SELECTIVE HARVEST, COMPENSATORY MORTALITY AND MOOSE IN ONTARIO

David Euler

Ontario Ministry of

Natural Resources, Wildlife Branch, M7A 1W3

Abstract: In 1983 Ontario is introducing a Selective Harvest System for moose that controls the harvest of bulls and cows. Bull and cow validation tags limit the number of adult animals available, however, there are no harvest restrictions on calves. An increase in hunting pressure on calves is expected, however, an excessive calf harvest is not considered likely. Hunting mortality is assumed to be additive on adults and partially compensatory on calves. If these assumptions are wrong it will be necessary to modify the program.

Wildlife managers in Ontario have encountered, as have others in Canada, the problem of declining moose herds and a reduced kill by hunters. The best estimate suggests a 35% decline in the provincial moose population over about a 15 year period. The collective judgement of those who have analyzed the situation carefully suggests that hunting, poaching, predation and habitat loss have combined to cause the herd to decline (Bisset 1978, Thompson 1978, Chamberlin et al. 1978, Morrison 1978). Efforts to reverse the decline include remedial measures in all areas. The purpose of this paper is to discuss the rationale for introducing a Selective Harvest System and outline the assumptions behind that reasoning.

The System is similar in concept to some other Canadian provinces and Scandinavia (Stewart and MacLennan 1977, Lykke 1974). A limited number of validation tags are issued to licensed hunters for either a bull or cow in specific wildlife management units, however, resident hunters can shoot calves without a validation tag in any unit. Only one animal is permitted per hunter. Thus, if a hunter holding a bull or cow tag shoots a calf first, he cannot shoot a bull or cow. Bull and cow permits are drawn at random from applications made by residents of Ontario. Applicants not receiving a bull or cow permit can hunt calves.

The tourist industry has been allocated 10% of the harvest of bulls and cows and non-residents must hunt with a tourist outfitter. Outfitters are allocated a specific number of validation tags which they supply to hunters who have agreed to use their facilities. Non-residents may also hunt calves using the services of an outfitter. Non-resident landowners and immediate relatives of Ontario residents are eligible to participate in the resident draw for adult validation tags.

This system was chosen after extensive debate and following attempts to limit the kill by shortening seasons and restricting hunters to 1 moose per 2 hunters. For numerous reasons, a program proposal limiting numbers of hunters in order to limit the kill was not acceptable to the hunting public and caused administrative problems. Therefore a system was found that would allow everyone the opportunity to hunt and which would prevent an over-harvest. A review of the options available was conducted before the final decision to adopt the Selective Harvest System was made.

Several questions had to be answered before this approach was accepted. First, would increased hunting pressure on calves be detrimental to the population? Second, would compensatory factors occur following the hunt to reduce the impact of hunting mortality and third, would non-compliance by hunters undermine the entire system?

INCREASED HUNTING PRESSURE ON CALVES

In the first year of the Selective Harvest System about 88,000 hunters applied for approximately 38,000 bull and 12,000 cow permits. In addition the tourist industry received about 3,000 bull and cow tags. Thus, about 53,000 hunters, on a provincial basis, will be licensed in 1983 for adult animals and the rest for calves. Some cooperative or "party" hunting is expected although how much and how effective it will be is unknown. Also, some hunters with licences may choose not to hunt at all and this of course will influence the final outcome.

There is little doubt that more people will be hunting calves than in previous years. In Ontario, however, calves rarely constitute more than 25% of the hunted herd and normally are in the 10-15% range or less. Hunter success rates, on a Provincial basis, are usually also in the 10-15% range. Therefore, of the potential 88,000 hunters, on average, only 10-15% will encounter a moose long enough to harvest it. On a broad probability basis less than 1 in 4 of these moose will be calves. Since most adult permit holders will attempt to harvest an adult, some will pass up the opportunity to shoot a calf. The net end results seems acceptable from a provincial population of 70-80,000 animals. Because they are less available and

not all hunters will be hunting them, the risk of an over-harvest of calves seems low. In addition, Crete et al. (1982) and Sylven et al. (1979) demonstrated that mortality on calves can be quite high without detriment to the population. Law (1979) also provides mathematical and theoretical support to the concept of selective harvest mortality on young age classes.

There may of course be exceptions to the general rule. Certain areas may have unusual hunting or predation pressure and local populations of calves may be hard-hit. If that happens, more restrictive measures may have to be taken. The risk of over-harvest. however, seems acceptable in the first year because the worst possible scenario will not produce irreparable damage.

COMPENSATORY AND ADDITIVE MORTALITY

The second problem concerns the role of compensatory mortality in the management process. This is a difficult concept and also incompletely understood. In this paper, compensatory mortality depends on the events which occur after animal predators, hunters or other agents remove animals from a population. If other mortality or natality factors "compensate" and fewer animals die or more are born in the period following the kill, than would have died or been born in the absence of the predation loss, then the original mortality was compensated for and is called compensatory.

In contrast, additive mortality occurs when the predator kill is "added" to other types of mortality and the population does not make-up for this loss. The key idea is that the population is not able to change mortality rates, birth rates or some other factor to compensate for the loss. The type of events which occur are often subtle and are

not always simple addition or subtraction. Shooting a cow in the fall for example, may mean that her calf will not live through the following winter because the adult is not there for protection. Further, offsprings of young females may not have the same probability of survival as offsprings of older females. Shooting an experienced female may have more impact on the population in later years than shooting an inexperienced female.

Research Evidence for Compensatory and Additive Mortality

There is no doubt that, under some circumstances, compensatory mortality exists in wildlife populations. Davis et al. (1964) demonstrated with two woodchuck populations, one hunted heavily and one not hunted, that the number of animals present at the end of the experimental period was equal in both groups. Mortality, natality, and movement patterns in the hunted population changed to help compensate for the increase in killed animals. The result was a hunted population equal in size to the unhunted population. Gullion (1972) has shown that ruffed grouse populations can be heavily hunted in the fall and will often remain at about the same level as when not hunted. In mallards, Anderson and Burnham (1976) demonstrated that hunting mortality is in part additive and in part compensatory.

Most research on this subject has investigated the impacts of animal predators on their prey. Errington (1956) for example, studied muskrats and mink for many years and espoused the idea that predation was almost entirely compensatory. He believed that predators removed surplus animals doomed to die anyway. Most recently Haber (1977) and Haber and Walters (1980) have developed theoretical concepts which address the same question. They believe that predation may act in an

additive way when prey are at low densities but tends to be compensatory at higher prey densities. They suggest this applies to hunters and other animal predators.

Connelly (1978) provides a review of recent literature concerning the effects of predators on prey animals. He produced two tables, one lists studies reporting that predation was limiting or controlling ungulates (i.e., additive mortality is occuring and is controlling the situation to some extent). The second lists studies showing that predators do not limit numbers of ungulate prey, (i.e., predation is largely compensatory). After reviewing these papers the only conclusion possible is that sometimes predator mortality on ungulates is compensatory and sometimes it is not.

The Canadian Committee on Ungulates Management polled Canadian wildlife managers prior to the Federal-Provincial Wildlife Conference in 1982 about their attitudes toward additive vs compensatory mortality (Eastman and Hatter 1983). As might be expected, opinions varied widely with most jurisdictions making decisions on the basis that hunting mortality is additive, not because they knew it was additive, but because that was a safe decision and less likely to cause mistakes in seasons or kill quotas.

Moose, Wolves and Hunting

In Ontario, where wolf populations are largely unhunted and naturally regulated, the interactions among wolf predation, hunting and moose population dynamics are also a concern. Gasaway et al. (1983) pointed out that predation by wolves can exert substantial control over moose populations in some circumstances. Predation may,

they report, impact substantially on young and adult animals and thus limit the population through recruitment and high losses of adults. Further kill by hunters can reduce moose/wolf ratios thus complicating the effect of predation on the moose population.

In two experimental areas in Ontario, Wildlife Management Units 23 and 31, the moose population appered to increase following reductions in hunting pressure (Table 1). If wolf predation was limiting the moose population in those two areas, the change in hunting pressure should have had no impact on the moose population. While these increases are not large, they suggest an increasing trend in population numbers. Wolf predation may not have been a significant problem in this area at this time.

Table 1: Changes in hunter numbers, hunter harvest, and moose population estimates for moose in Wildlife Management Units 23 and 31 in Ontario

Unit 23	Number of Hunters	Number of Moose Harvested	Population Estimate
1977	1315	171	
78	1495	239	1400 ± 280*
79	900	104	
80	1018	107	
81	954	137	
82	971	147	1762 ± 352*
Unit 31			
1977	2505	277	1168 ± 385*
79	2693	214	1048 ± 273*
79	2712	272	
80	1539	148	1157 ± 359*
81	1452	141	
82	1428	206	1571 ± 314*

*(90% confidence limit, ** see appendix)

Moose Production and Selected Harvest

An adult female moose has a life span of about 8 or 10 breeding years. This is probably a conservative figure because cases of moose reproducing at 18 or 19 years are not uncommon in Ontario. During that time, if the cow successfully bears and raises 2 moose to prime breeding age then she will have replaced herself and her mate and could die without decreasing the original population. Because mortality is high on calves, cows produce, over their life time, several more than are necessary to replace themselves. By inference the most likely place for compensation to occur then is the calf component. After an animal reaches adulthood it has undergone a selection process and the probability of surviving another year is much higher than the probability that a calf will survive another year.

There is no unequivocal research evidence that hunting mortality on moose calves is compensatory or additive. Further, in some years and in some locations, hunting may be additive while the opposite is true of other times. Based on the evidence available in circumstances involving ungulates and predation, however, compensating factors may play a part in moose ecology on calves in some cases.

HUNTER COMPLIANCE

The third problem concerns hunter compliance with the Selective Harvest System. If hunters cooperate, the theory and assumption behind the system seems workable. If hunters do not cooperate, of course, and large scale poaching or illegal hunting occurs then the entire system will fail. This is true of any regulation system,

however, and compliance by most hunters is expected. If it does not happen, further management activities will be required.

SUMMARY OF IDEAS BEHIND SELECTIVE HARVEST

1. Predictable control over the kill of adult moose will be achieved and can be kept at a planned and acceptable level, (in the absence of clear evidence this assumes that the adult hunting kill is additive).

2. The risk of over-harvest of calves, due to increased hunting pressure is acceptable because the probability that hunters will encounter enough calves to achieve an over-kill seems remote. Further the calf segment of the population can accept a higher mortality rate than other age classes and compensatory mortality, if present in moose, will most likely be present with the calf component.

3. If hunting pressure on calves becomes excessive then further control of the kill will have to be considered.

4. Although predation is a concern, it does not appear to be currently limiting moose population in Ontario.

SUMMARY

No wildlife management decision is free from the possibility of error. In this case, a management decision was made using the facts available, modified by political realities, and accepting a certain risk of being wrong. At this time the decision seems correct, however, only results from application of the system will determine its impact on the moose population.

If the calf harvest becomes too high, then steps to change hunting pressure on calves can be taken. The steps could be taken in stages, perhaps by first restricting hunters hunting calves-only to their choice of W.M.U. or by establishing quotas of calves per unit. The idea of selective harvest is to control the kill of the animals selectively. Thus it is an acceptable risk to allow higher pressure on calves than adults at first because the probability of an over-kill is low. If that decision is wrong, control can come at a later step. If the decision is correct thousands of people who would not have been allowed to hunt will be able to participate. The basic idea is selective harvest, i.e., selectively removing animals. The long term plan is to apply the system carefully, one step at a time, and learn as the evidence comes in. That will benefit both the moose herd and hunters of Ontario.

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APPENDIX

Aerial survey of moose is always difficult because of the wide nature of the confidence limits and the problems of missed moose (see Gasaway et al. 1983). In addition, in Table 1, the last number representing moose present in Unit 31 in 1982 was obtained using a helicopter while the others were obtained using fixed wing aircraft. Thus these figures must be seen as trend data, cannot be taken as exact numbers and do not permit vigorous statistical analysis.

The conclusion from these data is not that reduced hunting was responsible for an increase in moose. That conclusion would require an adequate control area which was not available. Instead the hypothesis, were predators responsible for the decline is tested. If predators were keeping moose numbers down, then a reduction in hunting would result in no change. The numbers in Table 1 suggest that a change in moose numbers probably occurred, thus the hypothesis that predators were responsible for keeping the moose herd down cannot be accepted from this evidence.