

Can beaver *Castor fiber* be selectively harvested by sex and age during spring hunting?

Abstract: In Norway, Sweden and Finland hunting Eurasian beaver *Castor fiber* Linnaeus, 1758 with firearms is presently the main harvest form and most are shot in late April and early May. As beaver cannot be sexed from external characteristics, and ageing by size is difficult, hunters usually shoot the first animal seen. This tends to select for pregnant females, which may conflict with management objectives. This study investigated whether pregnant females were more susceptible to being shot at a particular period of the season, time of day, or distance from the lodge to evaluate these criteria as a basis for selective shooting. Also, we examined the potential for using body size to selectively cull age groups. Beaver (n = 126) were shot between 13 March and 15 May, 1997-99, in southeast Norway. Neither period of the season nor time of day shot were adequate selective criteria. Pregnant females were shot significantly further away from the lodge than juveniles and averaged 2.6 times heavier. Thus hunting nearer the lodge and attempting to shoot smaller individuals may reduce the take-off of pregnant females. However, hunting in as few colonies as possible while leaving remaining colonies for recruitment should be more effective.

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Introduction

The Eurasian beaver *Castor fiber* Linnaeus, 1758 is rapidly returning to its original range throughout Europe and Asia following near extirpation (Rosell & Parker 1995, Nolet & Rosell 1998). Presently, beaver are being harvested throughout much of the former Soviet Union and in Estonia, Latvia, Lithuania, Finland, Sweden and Norway. While trapping is the only legal harvest method in the former Soviet Union (Y. Gorshkov, pers. comm.) and presently the most common method in Estonia, Latvia and Lithuania (M.M. Balodis, pers. comm.), hunting with firearms during spring is the dominating harvest form in Finland (S. Härkönen, pers. comm.), Sweden (Hartman 1999) and Norway (Parker et al. submitted). Expanding populations of beaver in Europe and Asia will eventually require population management schemes designed to reduce human conflicts and regulate harvest. In many countries, management is likely to eventually entail hunting beaver with firearms.

The selective harvest of individuals by e.g. sex and age to attain specific management goals is a cornerstone of modern population management. Selective harvest, however, requires that either morphological or behavioral differences exist between the sex and age groups that hunters and trappers can readily distinguish under field conditions or somehow employ to selectively remove individuals. The sexes of both Eurasian and North American *C. Canadensis* Kuhl, 1820 beaver cannot be distinguished by external morphological characteristics alone (Wilsson 1971, Novak 1987). Hunters are therefore unable to sex individuals before shooting. Likewise, no readily distinguishable morphological differences exist between the age groups that enable selective shooting, with the possible exception of size (Hartman 1992).

Parker et al. (in prep.) inspected beaver shot by hunters during spring. They found a higher incidence of pregnant females in 1) the hunting bag than predicted to exist in the

population and 2) among the first individuals shot in colonies than those shot subsequently. Restricting the take-off of pregnant females to optimize production will often be a management goal. In this study we inspected the frequencies of different sex and age groups in the bag in an attempt to identify behavioral differences between pregnant females and other population sub-groups that may enable hunters to shoot more selectively. We tested for differences between pregnant females and other sex and age groupings with respect to 1) their probability of being shot at different periods during the spring season, 2) mean time shot during the evening and 3) mean distance from the lodge individuals were shot. Finally, we evaluated the potential for using differences in body size to selectively harvest beaver.

Material and methods

The study was conducted in Bø Township (59°25'N, 09°03'E), Telemark County, southeast Norway during 1997-99 (Parker et al. in prep.). Beaver (n = 126) were shot by local hunters with center-fire rifles between 13 March and 15 May, most during evening. Beaver are chiefly nocturnal but often crepuscular and most hunting occurs around twilight. Hunters were instructed to shoot the first beaver that offered a good shot, and to only shoot animals that were standing in shallow water or on land, in order to simulate normal hunting procedure. The time each animal was shot was recorded. For those shot during evening, times were transformed into the number of minutes before or after sunset using standard almanac tables. The distance each beaver was shot from the lodge was estimated by hunters to the nearest 5 meters. Lodge locations were established the previous autumn during total counts of active colonies on the study area and most hunters were acquainted with these. Animals were weighed to the nearest 0.1 kg, autopsied and sexed by internal inspection of sex organs. They

were aged from patterns of tooth irruption and root closure or from counts of cementum annuli (van Nostrand and Stephenson 1964) and categorized as juveniles (young born the previous year), 2-year-olds (i.e. just short of 24 months) or adults. Pregnant females were defined as those containing at least one living fetus when shot.

A 2-tailed independent samples t-test (SPSS for Windows statistical software release 10.0) was used to test for differences between pregnant females and other sex and age groups with respect to 1) mean distance shot from the lodge and 2) mean number of minutes shot before or after sunset. The same test was used to test for differences in mean body weight between 2-year-olds, adults and juveniles. A Homogeneity test (Minitab statistical software release 12.1) was used to test for differences between the proportions of pregnant and all other beaver pooled shot during the different 2-week periods of the spring hunting season. For this test only the first individuals shot colonies were included in the analysis to insure independence of observations. Mean values are shown with ± 1 standard deviation and the limit for significance was set at $p \leq 0.05$.

Results

The proportion of pregnant females and all others shot within the different 2-week periods of the spring season did not vary significantly ($X^2 = 2.52$, $df = 3$, $p = 0.47$) (Fig. 1). Pregnant females ($n = 32$) were shot an average of 1 ± 32 minutes before sunset. Comparable values for juveniles ($n = 18$), 2-year-olds ($n = 28$) and adult males ($n = 38$) were 3 ± 40 , 2 ± 40 and 5 ± 37 minutes before sunset respectively. These means were not significantly different from that for pregnant females ($t = 0.282$, $df = 48$, $p = 0.187$; $t = 0.187$, $df = 58$, $p =$

0.85 and $t = 0.472$, $df = 68$, $p = 0.64$ respectively). Pregnant females were shot an average of 155 meters from the lodge (Fig. 2), which was significantly further away than juveniles ($t = 2.388$, $df = 42$, $p = 0.02$) though not significantly different from non-pregnant adult females ($t = 1.205$, $df = 37$, $p = 0.24$), adult males ($t = 1.679$, $df = 59$, $p = 0.10$) or 2-year-old males ($t = 1.195$, $df = 42$, $p = 0.24$).

The mean body weights of juveniles ($n = 18$), 2-year-olds ($n = 27$) and adults ($n = 80$) are shown in Fig. 3. The mean for 2-year-olds was significantly different from both juveniles ($t = 10.338$, $df = 44$, $p < 0.001$) and adults ($t = 8.796$, $df = 106$, $p < 0.001$).

Discussion

The greater susceptibility of pregnant beaver for being shot during spring hunting than others in the population (Parker et al. in prep.) suggests that behavioral differences may be the underlying cause. The increased nutritional demands of pregnancy (Robbins 1993) may induce increased foraging time and number of land visits with the approach of parturition in late May and early June, thereby increasing the probability of being shot. However, as the proportion of females in the bag did not increase significantly as spring advanced, this prediction was not supported. For similar reasons, pregnant beaver might tend to leave the lodge earlier than others and thereby be the first animal hunters see and shoot. Again, the prediction was not supported, as pregnant beaver were not shot earlier than others. This suggests that directing the hunting effort to the beginning of spring hunting, or to late in the evening, will not reduce the probability of shooting pregnant females.

The distance from the lodge that beaver were shot was of particular interest as the hunter's rule-of-thumb states that beaver seen on or near the lodge during spring are most

likely to be pregnant females. Beaver hunters often know the position of active lodges within the areas they hunt and could therefore direct hunting pressure near or away from them as desired. However, the prediction that beaver seen on or near the lodge are most often pregnant females was not supported here. On the contrary, pregnant females tended to be shot further from the lodge than other sex and age groups, the difference being significant for juveniles. A concentration of the hunting effort near the lodge might therefore tend to increase the proportion of juveniles and decrease the proportion of pregnant females in the bag.

During this study animals were shot either on land or standing in shallow water to insure both good shot placement and retrieval of the carcass. In our experience, this is also how most hunters shoot beaver, though occasionally they are shot while swimming. Most land visits by beaver at dusk during this time of year would be associated with either scent-marking or foraging behavior (Rosell et al. 1998, Rosell and Parker, pers. obs.). Swimming animals however, are neither scent-marking nor foraging, and samples of beaver shot while swimming may therefore have a different sex and age composition than those shot on land.

Juveniles averaged 39% and 54% of adult and 2-year-old weight respectively suggesting a potential for the selective harvest of juveniles based on size. However, we would expect this to be difficult, as beaver usually appear alone in the evening, in dim light, and are commonly shot at distances of 50-100 meters. Each of these conditions make relative size determination uncertain. Attempting to selectively harvest juveniles would also mean passing up shots at other animals, tending to decrease hunting efficiency. On the other hand, selectively shooting animals based on their body size is a common management practice for e.g. wild reindeer *Rangifer tarandus* and moose *Alces alces* in Norway and therefore a demand many hunters are accustomed to. Hunter ability to selectively shoot juveniles should be adequately tested before implementing juvenile quotas as a management technique.

It remains unclear why pregnant females are more susceptible to being shot during spring than other beaver. They were not shot earlier in the evening, which suggests that they do not leave the lodge earlier. However, our indirect method of measurement, i.e. comparison of mean times shot, may not have been sufficiently unbiased to establish any real differences that might exist in emergence times. Pregnant females did tend to travel further from the lodge than other beaver. We therefore hypothesize that their pursuit of better quality, and possibly more food during pregnancy leads them to more and longer land visits than other beaver, thereby increasing their susceptibility to being shot.

Management implications

Concentrating the hunting effort near the lodge and to smaller individuals may increase the proportion of juveniles shot. The most practical method of reducing the take-off of pregnant females during spring hunting, however, may be to limit the hunting effort to as few colonies as possible. Females in remaining colonies would not be exposed to hunting, leaving these colonies as sources for recruitment of new individuals to the population (Fryxell 2001). Alternatively, if the management objective is to limit the reproductive capacity of the population, as many colonies as possible should be hunted, shooting the first large animal that appears whenever possible.

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Figure texts

Figure 1. The number of pregnant beaver and all other beaver pooled shot within 2-week periods during spring 1997-99 in Bø Township, Telemark County, Norway. Proportions did not vary significantly between periods ($p = 0.48$).

Figure 2. The mean distance shot from the lodge (± 1 standard deviation) for juveniles, non-pregnant adult females, adult males, 2-year-old males and pregnant female beaver during spring 1997-99 in Bø Township, Telemark County, Norway. Pregnant females differed significantly from juveniles ($p = 0.02$) but not from the other three groups ($p > 0.05$).

Figure 3. Weight distribution of juveniles, 2-year-olds and adult beaver shot during spring 1997-99 in Bø Township, Telemark County, Norway. Means for groups are shown with ± 1 standard deviation. The mean for 2-year-olds was significantly different from each of the other groups ($p < 0.001$).