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EFFECTS OF TRANSLOCATION DISTANCE ON FREQUENCY OF RETURN BY ADULT BLACK BEARS

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A frequent question of black bear (*Ursus americanus*) managers is how far nuisance bears must be moved to minimize chances of their return. To address this question, I summarized translocation and movement data for 179 black bears >2 years old from researchers in 11 states and provinces (Table 1). These bears were drugged for ear-tagging and were typically unconscious while being transported. Locations of kills provided most of the movement data, but in a few cases end points were determined by recapture or telemetry. Bears were considered to have returned if they were found within 8-20 km of the capture site, depending upon the criterion for homing used by the individual researchers; home ranges differ with sex and region (Amstrup and Beecham 1976). Data sets in Table 1 are those with sufficient age data to exclude bears <2 years old, which return home less frequently than older bears (Barnes and Bray 1967, Harger 1970, Alt et al. 1977). Sex ratios varied from 27:1 (M:F) in New Hampshire (Orff 1982) to 3:17 in Oregon (McCollum 1974). The overall sex ratio was about 109:70. The frequency of returning was calculated as the percentage of the bears for which movement data were available, i.e., bears with unknown fates were excluded.

PERCENTAGE OF BEARS RETURNING

The percentages of bears returning from translocation distances of <64, 64-120, >120-220, and >220 km were 81%, 48%, 33%, and 20%, respectively (Table 1). Frequencies of return in the first group (bears translocated <64 km) differed significantly from those in the second group ($P < 0.001$, $\chi^2 = 15.3$), but frequencies in the second group did not differ significantly from pooled frequencies for the third and fourth groups ($P > 0.05$, $\chi^2 = 3.05$).

Sexes of individuals were available for 67 males and 46 females: 36 (54%) of the males and 32 (70%) of the females returned. Although frequencies of return by sex did not differ significantly ($P > 0.05$, $\chi^2 = 2.85$), the lower percentage of males returning may have a biological basis. The male sample undoubtedly included some dispersing subadults (2- and 3-year-olds) that were not residents of the capture sites and that would not be likely to return (Rogers 1977:144). Of 10 subadult males, including 5 translocated 32-53 km in Wisconsin (Massopust and Anderson 1984) and 5 translocated 48-85 km in Alberta (J. R. Gunson, Alberta Dep. Energy and Nat. Resour., unpubl. data), only 1 returned home (53 km), which suggests that translocation distances ≤32 km may be effective in translocating subadult males. By comparison, 106 (73%) of 145 other bears (possibly including other subadult males) returned after being translocated <120 km (Table 1). Females and adult males seldom disperse, making it less likely that they would be captured outside their usual ranges (Rogers 1977:144), although some bears of each sex forage outside their usual ranges in late summer and fall in some regions (Jonkel and Cowan 1971, Piekieiek and Burton 1975, Rogers 1977:104, Alt 1978, Garshelis and Pelton 1981).

Reporting formats in 7 studies did not allow incorporation into Table 1 because of (1) pooling of ages or translocation distances or (2) use of a different method of calculating frequency

Table 1. Frequency of return to within 8-20 km of capture site for recovered black bears >2 years old as affected by distance of translocation.

Location (Source)	Distance translocated (km)							
	8-<64		64-<120		120-<220		220-271	
	Rec.[a]	Ret.[b]	Rec.	Ret.	Rec.	Ret.	Rec.	Ret.
Michigan (Harger 1970)	16	15	19	11	4	0	5	1
Michigan (Erickson et al. 1964)			4	0	1	1		
New Hampshire (Orff 1982)	8	4	8	4	12	5		
Wisconsin (Massopust and Anderson 1984)	19	11	7	6	1	0		
Pennsylvania (Alt et al. 1977)	20	20	2	0				
Oregon (McCollum 1974)	19	15	1	1				
Alberta (Gunson, unpubl. data)	7	6	10	2				
Minnesota (Rogers, unpubl. data)	4	4	4	2				
Newfoundland (Payne 1975)	3	3	1	1				
California (Piekieiek and Burton 1975)	2	1						
Massachusetts (Elowe, unpubl. data)	1	1						
Virginia (Stickley 1961)	1	1						
	100	81	56	27	18	6	5	1

[a] Number recovered.
[b] Number of recoveries within 8-20 km of capture site.

of return. In 4 studies that may have included bears <2 years old, frequencies of returning tended to be less than those listed in Table 1. In Yellowstone National Park, 41 (67%) of 61 black bears returned after being translocated 6-67 km (Barnes and Bray 1967:117). In British Columbia, 37 (69%) of 54 returned after being translocated 10-99 km (Rutherglen and Herbison 1977). In New York, 19 (45%) of 42 returned from 14-64 km away and 3 (21%) of 14 returned from 64-107 km away (Sauer et al. 1969). In north-central Pennsylvania, 21 (75%) of 28 returned after being translocated ≤64 km, with each sex being moved farther than minimum home range diameters estimated to be 19.7 km for males and 8.7 km for females (McLaughlin et al, 1981). Of 3 males translocated more than 64 km, 1 returned (McLaughlin et al. 1981).

Researchers at Glacier, Great Smoky Mountains, and Yosemite national parks estimated frequency of return as a percentage of bears translocated, rather than as a percentage of the bears for which recovery data were available. This was necessary because, without hunting, movement data were seldom obtained for bears that did not return to capture sites or other nuisance sites. The estimates were aided by high visibility of nuisance bears in national parks. In Glacier, 109 (64%) of 170 translocated black bears returned; 104 (73%) of 143 returned after being translocated ≤80 km in terrain without physiographic barriers, but only 5 (19%) of 27 returned from areas separated from home by mountains or numerous ridges (McArthur 1981). In the other 2 national parks, fewer bears returned than in other areas where bears were translocated <64 km. In Great Smoky Mountains National Park, only 36 (47%) of 76 bears (including only 1 <2 years old) returned the first time they were translocated <65 km (Beeman and Pelton 1976). In Yosemite, an even lower percentage returned after being translocated <50 km, but the exact percentage was not stated because data from bears returning to any developed area were pooled (Harms 1976, 1980; Cella and Keay 1980).

The low percentage of bears that returned in Yosemite and Great Smoky Mountains national parks may be due in part to poaching of translocated bears outside park boundaries

(Beeman and Pelton 1976), to more rugged terrain in the parks than in most other areas studied (McArthur 1981), and to possible non-detection of bears that returned but did not continue nuisance activities. In addition, an unusually high portion of the translocated bears may not have been residents at problem locations. Where a diligent capture-removal program is practiced, as in those parks, problem locations would attract dispersing sub-adults and bears foraging outside their core areas (Kemp 1976; Rogers 1976, 1977:155; Young and Ruff 1982). Such bears would show a weaker tendency to return. In Yosemite, Harms (1980) and Cella and Keay (1980) reported that after several years of control, most bears captured at problem locations were previously untagged, indicating ingress.

EFFECTS OF TRANSLOCATION ON BEARS

In all studies of black bear homing there are translocated individuals whose fates are unknown. Questions remain as to whether these return home in percentages similar to those whose movements are known or whether they die of natural causes, including aggression from other bears. Available data indicate that translocation does not greatly increase natural mortality among bears ≥ 2 years old. Harger (1970) found that similar percentages of translocated (41%) and nontranslocated (38%) bears were recovered, which suggests that translocation did not increase mortality from natural causes in Michigan. None of 32 translocated bears was killed by bears or died of other natural causes while being radio-tracked in Alberta (J. R. Gunson, unpubl. data), Michigan (Harger 1970), Minnesota (L. L. Rogers, unpubl. data), Pennsylvania (Alt et al. 1977, McLaughlin et al. 1981), and Wisconsin (Massopust and Anderson 1984). The 32 included a cub, 2 yearlings, 2 2-year-olds, and 27 older bears. I found no reports of injuries among recaptured translocated bears.

Mortality among cubs that accompany translocated mothers may increase with translocation distance. Five cubs that were translocated with their 3 mothers 14-38 km survived (McCollum 1974, Alt et al. 1977, Rutherglen and Herbison 1977), but 3 of 6 cubs that traveled 72 to > 129 km with 3 other mothers were lost (Payne 1975; Graber 1981; J. R. Gunson, unpubl. data), and 6 of 9 cubs and yearlings that accompanied brown bear *(U. arctos)* mothers translocated >173 km were lost (Miller and Ballard 1982).

Energy costs associated with translocation and homing are little known. An adult female that twice homed from release sites 30 km away during a 2-week period in early summer lost 7 kg despite supplemental feeding on garbage (Harger 1970). However, an adult male in California maintained his release weight of 191 kg while moving 93 km in 12 days (Graber 1981). A female that weighed 41 kg when translocated from Minnesota to Arkansas gained 63.5 kg in 79 days while moving 257 km in late summer and early fall (Rogers 1974; M. J. Rogers, unpubl. data). Two translocated black bear females that returned home within a month from 23 and 65 km away produced cubs the next winter (J. R. Gunson, unpubl. data), but 4 brown bear females that were in estrous when translocated >145 km produced none (Miller and Ballard 1982).

EFFECTS OF TRANSLOCATIONS ON POPULATIONS AT RELEASE SITES

Translocated bears could adversely affect residents of release areas by increasing competition for food. However, the fact that translocated bears typically leave release sites within a few days and move widely, whether they return home or not (Harger 1970; McCollum 1974; Alt et al. 1977; McLaughlin et al. 1981; J. R. Gunson, unpubl. data), indicates that they should have little more effect on resident bears than do dispersing bears or bears foraging nat-

urally outside their usual ranges. Black bears in Minnesota foraged up to 201 km outside their usual ranges (Rogers 1977:108).

Successful translocations could also adversely affect populations by introducing new genes, which could disrupt adaptations to local environments (Shields 1982, 1983). However, natural dispersal distances in at least some areas are longer than most translocations. Young males in Minnesota dispersed ≤224 km and dispersed an average of >90 km (Rogers 1977: 145, 147). Therefore, translocations within a state or province probably would not adversely affect genetics.

BENEFITS OF TRANSLOCATIONS

Telemetry data indicate that most bears that return home do so within a month, but many that return are not seen or recaptured until the following year or not at all (Harger 1970; Alt et al. 1977; McLaughlin et al. 1981; Massopust and Anderson 1984; J. R. Gunson, unpubl. data; M. J. Rogers, unpubl. data). Recurring nuisance behavior was eventually found in 15% (McLaughlin et al. 1981) to 65% (Massopust and Anderson 1984) of the translocated bears. McLaughlin et al. (1981) stated that translocation of nuisance bears reduced their nuisance activity, regardless of translocation distance; bears that resumed nuisance activity were usually recaptured at a different site for the same type of nuisance activity about a year after the original capture. Recurrence in the same year may be reduced by the negative conditioning of capture and translocation and by ripening of wild food or onset of hibernation by the time bears return. Translocations preserve some adult females for additional reproductive cycles and preserve the majority of bears at least until fall hunting seasons. Eighty-six percent of bears killed by hunters are used for food or trophies, or both, according to a survey in Wisconsin (Dahlen 1959), but few bears killed as nuisances are used (L. L. Rogers, unpubl. data). Questions remain concerning the factors that determine which bears will persist in nuisance activities after translocation and concerning the costs and benefits of translocation in areas of low vs. high density bear populations.

SUMMARY

Adult black bears must be translocated > 64 km to assure that <50% return. Returns may be further reduced if bears are translocated across physiographic barriers. Translocation distances of ≤32 km may prevent returns of subadult males. Many bears that return do not resume nuisance activity or delay resuming until the next year. No increase in natural mortality has been noted among translocated bears ≥2 years old, but mortality among cubs may increase with translocation distance.

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