

MOOSE HUNTERS' PERCEPTIONS OF FOREST HARVESTING

Réhaume Courtois¹, Jean-Pierre Ouellet², and Anne Bugnet²

¹ Société de la faune et des parcs du Québec, Direction de la recherche sur la faune, 675 René-Lévesque Est, 11^e étage, boîte 92, Québec, PQ, Canada G1R 5V7; ² Département de biologie, Université du Québec à Rimouski, 300 Allée des Ursulines, Rimouski, PQ, Canada G5L 3A1

ABSTRACT: Ecosystem management takes into account all components of ecosystems, including people. In this context, an improved knowledge of moose (*Alces alces*) hunters' preferences and perceptions is a prerequisite to the implementation of ecosystem management in the boreal forest. In Québec, they are one of the most important and one of the most influential groups of outdoor recreationists. In an area subject to intensive forest harvesting in Northwestern Québec, >90% of hunters interviewed ($n = 188$) identified camaraderie, presence of a natural environment, and high moose density as the most important criteria in determining the location of hunting areas. Over 60% of hunters thought that forest harvesting systems used within their hunting areas were inappropriate. Hunters wanted restrictions on size of cutovers, increased proportion of residual forest, adaptation of cutovers into landscape features, reduction in woody debris, and increased width of forested buffer strips along lakes, watercourses, and around hunting camps. Few differences were noted between hunters with or without cuts within their hunting areas or between hunters in vehicles and those who hunted from camps, suggesting that hunters' perceptions were also influenced by sociological parameters external to the hunting experience. Satisfaction with respect to the hunting experience depended upon the number of moose seen and killed, age of hunters, and presence of cuts within the hunting areas. These results are interpreted in the context of forest ecosystem management.

Key words: beliefs, clear-cuts, cutting, ecosystem management, forest management, hunting, knowledge, logging, motivation, perception, sociological profile

RÉSUMÉ: La gestion écosystémique vise à prendre en considération toutes les composantes de l'écosystème, y compris les humains. Dans ce contexte, une meilleure connaissance des préférences et des perceptions des chasseurs d'orignaux (*Alces alces*) semble un prérequis important pour la gestion de la forêt boréale. Au Québec, ceux-ci constituent l'un des plus forts contingents d'usagers de la forêt et l'un des groupes les plus influents. Dans un site d'étude fortement utilisé pour l'exploitation forestière dans le nord-ouest du Québec, >90% des chasseurs interviewés ($n = 188$) ont identifié la camaraderie, la présence d'un environnement naturel, et de fortes densités d'orignaux comme les principaux critères considérés lors du choix de leur site de chasse. Plus de 60% des chasseurs pensaient que les techniques d'exploitation forestière utilisées dans leur site de chasse étaient inadéquates. Ils désiraient des coupes de plus petite superficie, une plus forte proportion de forêt résiduelle, des coupes aux contours adaptés aux caractéristiques du paysage, une réduction des débris ligneux, et des lisières boisées plus larges le long des plans d'eau et des camps de chasse. Peu de différences ont été notées en fonction de la présence ou de l'absence de coupes dans le site de chasse ou entre les chasseurs en véhicules ou ceux qui chassaient à partir de camps de chasse. Ceci suggère que la perception des chasseurs est aussi influencée par des paramètres sociologiques externes à la chasse. La satisfaction pour l'activité de chasse dépendait du nombre d'orignaux vus et récoltés, de l'âge des chasseurs, et de la présence de coupes dans le territoire de chasse. Ces résultats sont interprétés dans le contexte de la gestion écosystémique.

Mots-clés: aménagement forestier, chasse, connaissance, coupe totale, croyance, exploitation forestière, gestion écosystémique, motivation, perception, profil sociologique

ALCES VOL. 37 (1): 19-33 (2001)

Forest management has evolved through 4 phases of increasing sophistication: an exploitive phase with few considerations for resource sustainability, an administrative phase characterized by simple regulations mostly oriented through the promotion of fibre production, an ecologically-based phase that followed a better understanding of forest ecosystems and, finally, a socially-oriented phase characterized by an increased involvement of individuals and organizations in resource management decisions (Gilmore 1997). This last phase, usually referred to as ecosystem management, is currently seen as the most promising means to assure sustainable use of natural resources while minimizing conflicts between users. However, implementation of ecosystem management is complex because it requires information on all components of an ecosystem, including people (Grumbine 1994). Unfortunately, biologists and foresters tend to concentrate on what they do best: understanding the needs of wildlife and forests, but too often neglecting the human component of ecosystems. While scientifically acceptable, it is not surprising, for example, that clear-cuts, could experience fierce opposition. A better understanding of the needs of users, namely that of the forest industry and that of outdoor recreationists is essential to propose socially acceptable management measures (Eastman 1973, Morton et al. 1995).

The needs of the forest industry involve profitable timber production and acceptable rates of return on capital while at the same time fulfilling environmental obligations (Anonymous 1994). Forest management practices that ensure adequate regeneration were developed in accordance with the sustainable yield concept in order to meet these objectives over the short and long term (Barrette et al. 1996). Concerns about wildlife populations in the 1960s and 1970s have resulted in the establishment of sev-

eral forest harvesting guidelines, including forest buffers around lakes and watercourses, cut-size restrictions, forested corridors between adjacent cutovers, and residual forests within cutovers. Such logging guidelines are aimed toward protecting water quality, maintaining minimum cover for terrestrial wildlife over the short-term, and favouring the establishment of diversified forest stands over the long-term (Eastman 1973, OMNR 1988, MER 1989).

People's values and motives also must be included in the forest planning process (Schroeder 1996). Previous studies were aimed at determining the motivations of big game hunters in order to optimize game management strategies. These studies have demonstrated that hunters seek a variety of types of satisfaction (Rollins 1987, Decker and Connelly 1989) and 3 broad categories of hunters have been identified (Decker and Connelly 1989): (1) affiliative-oriented hunters primarily seek the company of friends and relatives; (2) achievement-oriented hunters search for self-accomplishment through discovery, working with equipment, and/or obtaining meat or a trophy; and (3) the most common are appreciative-oriented hunters, who practice outdoor activities because they want to be in a peaceful and familiar environment in order to escape routine and stressful situations.

Other research has dealt with economic impacts of moose hunting (Bisset 1987, Bluzma 1987, Condon and Adamowicz 1995), economic values of different forest stand types and depreciation of outdoor recreationists' perceptions due to wildfires, forest cutting, and proximity of hunting areas from hunters' residences (Condon and Adamowicz 1995; Morton et al. 1995; Boxall et al. 1996a, 1996b; Adamowicz et al. 1997). While primarily oriented towards the development of adequate sampling methodology, these studies have shown the prime importance of natural landscape, reduced contact

with other recreationists, improvement in game numbers, and the negative impact of habitat modification on the value recreationists place upon a specific area.

To our knowledge, there have not been studies to determine how forest harvesting influences moose hunters activities or how forest practices could be modified to minimize the impact on sport hunting. Both positive and negative outcomes can be predicted. For example, although roads created by the forest industry allow easier access to hunting areas, improved access could increase the number of hunters into a specific area, thus creating competition for a limited number of available moose in a specific area and contribute to crowding of hunters. Crowding and the modifications to the natural landscape by forest activities both diminish the satisfaction of appreciative-oriented hunters.

Hunters objectives must be understood in order to provide a fulfilling recreational activity. Only direct questioning of the participants can assess such psychological evaluation (Heberlein 1992). In this study, our objective was to determine if changes in forestry practices were required to maintain hunter satisfaction and, consequently, their continued participation in moose hunting. We collected information: (1) on moose hunters' preferences for specific hunting areas; (2) on hunters' perceptions of current forest harvesting practices; and (3) on the overall satisfaction of the hunting experience. We then assessed whether moose hunters' preferences and perceptions were influenced by the presence of clear-cuts, by specific demographic factors, or by hunting success. Using this information, we suggest forestry guidelines and hunting management changes that could harmonize hunters' needs and those of the forest industry. This work was part of a larger study that aimed to determine the short-term impact of forest harvesting on several wildlife species

and people (Potvin et al. 1999).

STUDY AREA

The study was conducted in North-western Québec in a 2183-km² area of boreal forest subject to intensive logging. The forest was dominated by black spruce (*Picea mariana*) and jack pine (*Pinus banksiana*) stands, but mixed stands composed of balsam fir (*Abies balsamea*), paper birch (*Betula papyrifera*), and trembling aspen (*Populus tremuloides*) also were present.

The west-central section of the study area was dominated by clear-cuts, aged 7 - 11 years. Forested strips 40 - 60 m wide were maintained along primary watercourses and lakes. Size of cutovers were not restricted and advanced regeneration was not protected. Clearcutting with protection of advanced regeneration was practised in the northern and southeastern parts of the study site during the last 2 years of the study. In these cuts, 3 to 10-ha residual stands occupied 4% of the cut areas, and 20-m forested strips were maintained around all lakes and other watercourses. Cutover size was limited to 250 ha, and cutovers ≥ 100 ha were separated by 60 - 100 m forested buffer zones. Advanced natural regeneration was protected by using the same trails for harvesting and hauling timber. In cut areas, the landscape was drastically modified by logging. All commercial (≥ 9 cm) conifer and trembling aspen trees had been removed. Residual trees, usually white birch, were sparse.

The west-central and the southeastern parts of the study area were easily accessible by road while the northern portion was accessible only by water. During the 16-day hunting season, hunting pressure varied between 1.9 and 11.5 hunter days/km², depending on the part of the study site (Courtois and Beaumont 1999). Generally, hunting pressure was greater near urban

areas and where moose densities were the highest. After aerial surveys, moose densities varied between 0.1 / km² and 0.6 / km², depending on the part of the study area (Courtois and Beaumont 1999).

Two categories of hunters frequented the study site: hunters in vehicles, and hunters staying at camps. The former travelled slowly along forest roads in vehicles on a daily basis (average duration of the activity: 1.2 days) and most often 2 people per vehicle without any artificial means (seats on truck, etc.) to improve visibility. Hunters who hunted from camps were much less mobile. They travelled to a base in the forest (camp, trailer, or tent) and hunted from this site for the entire duration of their stay (average: 5.5 days), mainly in groups of 3-4 hunters. A map of the study site is available in Courtois and Beaumont (1999).

METHODS

Data were obtained by intercepting all vehicles leaving the study site, regardless of whether or not the hunters had killed a moose. In a preliminary study in 1991, we distributed written questionnaires with pre-stamped return envelopes at the opening of the hunting season. This technique was abandoned due to a very low rate of return and replaced with direct interviews on the study site. Surveys were conducted during the firearm hunting season (12-27 October, 1992) at 3 registration stations between 08:00 and 18:00 hours. In addition, stations remained open until noon on 28 October in order to survey hunters who departed following the close of the season. Following a brief description of the purpose of the study, the interviewers asked the vehicle drivers to respond orally to the questionnaire. To avoid any auto-correlation in the data, only one questionnaire was filed per group. On some occasions, the interviewed hunters consulted their partners to solicit their opinions. Such hybrid answers could differ

from individual responses, but we observed that hunters' perceptions were firmly set, judging from the rapid answers that they usually provided.

The questionnaire contained 6 sections that had been developed from interviews with regional wildlife managers. The first section included background information (i.e., portion of the study area frequented, presence of cuts in the hunting site as observed by the hunter, date), specific demographic questions (category of hunter [camp, vehicle], age, hunting experience, time invested in preparing for the hunting trip), harvest statistics (number of hunting days, moose, and small game harvests), and hunter's knowledge of the particular hunting areas (years hunting in that hunting area). The second section sought information on preferences (accessibility, visual aspect of the environment, noise, camp, trails, tree stands, moose abundance) about the choice of hunting areas. Parts three and four of the questionnaire dealt with hunters' perception of the impacts of logging and the actual logging methods employed. The fifth part attempted to determine the beliefs of hunters about limiting factors of moose populations (hunting, predation, poaching, and logging). Finally, hunters were invited to make an overall assessment of their hunting experience. Hunters' perceptions and beliefs were assessed with direct statements (e.g., logging has caused a reduction in moose numbers) and answers were recorded on a 5-point Likert scale (Rollins and Romano 1989) ranging from strongly agree (1) to strongly disagree (5). The respondent was given a sheet with the Likert scale to more easily and more consistently code answers. The interviewers read the question, then recorded the oral answer on the questionnaire.

Questions on hunters' preferences, perceptions, beliefs, and overall satisfaction were the dependent variables that we tried

to explain by the presence of clear-cuts, hunter category, specific demographic factors, number of moose seen, and hunting success for moose and small game (independent variables). We used the *G* statistic to assess changes in hunters' preferences, perceptions, beliefs, and satisfaction according to the category of hunters and the presence of cuts within the hunting areas. Hunters' overall satisfaction was then correlated with harvest of small game, number of moose seen, as well as age of the respondent, hunting experience (years), and knowledge of the hunting area (years frequented). Spearman's rank correlation was employed because this coefficient is well adapted to monotonic ordinal scale data. Given the large number of comparisons, only correlations with $P \leq 0.01$ were deemed significant.

On several occasions, more than one group was present at the same time for registration, thus limiting our ability to interview all groups due to restricted manpower and budget. However, all groups that were interviewed agreed to answer the questionnaire. Because interviews were conducted outdoors along forest roads, names and addresses of non-respondents were not available and a test for non-response bias was impossible.

RESULTS

Choice of Hunting Areas

One hundred and eighty-eight groups of hunters were interviewed, representing 34% of the 380 groups that frequented the study site in 1992. The choice of specific hunting areas seemed to be based upon a number of sociological, biological, and environmental factors. The most important criteria were presence of a natural environment (i.e., quality of the landscape), high moose density (tracks and animals seen), and above all, to be part of a group that gets along well together. Over 90% of respondents ($n =$

188) strongly agreed or mostly agreed with these points (Table 1). Other factors that were important ($\geq 85\%$ agreement) included having a comfortable camp, a secluded site (i.e., few other hunting parties and hunting camps), a good possibility of harvesting a moose, and good maintenance of the hunting areas (i.e., trails and tree stands). Preferences did not differ among hunters with respect to the presence or absence of cuts in their hunting areas. However, a higher proportion of hunters in vehicles (63%) than hunters from camps (42%) preferred easily accessible hunting areas ($P < 0.01$).

Impacts of Forest Harvesting

Hunters considered that the most important impacts of logging were deterioration of the natural landscape and increased number of hunters, with 77% of hunters agreeing or strongly agreeing with these two statements (Table 2). Increased accessibility to the site, greater vulnerability of moose to predators, and reduction of moose numbers were also noted by more than 60% of hunters. Deterioration of the natural landscape as a result of logging was more frequently mentioned ($P < 0.01$) by hunters who frequented hunting areas where cuts had been made recently compared to hunters in areas where no cutovers occurred (84 vs. 66%). The former were also more likely to express opinions that logging increased the vulnerability of moose to predators (67 vs. 62%) and that forest harvesting produced good deciduous regeneration (67 vs. 48%). More persons who hunted from vehicles than from camps ($P < 0.01$) perceived improved access to hunting areas (86% vs. 59%), and a reduction in moose numbers (88% vs. 64%) following cutting.

Forest Harvesting Methods

The majority of respondents (64%) disagreed or strongly disagreed that cutting

Table 1. Preferences of moose hunters in their choice of hunting areas in Northwestern Québec after a survey conducted in 1992.

Statements	Percentage of hunters (185 ≤ n ≤ 188) ¹					Statistical Comparisons ²
	Strongly Agree		Disagree		Strongly Disagree	
	Agree	Neither agree nor disagree	Agree	Disagree		
The hunting area should be easily accessible by road or water	53	17	5	7	18	N.S. ³
The entire hunting area should be accessible (roads, trails, ATV)	38	9	10	19	24	Vehicle > Camp
The landscape should be as natural as possible	91	5	3	1	0	N.S.
There should be little noise (e.g., forest workers, vehicle, hunters)	85	5	3	2	5	N.S.
There should be few hunters	74	11	7	3	5	N.S.
There should be few other hunting camps	76	11	8	2	3	N.S.
The hunting camp should be comfortable	80	10	6	3	1	N.S.
The group of hunters should get along	96	3	1	0	0	N.S.
The hunting area should be maintained (trails, tree stands)	70	15	7	2	6	N.S.
There should be a lot of moose (tracks, sightings)	78	14	4	2	2	N.S.
One should have a high chance of success in killing a moose	69	17	5	5	4	N.S.

¹ Some questions were occasionally left blank.² Statistical comparisons (1) between hunters from camps and hunters in vehicles, and (2) between hunters in areas with or without cutovers.³ No significant difference at $P < 0.01$.

Table 2. Perceptions of moose hunters with respect to impacts of forest harvesting in Northwestern Québec after a survey conducted in 1992.

Statements	Percentage of hunters (180 ≤ n ≤ 188) ¹				Statistical Comparisons ²	
	Strongly Agree	Agree	Neither agree nor disagree	Disagree Strongly Disagree		
Direct experience						
Improved access to the hunting area	51	15	7	8	19	Vehicle > Camp
Deteriorated the natural landscape	67	10	7	6	10	Cut > Uncut
Disturbed hunting experience because of noise	47	12	21	6	14	N.S. ³
Led to an increase in number of hunters	67	10	7	4	12	N.S.
Forced hunters to relocate their facilities (camps, tree stands, trails)	28	11	30	7	24	N.S.
Facilitated detection and harvesting of moose (sightings, tracks)	28	19	17	9	27	N.S.
Opinion						
Increased browse for moose (young deciduous)	39	14	17	14	16	Cut > Uncut
Caused a reduction in moose numbers	49	14	12	7	18	Vehicle > Camp
Facilitated predation of moose due to lack of escape cover	47	16	20	7	10	Cut > Uncut

¹ Some questions were occasionally left blank.

² Statistical comparisons (1) between hunters from camps and hunters in vehicles, and (2) between hunters in areas with or without cutovers.

³ No significant difference at $P < 0.01$.

methods employed around their hunting areas were acceptable (Table 3). The main reasons cited were insufficient residual forest (72% disagreed or strongly disagreed that residual forest was adequate), cutovers too large (68%), poor landscape-adapted forest management (64%), too narrow buffer strips around lakes and watercourses (61%), and excessive woody debris in cut areas (60%). Hunters in cutover areas perceived better deciduous regeneration than hunters in natural landscapes (67% vs. 48%). More hunters from camps than hunters in vehicles ($P < 0.01$) considered that buffer strips along watercourses (29% vs. 23% agreement), woody debris left in cuts (31% vs. 16%), and buffer strips around camps (21% vs. 10%) were adequate. However, a higher proportion (65% vs. 47%) of hunters in vehicles perceived conifer regeneration as sufficient.

Limiting Factors of Moose Populations

Poaching was considered the most important limiting factor of moose populations (87% agreement) but other factors proposed in the questionnaire were also implicated: hunting by 64% of respondents, and predation and logging by 61% of hunters surveyed (Table 4). No significant differences were noted between the categories of hunters or between those with or without cuts within their hunting areas.

Only 46% of respondents were satisfied or very satisfied with their hunting experience. Overall satisfaction with their hunting experience was 41% for hunters that used an area that was recently cut (< 10 years) as compared to 63% for hunters in uncut areas ($P < 0.01$). Hunter satisfaction was positively correlated with number of moose seen and killed ($r = 0.438$ and $r = 0.468$ respectively, $P < 0.001$). Moose hunters, particularly those using vehicles, hunted grouse. However, satisfaction was not correlated with hunting success for

ruffed grouse (*Bonasa umbellus*; $r = 0.115$, $0.10 < P < 0.20$) or spruce grouse (*Falcapennis canadensis*; $r = 0.136$, $0.05 < P < 0.1$). Overall satisfaction was positively correlated with age of hunters ($r = 0.195$, $0.005 < P < 0.01$). Other independent variables were not correlated with hunter satisfaction.

DISCUSSION

In debates over forest management, arguments inevitably arise over how people should interact with nature and with each other. Gerlach and Bengstron (1994) stated "both supporters and opponents of ecosystem management call for people and their needs to be considered in environmental and natural resource management decisions". Different groups likely have different motivations which must be explicitly expressed to avoid misunderstandings and unsatisfactory management decisions. Our results suggest that moose hunters are more likely to be appreciative- and affiliative-oriented, a situation that seems widespread among big game hunters (Rollins 1987, Decker and Connelly 1989, Rollins and Romano 1989). The most important attributes in the choice of hunting areas include the ability of groups of hunters to get along well together and their pleasure of being in natural environments. Most hunters judged these criteria more important than the challenge of stalking moose or the desire for meat (Decker and Connelly 1989). Increased accessibility (e.g., roads), often seen by foresters as a major positive influence of forest harvesting, was the least important criterion for moose hunters in their choice of hunting areas.

Perceptions Regarding the Impacts of Forest Harvesting

As in previous studies (Morton et al. 1995), most hunters interviewed in this study had an overall negative perception of forest

Table 3. Hunters' perception regarding forest harvesting methods employed in their hunting area in Northwestern Québec after a survey conducted in 1992.

Statements	Percentage of hunters ($183 \leq n \leq 188$) ¹					Statistical Comparisons ²
	Strongly Agree		Disagree		Strongly Disagree	
	Agree	Neither agree nor disagree	Disagree	Disagree		
Cutting methods are acceptable	14	11	11	20	44	N.S. ³
Cutover sizes are acceptable	10	10	12	19	49	N.S.
Shape of cutovers are adapted to the landscape	11	10	15	20	44	N.S.
Lake and watercourse buffer strips are adequate	16	14	9	22	39	Camp > Vehicle
Sufficient residual forest remains after cutting	11	7	10	21	51	N.S.
There is little woody debris left in cutovers (waste)	14	14	12	16	44	Camp > Vehicle
Buffer strips around camps are adequate	10	10	24	19	37	Camp > Vehicle
Cuts are well distributed over the landscape	15	12	27	14	32	N.S.
There is good conifer regeneration	29	24	16	12	19	Vehicle > Camp
There is good deciduous regeneration	44	18	12	14	12	Cut > Uncut

¹ Some questions were occasionally left blank.

² Statistical comparisons (1) between hunters from camps and hunters in vehicles, and (2) between hunters in areas with or without cutovers.

³ No significant difference at $P < 0.01$.

Table 4. Beliefs of moose hunters related to limiting factors of moose populations in Northwestern Québec after a survey conducted in 1992.

Statements	Percentage of hunters (n = 188)				Statistical Comparisons ¹
	Strongly Agree	Agree	Neither agree nor disagree	Disagree Strongly	
Hunting decreases moose numbers	47	17	8	11	N.S. ²
Predation decreases moose numbers	42	19	16	9	N.S.
Poaching decreases moose numbers	75	12	5	3	N.S.
Logging decreases moose numbers	40	21	9	21	N.S.

¹ Statistical comparisons (1) between hunters from camps and hunters in vehicles, and (2) between hunters in areas with or without cutovers.

² No significant difference at $P < 0.01$.

harvesting. Over three-quarters of the hunters considered that logging negatively affects the landscape. Clear-cuts had a major negative visual impact, and aesthetic changes to the landscape could influence moose hunters who were looking first and foremost for pristine sites. This negative aspect was accentuated further by the presence on the ground of woody debris which hunters considered wasteful.

Increased access has been cited as a positive by-product of forest cutting (Morton et al. 1995) but may not be perceived as a positive factor by all moose hunters. In our case, improved access was seen positively more frequently by hunters in vehicles than by those hunting from camps. These latter individuals do not necessarily rely on roads to travel to their hunting areas. In many parts of the study site, hunters could use navigable waterways to reach their base-camp in the forest. In other areas, aircraft can be used (Gingras et al. 1989). Moreover, only 47% of respondents considered access to all parts of their hunting area important, which concurs with other studies indicating that road quality was not a real concern to moose hunters (Boxall et al. 1996a).

Hunters in vehicles explored the network of accessible roads and trails on a daily basis (Courtois and Beaumont 1999). Movements of hunters increased contact between unrelated hunting parties, diminishing peacefulness and adding to competition among hunters for the limited number of moose available. To improve perceived hunting quality, reduced crowding seems as important as game density and more important than actual game harvest (Heberlein 1992, Morton et al. 1995, Boxall et al. 1996a). For these reasons, many hunters staying at camps prefer sites offering little terrestrial access.

A slight majority of hunters (53%) perceived positive impacts of logging, such as

increased production of deciduous browse, an important food of moose. Although deciduous trees are rather good competitors within openings created by timber harvesting, a 5 to 15-year time lag is required to create good moose habitat (Vallée et al. 1976). Perhaps hunters' perceptions were strongly influenced by very recent cuts or alternatively the establishment of deciduous species may not yet be apparent in many hunting areas.

Several hunters indicated that logging decreased moose numbers and increased vulnerability to predators, a situation also reported in the literature (Girard and Joyal 1984, Joyal 1987). This opinion, which was more frequent among hunters whose hunting areas had been cut, can undoubtedly be explained by the perceived loss of shelter and cover for moose (Eason et al. 1981, Girard and Joyal 1984, Joyal 1987).

Perceptions of hunters did not differ greatly according to whether or not logging operations had recently been carried out in their hunting area. The general perception of cutovers was negative by most hunters. Hunting experience may be only one of the determinants of hunter attitudes about forestry practices. Other societal factors (socialization, media, education level, etc.) probably also have influenced perception of hunters.

Satisfaction of Hunters Regarding the Hunting Experience

Overall hunter satisfaction regarding the hunting experience was particularly low for a coveted activity such as moose hunting, a sport practiced by 130,000 people each year in Québec (Courtois and Lamontagne 1999). This situation could be attributed to several factors. First, overall satisfaction of the hunt was significantly lower for hunters that used a site that was recently cut, a situation that affected 75% of the hunters interviewed. Satisfaction

also depended upon the number of moose seen and harvested, and these parameters were fairly low in our study site (3.2 moose seen and 0.4 moose killed / 100 hunting days). The importance of the number of moose seen to overall hunter satisfaction is consistent with other studies (Decker and Connelly 1989, Rollins and Romano 1989) and is not surprising here since moose are of primary interest to hunters. The availability and harvest of small game did not appear to contribute to moose hunter satisfaction. In particular, hunters staying at camps harvested very few small game species to avoid any activity (e.g., gunfire noise) that might diminish their chances of seeing moose.

This study also revealed that overall satisfaction with respect to their hunting experience increased with age of hunters. As hunters become more experienced and more mature, they tend to be more appreciative-oriented and less achievement-oriented (Decker and Connelly 1989). Older hunters also may be specialized in their recreation and thus may actually place little value on harvesting an animal (Bryan 1977, Ditton et al. 1992). These hunters see hunting more as a chance to be out in nature than as an opportunity to bring home a moose or trophy. Older hunters may have more time at their disposal than do younger hunters and they likely place less importance on having the hunting trip pay off quickly with a harvest. Moreover, several studies have shown that income tends to increase with age and that increased income fosters a greater participation in (Statistics Canada 1978, David and Genest 1984) and more satisfaction with (Gauthier and Gignac 1995) recreational activities. This is likely the case for moose hunting, as it is a relatively expensive activity to participate in (equipment, travel, license, etc.). However, other authors have found that participation in recreational activities declines with age (Statistics Canada 1984), particularly in

activities associated with wildlife (IQOP 1985). It is likely that older hunters who were dissatisfied with previous hunting experiences had already ceased this activity (Rollins and Romano 1989), which might explain why most of the older hunters who were still hunting were generally satisfied.

Management Implications

In the Canadian boreal forest, clearcutting is the most prevalent logging system used in all jurisdictions and general logging guidelines are similar (OMNR 1988, MER 1989). The recent interest in forest harvesting systems that mimic natural dynamic processes or take inspiration from natural perturbations (Bergeron et al. 1999) does not imply that clearcutting will disappear. Techniques, particularly those that protect advanced regeneration and soils, will probably remain as appropriate harvesting methods in the near future (Potvin et al. 1999) because the boreal forest is generally characterized by even-aged stands resulting from extensive wildfires. Hunters prefer less drastic logging methods than clearcutting but they do not seem to be categorically opposed to any particular type of harvesting system. The logging guidelines that were in effect at the time of this study, however, did not satisfy most hunters over the short term. Because hunters are looking for a natural and quiet setting, they often associate logging with reduced natural conditions, increased access, and noise pollution around their hunting areas. As a result, hunters are demanding greater restrictions on the size of the cutovers, increased proportions of residual forest, reductions in woody debris, an increase in the width of forested buffer strips along rivers and around lakes, and buffer zones around hunting camps. Such restrictions have been found to reduce the negative visual impact of clear-cuts (Boxall et al. 1996b) and managers can start from these criteria to imple-

ment ecosystem management.

Another, and probably better way to meet hunters' expectations would be to distribute 50 to 100-ha clear-cuts to create a mosaic pattern on the forest landscape (Eason 1989, Courtois et al. 1998). This approach seems to be the only one capable of meeting the needs of moose hunters, in particular those who hunt from camps, since their hunting areas are limited to a few km² (Courtois and Beaumont 1999). While hunters can theoretically hunt in any public forest, crowding substantially reduces possibilities to find unused hunting areas. In Québec, moose hunters using camps are more or less restricted to a particular hunting area because most other suitable sites are occupied by other hunting parties. Moreover, the construction of camps and other semi-permanent facilities constitute serious limitations to hunters' mobility. Consequently, after finding a suitable vacant area, a hunting group will develop it and indicate occupancy with the use of signs and other visible cues.

Accurate information could improve hunter's overall knowledge of forest management, change their negative perceptions and, in some areas, help them to find hunting areas that correspond to their desires (Decker and Connelly 1989, Rollins and Romano 1989, Heberlein 1992, Diefenbach et al. 1997). In areas used intensively by hunters, such as wildlife reserves, information on the location and extent of present and past forestry activities, status of the regeneration, as well as the long-term positive impact of forest cutting on moose habitat should be provided to the public. This would help hunters to choose preferred areas and have a more positive perception of forest harvesting. In Québec, hunting is the most important limiting factor for moose populations (MLCP 1993) but many moose hunters overestimate the impact of poaching and predation. Better education on the

biological limiting factors of moose populations could improve hunters' knowledge of moose management.

ACKNOWLEDGEMENTS

This study would not have been possible without the participation of Marc Lefebvre, Robert Dupuis, and Jean-Luc Lockhead of the firm Enviréo, and Aldée Beaumont of the Ministère de l'Environnement et de la Faune du Québec who conducted most of the interviews. The authors also would like to thank Alain Caron, Marie-Odile Buchwalter, and Eric Jaccard for their assistance during the documentary research and Wendy King for reviewing the manuscript. The authors are particularly indebted to Gerry Redmond and one anonymous referee for suggestions that improved the manuscript. Finally, we would like to thank the moose hunters of Northwestern Québec who were kind enough to answer our questionnaire.

REFERENCES

- ADAMOWICZ, W. L., J. SWAIT, P. BOXALL, J. LOUVIERE, and M. WILLIAMS. 1997. Perceptions versus objective measures of environmental quality in combined revealed and stated preference models of environmental valuation. *Journal of Environmental Economics and Management* 32: 65-84.
- ANONYMOUS. 1994. Ecological objectives for industrial forestlands. *Journal of Forestry* 92: 18-19.
- BARRETTE, Y., G. GAUTHIER, and A. PAQUETTE. 1996. Gestion des ressources, aménagement de la forêt pour fins de production ligneuse. Pages 645-672 in *Manuel de foresterie*. Presse de l'Université Laval, Québec, Québec, Canada.
- BERGERON, Y., B. HARVEY, A. LEDUC, and S. GAUTHIER. 1999. Stratégies d'aménagement forestier qui s'inspirent des perturbations naturelles: considérations à l'échelle du peuplement et de la forêt. *Forestry Chronicle* 75: 55-61.
- BISSET, A. R. 1987. The economic importance of moose (*Alces alces*) in North America. *Swedish Wildlife Research Supplement* 1: 677-698.
- BLUZMA, P. P. 1987. Socio-economic significance of moose in the USSR. *Swedish Wildlife Research Supplement* 1: 705-723.
- BOXALL, P. C., W. L. ADAMOWICZ, J. SWAIT, M. WILLIAMS, and J. LOUVIERE. 1996a. A comparison of stated preference methods for environmental valuation. *Ecological Economics* 18: 243-253.
- _____, D. O. WATSON, and J. ENGLIN. 1996b. Backcountry recreationists' valuation of forest and park management features in wilderness parks of the western Canadian Shield. *Canadian Journal of Forest Research* 26: 982-990.
- BRYAN, H. 1977. Leisure value systems and recreational specialization: the case of trout fishermen. *Journal of Leisure Research* 9: 174-187.
- CONDON, B., and W. L. ADAMOWICZ. 1995. The economic value of moose hunting in Newfoundland. *Canadian Journal of Forest Research* 25: 319-328.
- COURTOIS, R., and A. BEAUMONT. 1999. The influence of accessibility on moose hunting in Northwestern Québec. *Alces* 35: 41-50.
- _____, and G. LAMONTAGNE. 1999. The protection of cows: its impact on moose hunting and moose populations. *Alces* 35: 11-29.
- _____, J.-P. OUELLET, and B. GAGNÉ. 1998. Characteristics of cutovers used by moose (*Alces alces*) in early winter. *Alces* 34: 201-211.
- DAVID, R., and A. GENEST. 1984. Le loisir au Québec en 1982, étude auprès de la population. Ministère du Loisir, de la Chasse et de l' Pêche du Québec, Di-

- rection de l'Analyse et Recherche Socio-economique, Report. Québec, Québec, Canada.
- DECKER, D. J., and N. A. CONNELLY. 1989. Motivations for deer hunting: implication for antlerless deer harvest as a management tool. *Wildlife Society Bulletin* 17: 455-463.
- DIEFENBACH, D. R., W. L. PALMER, and W. K. SHOPE. 1997. Attitudes of Pennsylvania sportsmen towards managing white-tailed deer to protect the ecological integrity of forests. *Wildlife Society Bulletin* 25: 244-251.
- DITTON, R. B., D. K. LOOMIS, and S. CHOI. 1992. Recreational specialization: reconceptualization from a social word perspective. *Journal of Leisure Research* 24: 33-51.
- EASON, G. 1989. Moose response to hunting and 1 km² block cutting. *Alces* 25: 63-74.
- _____, E. THOMAS, R. JERRALD, and K. OSWALD. 1981. Moose hunting in a recently logged area. *Alces* 17: 111-125.
- EASTMAN, D. S. 1973. Integrating moose habitat management with forest development. *Proceedings of the North American Moose Conference and Workshop* 9: 1-12.
- GAUTHIER, G., and L. GIGNAC. 1995. La pratique des activités de loisir culturel et scientifique des Québécois. Ministère des Affaires Municipales, Direction Loisir Programmes Jeunesse, Québec, Québec, Canada.
- GERLACH, L. P., and D. N. BENGSTRON. 1994. If ecosystem management is the solution, what's the problem? *Journal of Forestry* 92: 18-21.
- GILMORE, D. W. 1997. Ecosystem management - a needs driven, resource-use philosophy. *Forestry Chronicle* 73: 560-563.
- GINGRAS, A., R. AUDY, and R. COURTOIS. 1989. Inventaire aérien de l'orignal dans la zone de chasse 19 à l'hiver 1987-88. Ministère de l'Environnement et de la Faune du Québec, Direction de la gestion des espèces et des habitat, Report 1553.
- GIRARD, F., and R. JOYAL. 1984. L'impact des coupes à blanc mécanisées sur l'orignal dans le Nord-Ouest du Québec. *Alces* 20: 3-25.
- GRUMBINE, R. E. 1994. What is ecosystem management? *Conservation Biology* 8: 27-38.
- HEBERLEIN, T. A. 1992. Reducing hunter perception of crowding through information. *Wildlife Society Bulletin* 20: 372-374.
- (IQOP) INSTITUT QUÉBÉCOIS D'OPINION PUBLIQUE. 1985. Étude sur le loisir des Québécois. Institut Québécois d'Opinion Publique, Conférence National du Loisir, Québec, Québec, Canada.
- JOYAL, R. 1987. Moose habitat investigations in Québec and management implications. *Swedish Wildlife Research Supplement* 1: 139-152.
- (MER) MINISTÈRE DE L'ÉNERGIE ET DES RESSOURCES. 1989. Modalités d'intervention en milieu forestier. Ministère de l'Énergie et des Ressources, Québec, Québec, Canada.
- (MLCP) MINISTÈRE DU LOISIR, DE LA CHASSE ET DE LA PÊCHE. 1993. Plan de gestion de l'orignal, 1994-1998: objectifs de gestion et scénarios d'exploitation. Publication du Québec, Québec, Québec, Canada.
- MORTON, K. M., W. L. ADAMOWICZ, and P. C. BOXALL. 1995. Economic effects of environmental quality change on recreational hunting in northwestern Saskatchewan: a contingent behaviour analysis. *Canadian Journal of Forest Research* 25: 912-920.
- (OMNR) ONTARIO MINISTRY OF NATURAL RESOURCES. 1988. Timber manage-

ment guidelines for the provision of moose habitat. Ontario Ministry of Natural Resources, Toronto, Ontario, Canada.

- POTVIN, F., R. COURTOIS, and L. BÉLANGER. 1999. Short-term response of wildlife to clear-cutting in Québec boreal forest: multiscale effects and management implications. *Canadian Journal of Forest Research* 29: 1120-1127.
- ROLLINS, R. 1987. Hunter satisfaction with the selective harvest system for moose in Northern Ontario. *Alces* 23: 181-193.
- _____, and L. ROMANO. 1989. Hunter satisfaction with the selective harvest system for moose management in Ontario. *Wildlife Society Bulletin* 17: 470-475.
- SCHROEDER, H. W. 1996. Ecology of the heart: understanding how people experience natural environments. Pages 13-27 in A. W. Ewert, editor. *Natural resource management: the human dimension*. Westview Press, Boulder, Colorado, USA.
- STATISTICS CANADA. 1978. *Statistiques de la culture, activités récréatives 1976*. Statistiques Canada, Division de l'éducation, des sciences et de la culture, Section des voyages, du tourisme et des loisirs, Ottawa, Ontario, Canada.
- _____. 1984. *Tourisme et loisirs, résumé statistique 1984*. Division de l'éducation, de la culture et du tourisme, Section des voyages, du tourisme et des loisirs, Ottawa, Ontario, Canada.
- VALLÉE, J., R. COUTURE, and R. JOYAL. 1976. Étude de la régénération après coupe des essences composant la diète alimentaire de l'orignal. *Phytoprotection* 57: 155-164.