It occupies 78,542 ha and is 111 km long. Dominant forest cover types are red oak (*Quercus rubra*) and chestnut oak (*Q. prinus*). Most bears were captured on the SNP or on private lands surrounding the Park.

Bear release sites were primarily on the George Washington National Forest (GWNF). The GWNF lies predominantly in the Allegheny chain of the Appalachian Mountains and occupies approximately 607,000 ha. Forest cover types are similar to those of the SNP.

The Shenandoah Valley, approximately 140 km long by 40 km wide, lies between the Blue Ridge and Allegheny mountains. This area is primarily open agricultural land interspersed with small woodlots. Interstate 81 bisects the valley in a northeast-southwest direction.

METHODS

From 1970 to 1984, 540 black bears were captured and released. Bears were captured in aluminum culvert traps or Aldrich foot snares. Of the 540 bears captured, 240 were released at the trap site and 300 were translocated to other areas. Preferred release sites were on public land with restricted access because of problems with illegal hunting. Most translocated bears were nuisance animals that were caught damaging apiaries or agricultural crops. Apiary damage occurred most frequently in the spring (late Mar to mid-Jun), and the majority of crop damage occurred in the late summer (early Aug through Sep).

Bears were immobilized using M-99 (etorphine) (Wallach et al. 1967) or a 2:1 mixture of Ketaset (ketamine hydrochloride) and Rompun (xylazine). M50–50 (diprenorphine) was used as the antagonist

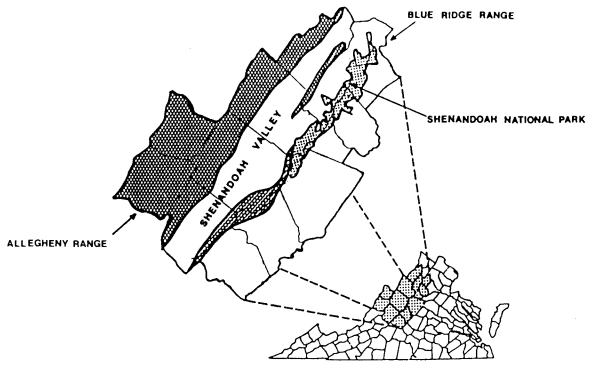

Fig. 1. Nuisance black bear study area.

drug for M-99. Bears were marked with a metal ear tag in each ear and with a lip tattoo. A $50 reward was offered for returned tags. Some bears were weighed in the field, but most weights were estimated. A tooth was extracted from each bear to determine age as described by Willey (1974).

Trap, release, and recovery sites were plotted on 7.5 minute U.S. Geological Survey topographic maps. Each location was then converted to X and Y coordinates using the Universal Transverse Mercator (UTM) grid system. A computer program was then used to calculate the distance between locations. Differences in bear movement among sex, age, and weight classes were tested using the Wilcoxon Rank Sum Test and the Kruskal-Wallis Test (Hollander and Wolfe 1973). Directional data were analyzed using procedures for circular statistics (Batschelet 1981).

RESULTS

Of the 540 bears captured, 186 (34%) were later recovered. Recovery information was available for 87 of the 240 (36%) nonrelocated bears and 99 of the 300 (33%) translocated bears. Most of the recovered bears (67%) were legally harvested by hunters (Table 1), even though many nonrelocated bears were caught and released in Shenandoah National Park where no hunting is permitted. Many of these bears were killed by hunters just outside the Park boundary. The refuge provided by the Park did not seem to reduce the chance of a bear eventually being recovered.

Although recovery rates were similar, bears that were not moved lived significantly longer ($\bar{x}$ = 748 days, $P < 0.001$) than bears that were translocated ($\bar{x}$ = 316 days). Furthermore, nonrelocated females lived longer ($\bar{x}$ = 1,191 days, $P < 0.01$) than nonrelocated males ($\bar{x}$ = 620 days). Females may have been less likely to venture outside the Park boundary because of their smaller home range size (Garner 1986). There was no difference ($P > 0.10$) between recovery times of translocated males and females.

Nonrelocated bears were recovered an average of 19.6 km from their trap site. Large males (> 136 kg) were recovered significantly farther from their capture location ($\bar{x}$ = 36.6 km, $P < 0.05$) than other nonrelocated bears. The larger home range size for males is probably responsible for this result.

Among translocated bears, females were recovered significantly farther ($\bar{x}$ = 73.2 km, $P < 0.05$) from their capture site than were males ($\bar{x}$ = 54.0 km). Females dispersed shorter distances from the release area and returned home less frequently.

Translocated bears were recovered an average of 28 km from their release site and 58 km from their original capture site. The distance that bears were recovered from their capture site appeared to be related to the distance that they were translocated. There was no difference between bears that were moved less than 17 km and those that were not moved (Table 2). Bears moved 17–80 km were recovered farther away ($P < 0.05$) than bears moved less than 17 km. Bears moved more than 80 km were recovered

Table 1. Summary of how relocated and nonrelocated black bears were recovered in Virginia for 1970–84.

Recovery type	Nonrelocated		Relocated		Total	
	N	%	*N*	%	*N*	%
Hunter	52	59.8	72	72.7	124	66.7
Nuisance	22	25.3	10	10.1	33	17.7
Automobile	8	9.2	9	9.1	17	9.1
Illegal	3	3.4	8	8.1	10	5.4
Trap	2	2.3	0	0.0	2	1.1
Total	87	100.0	99	100.0	186	100.0

Table 2. Mean distance that bears were recovered from their capture and release sites in relation to distance translocated.

Distance translocated (km)	*N*	Distance recovered from capture site (km)	Distance recovered from release site (km)	Percent that returned home
0	87	19.6[a]	19.6[a]	—
1–16	6	19.8[a]	26.5[a]	67
17–48	30	45.1[b]	34.4[a]	13
49–80	43	53.0[b]	22.6[a]	9
>80	20	100.8[c]	29.0[a]	0

[a,b,c] Distances with the same letter within a column are not significantly different ($P > 0.05$) from each other.

farther from their capture site ($P < 0.05$) than all other bears.

Bears were considered to be oriented homeward if they were recovered within 22.5° of the home direction (Rogers 1986). Of the 99 relocated bears, 23 (23%) appeared to be heading home. The mean direction traveled by relocated bears was 26° (Fig. 2). This course was not significantly different from the home direction ($P > 0.05$). The mean direction traveled by bears that did not reach home ($N = 87$) was 37°. This vector differed significantly from the home angle ($P < 0.05$). The Rayleigh Test (Batschelet 1981) was used to reject the null hypothesis that movement was random for all bears ($P < 0.001$) and for bears that did not return home ($P < 0.003$).

Bears were considered to have returned home if they were recovered within 15 km (males) and 10 km (females) of their original capture site. These distances are based on home range estimates for bears in Virginia (Garner 1986) and are similar to those reported by Massopust and Anderson (1984). Twelve of the 99 relocated bears reached home before being recovered. All bears that returned home were males older than 2.5 years. However, 16 other males older than 2.5 years did not return home. Our results are consistent with research from other states (Alt et al. 1977), where older males are suspected to return home more frequently than females or young males.

DISCUSSION

Translocation of nuisance bears appears to be a feasible solution to human-bear conflicts in Virginia. Only a small percentage (10%) returned home and relatively few (3%) of the relocated bears were known to be involved in further nuisance activity. Although euthanasia has been suggested as a more practical damage control alternative, it has little public support in Virginia. With at least 24% of all translocated bears legally harvested by hunters, translocation appears to be a useful tool for reducing nuisance activity without destroying bears. In contrast, bears that are killed as a result of damage complaints are not used for meat and no recreational hunting opportunities are provided.

An objective of any relocation program is to transport a bear far enough from its capture site to prevent its return. Alt et al. (1977) and Rogers (1986) have suggested that bears must be moved at least 64 km to assure that a majority will not return. In Virginia, 0 of 33 recovered bears that were moved farther than 64 km returned home. Of the 12 bears that did return

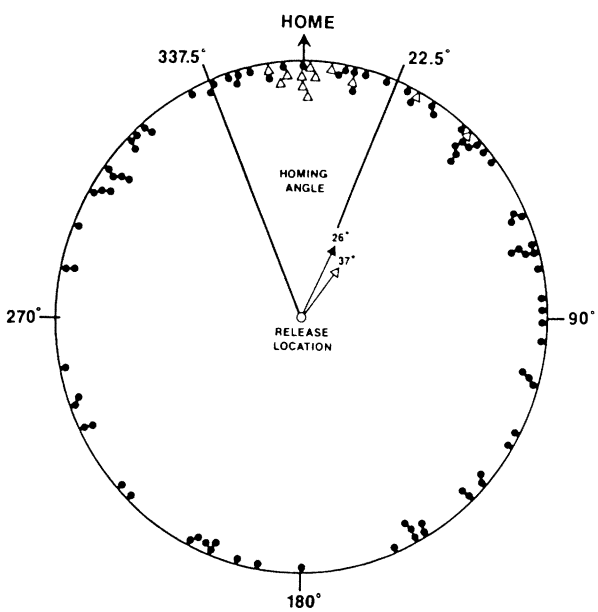

Fig. 2. Directional movements of translocated bears in relation to the home direction. Bears recovered with an angle of 22.5° on either side of the home direction were considered to be homing. Open triangles represent bears that returned home ($N = 12$). Filled circles represent bears that did not return home ($N = 87$). The black arrow is the mean vector for the entire sample (26° ± 26, 95% confidence interval) and the white arrow is the mean vector for bears that did not return home (37° ± 33, 95% confidence interval).

home, the average distance translocated was 29 km (range 5–54 km). This study suggests that Virginia black bears return home less frequently than has been reported in other states.

The relatively low percentage of bears that returned home in this study may be related to land use patterns between the capture and release site. Most of the bears relocated in Virginia were captured in the Blue Mountains and released in the Allegheny Mountains. To return home, translocated bears had to cross the Shenandoah Valley, an agricultural area heavily populated by humans. A 4-lane interstate highway (I-81) also separates the 2 mountain ranges. Although some translocated bears did cross the Shenandoah Valley (Martin unpubl. data), most seemed to avoid this heavily populated area. Of the 73 recovered bears that had been translocated across the valley, only 11 (15%) moved back to the Blue Ridge Mountains. Apparently, the Shenandoah Valley served as a barrier that prevented bears from returning home. Physiographic barriers have been correlated with successful translocation of black bears in Montana (McArthur 1981); Pelton (1984) suspected that human disturbance reduced the percentage of bears homing in the Great Smoky Mountains National Park. Both of these factors could have been important in this study.

In summary, our data suggest that short translocation distances can be effective in relocating Virginia black bears, especially when bears are moved across a physiographic barrier or an area heavily populated by humans. Bears that were moved 17–80 km were successfully transplanted 93% of the time. Bears that were moved more than 80 km never returned. Although distance translocated undoubtedly affects the frequency of bears returning, human activity and land use patterns appear to be more important factors affecting bear movement.

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