Are the same bears repeatedly translocated from corn crops in Wisconsin?

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Abstract: American black bear (Ursus americanus) damage to corn crops in northern Wisconsin is managed by capturing and translocating bears away from fields where damage is occurring. Translocating wildlife is often not a preferred wildlife management technique because of the potential return and repeated capture of animals. Hundreds of bears are translocated in Wisconsin annually, but because anesthetizing, marking, and tracking individual bears is prohibited at the time of year that translocations occur, it is not known whether the same few bears are moved multiple times, or if a large pool of new bears continues to be trapped and translocated. To determine if bears are frequently recaptured, we used genetic techniques to identify translocated bears during 2006 and 2007. Of the 520 bears identified, very few (4%) were recaptured. Of the bears that were recaptured, most (71%) tended to return to within 10 km of their original capture locations. Our inferences relative to the direct cause of low capture rates are limited, but our results show that bears translocated from corn fields are not repeatedly recaptured in Wisconsin.

Key words: American black bear, corn, crop, damage, genetics, translocation, Ursus americanus, Wisconsin

When American black bears (Ursus americanus) attempt to obtain anthropogenic food sources, their behaviors are destructive and potentially dangerous to both humans and bears, and many agencies direct significant resources and efforts toward bear management (Spencer et al. 2007). Bears are particularly challenging to manage because they range over wide areas, are behaviorally opportunistic and persistent, and will alter their behaviors to avoid or adapt to humans even while acquiring anthropogenic or seasonally available food sources (Breck et al. 2009). Concentrations of food resources can stimulate long-range bear movements and extend home ranges (Pelton 2003), and bears have been recorded to travel up to 160 km to access concentrations of food, particularly in the fall when fat reserves are important for winter dormancy (Rogers 1977). Bears also tend to switch from the ‘wild’ diurnal pattern to a crepuscular and nocturnal activity pattern to avoid times of human activity (Ayres et al. 1986, Beckmann and Berger 2003, Lyons 2005, Matthews et al. 2006). Further complicating identification and management of problem animals, bears also transfer behaviors socially (Mazur and Seher 2008). Due to complex biological and behavioral proclivities, managing conflicts with bears while simultaneously supporting their populations is a daunting task that will require a variety of tools and innovative approaches (Shivik 2006).

Agricultural processes have changed through time, but bears have adapted to use new food sources such as short-maturity corn crops (Stowell and Willging 1991). In north central states, damage to corn can be particularly significant: 55% percent of surveyed farmers reported crop loss from bears, and respondents estimated an average annual bear-related loss of 11% of their corn and oats (Garshelis et al 1999).

To manage damage in Wisconsin, the state established a Wildlife Damage Abatement and Claims Program (WDACP) in 1983 that provides damage prevention assistance and partial compensation for crop losses from wildlife (Koele 2008). In the program, the US Department of Agriculture’s Wildlife Services has worked according to a cooperative service agreement with the Wisconsin Department of Natural Resources and the Wisconsin Department of Natural Resources (Koele 2008).
Resources and County Land Conservation Committees to provide bear damage abatement assistance since 1990. Participants in the program are required to allow public hunting access and the application of damage abatement methods on their farms. In exchange for this, participants are eligible for partial compensation of appraised agricultural losses. During 2006 and 2007, 74 and 87 farms, respectively, were enrolled in the program for bear damage abatement assistance, and total assessed damage was $114,520.77 and $101,572.71 (B. Koele, Wisconsin Department of Natural Resources, Madison, Wisconsin, USA, personal communication, 2010). Wildlife Services received 162 complaints from farmers in 2006 and 146 in 2007 (US Department of Agriculture [USDA] 2007).

In the Wisconsin program, some shooting permits are issued to farmers who have chronic depredation to crops from bears, but the primary abatement method to reduce bear damage to corn is to trap and translocate bears (Hopkins et al. 2010); 479 and 382 bears were relocated in 2006 and 2007, respectively (B. Koele, personal communication, 2010). Translocation is potentially problematic and ineffective, however, because translocated animals often return to the site of capture and need to be moved again (Linnell et al. 1997); thus, translocation is usually not a preferred management method in wildlife damage management situations (Conover 2002). One of the first steps needed to evaluate a translocation program is to determine the proportion of translocated animals that are recaptured and moved repeatedly.

However, identifying individual bears to determine their recapture rate in Wisconsin has been particularly difficult. Crop damage and translocation occur over a short period in the fall. Being close to hunting season, there is potential for human harvest and consumption of recently translocated bears. Thus, techniques such as sedating and anesthetizing bears for handling and marking are prohibited, and the identity and damage history of bears moved from corn crops in Wisconsin is unknown.

We therefore identified individual bears translocated in northern Wisconsin using mildly-invasive sampling procedures and genetic methods. Our objective was to determine if bears frequently returned to their original site of capture and were repeatedly translocated.

Study area
Management occurred on farm fields in the bear management zones of northern Wisconsin (Fig. 1), where habitats were northern dry-mesic forests; sugar maple (Acer saccharum), maple leaf viburnum (Viburnum acerifolium), lady fern (Athyrium filix-femina), American beech (Fagus grandifolia), and blue-bead lily (Clintonia borealis) were representative species (Kotar et al. 2002). Land-use type included large tracts of federal, state, county, and industrial forests, with small towns, farms, resorts, and homes interspersed in the forest habitats; human densities were low (1 person/10 km²), and people resided in vacation homes or in farms of typically 90 ha (Stowell and Willging 1991).

There were 4 bear management units in Wisconsin, and our study site was almost entirely within units A, B, and D with 4 farms located in unit C; the estimated bear population estimates for units A, B, and D were 16,900 in 2006 and 17,400 in 2007 (Rolley et al. 2010).

Methods
For this study, we worked with Wildlife Services specialists who captured and relocated bears accord-
ing to damage management protocols (Koele 2008). Bears were captured on 55 farms in 2006 and 50 farms in 2007 from 11 August to 9 October in 2006 and from 3 August to 12 October in 2007. Bears were trapped using culvert style traps, and multiple traps were set on individual fields when damage was extensive or multiple bears were present. Traps were monitored daily and removed after bear activity decreased to <1 bear capture/week, damage ceased, or the crop was harvested.

Before translocation and release on public lands, technicians aimed a biopsy dart (20 mm sampling needles, Dan-Inject, Børkop, Denmark) at the hindquarters of the captured bear. All portions of the dart or tools that came into contact with tissue samples were rinsed in 95% ethanol and immediately flamed to destroy any contaminating DNA before sample collection. Darts were designed to excise a skin tissue sample and then fall free. Darts were collected after the bear was released from the trap, and samples were stored in 95% ethanol.

Samples were sent to a private laboratory for analysis and individual identification (Wildlife Genetics International, Nelson, British Columbia, Canada). Six microsatellite loci, G10P, MU59, G1D, G10H, G10L, and G10M, were selected by the laboratory based on the success of previous work with black bears in Wisconsin (Belant et al. 2005). DNA was extracted by Wildlife Genetics International using DNeasy Tissue kits following the manufacturer’s instructions (Qiagen, Valencia, California, USA) or by a Utah State University laboratory using a salt-chloroform extraction (Müllenhbach et al. 1989). Microsatellite loci were amplified from extracted DNA following Paetkau et al. (1998).

Error-checking analysis followed selective data reanalysis (Paetkau 2003). Quality control measures included negative controls, re-genotyping of a minimum of 3% of the samples, and replication of 7 of the 20 samples that were found to have identical genotypes (see Results). No genotypes differing at only one locus (1 or 2 alleles) were detected. Eight pairs of genotypes differed at 2 loci (2–4 alleles), and each of these were confirmed through re-analysis. These results suggest that the probability of inflating the number of individuals due to genotyping error was extremely low (Kendall et al. 2009).

The probability of observing the same multilocus genotype in 2 individuals is a function of the number of loci used, allele frequencies at these loci, and the relatedness of the individuals in the population. To assess this probability, we calculated the probability of identity, both for randomly selected individuals in the population and for siblings (Taberlet and Luikart 1999, Waits et al. 2001) using GenAlEx software (Peakall and Smouse 2006).

The probability of the observed genotypic frequencies under a model of Hardy-Weinberg equilibrium between allele and genotype frequencies was estimated for each locus using a Markov chain algorithm (Guo and Thompson 1992) as implemented in GenePop software (Raymond and Rousset 1995a). We assessed genotypic disequilibrium, or the probability that genotypes at all pairs of loci are independent, using a Markov chain algorithm (Raymond and Rousset 1995b) with a log likelihood ratio statistic in GenePop (Raymond and Rousset 1995a).

Given each sample’s bear identity, location, and date information, we calculated the number of bears that were recaptured. For recaptured bears, we also calculated the number of days before recapture and the distance between recapture points. Because we were evaluating a management procedure through direct observation rather than experimentation, we used descriptive statistics and their associated measures of variance to evaluate variables such as recapture rate and time and distance to recapture points.

Results

Bears were captured and translocated from across the northern Wisconsin landscape (Fig. 1). Bears were translocated from 11 August to 9 October 2006 and 3 August to 12 October 2007, and weekly capture rates rapidly diminished through time (Fig. 2). Genetic identification was successful, with 541 out of 567 samples (95%) producing a genotype, including the identities of 520 individuals. Given the observed allele frequencies in the dataset, the probability of observing identical genotypes in different randomly selected individuals was $4.2 \times 10^{-9}$, and even among full siblings this probability was 0.0015, indicating that the probability of observing the same genotype in different individuals was quite low. We detected no evidence of Hardy-Weinberg disequilibrium: the probability of the observed allele frequencies under the assumption of Hardy-Weinberg equilibrium ranged from 0.24 to 0.76. Similarly, there was no evidence of genotypic
disequilibrium: the probabilities of the observed co-occurrence of alleles at all pairs of loci ranged from 0.13 to 0.99.

The proportion of bears recaptured was low (n = 20; 4%). Of the 20 recaptured bears, 1 was recaptured twice (Table 1) and 2 that were captured in 2006 were recaptured in 2007. Overall, mean latency to recapture was 45 days (Table 1). When only considering within-year recapture, recaptured bears were recaptured within 13 days. Bears were translocated a wide range of distances (40.4–63.6 km, Table 1), but 43% of bears were recaptured at the same site of capture, and 71% were recaptured within 10 km of their initial capture site.

**Discussion**

Although we were not able to tag or physically mark bears that were translocated, we used a genetic sampling approach that allowed us to monitor the recapture rate of bears translocated in Wisconsin during the normal course of the translocation program. Our panel of genetic markers was reliable and informative, allowing identification at the individual level with a high degree of certainty.

Only a small percent (4%) of bears that were moved from corn crops in Wisconsin were recaptured during 2 years of the translocation program. Thus, we conclude that the same bears were not being repeatedly translocated. The desire for some bears to return to sites where they were initially captured was apparent, however. The majority (71%) of recaptured bears were recaptured at or near the location where they were originally captured.

The initial capture rate of bears was by far the highest in the first week of trapping, and capture rates fell rapidly after that (Fig. 2). The pattern of recaptures was similar and in 2006, for example, all 11 of the recaptures occurred in the first 35 days of the 59-day trapping effort (Table 1). Thus, in 2006, 100% of recaptures occurred during the first 60% of trap days. Similarly, in 2007, 100% of recaptures occurred during the first 49% of trap days (Table 1).

The reason for the low recapture rate is unknown. It is possible that bears do return to corn fields but become trap shy. Unfortunately, our recapture rates were too low to permit precise calculations of recapture probabilities or population size. Future researchers could benefit by collecting samples from another method for comparison, e.g., using hair-snag stations near the capture sites, or by obtaining samples from bears harvested during hunting seasons to determine if known bears are killed or return but do not reenter culvert traps.

Other hypotheses explaining the low recapture rate are also possible. First, the period in which corn is attractive to bears is relatively short and bears may switch to other food resources after translocation. Second, many captured bears may be young and not have developed strong site fidelity. Lastly, it is possible that some translocated bears are removed from the population during hunting season. Although we demonstrated that bears are not repeatedly captured in Wisconsin’s program, more research is needed to determine exactly why bears are not recaptured.

**Management implications**

Tissue sampling can be an effective and minimally intrusive method for identifying black bears in the midst of a damage management program. Evidence indicates that the bear translocation program in Wisconsin does not repeatedly move the same animals multiple times, but the reasons for this...
result (e.g., removal by hunting, trap-shyness) have yet to be determined.

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**Table 1. Capture histories for 12 black bears captured in 2006 and 8 black bears captured in 2007 that were recaptured during a bear translocation program in northern Wisconsin, USA. Translocation was the distance to the point where bears were released after initial capture. Recapture was the distance between the initial capture point and the recapture location.**

<table>
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<th>Bear</th>
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<th>Recapture latency (days)</th>
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