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SNOWMOBILERS, THEIR EXPERIENCE AND HABITAT PREFERENCES, AND THE IMPLICATIONS FOR WINTERING MOOSE IN MCLEAN CREEK AREA, ALBERTA

by

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ABSTRACT

The compatibility of habitat requirements of snowmobilers and of moose was assessed. 306 snowmobile users were interviewed from January to April, 1982, at McLean Creek Snowmobiling Area, Alberta. Physical, psychological, and socio-economic dimensions of the sample were derived and described, as well as their local behavioural characteristics, and their preferences for vegetation type, vegetation density, slope angle, snow depth, and snow type.

Comparison of the snowmobiler requirements with those of moose indicates clear conflict of demand over "short deciduous" vegetation stands, and conifer and deciduous stands having densities of 100 - 1000 stems per hectare; such stands offer at the same time good snowmobiling and the bulk of moose browse. Moderate potential conflict exists over "roads and trails", moderate slopes, tree stands having densities of 1001 - 2000 stems per hectare, and powder snow on a firm base. A clear conflict over these conditions is expected to be initiated actually only in the presence of deep snow accumulations, such as do not occur at McLean Creek Area. Minimum demand conflict exists for most parameters measured, including non-vegetated terrain, dense stands of trees, thin powder snow, deep powder snow, landform types, flat topography, and steep slopes.

General recommendations are made to provide for integration of snowmobiler and moose habitat. It is recommended that McLean Creek Area be closed to snowmobiling, due to low snow accumulations, and a more suitable

site be identified at alpine/subalpine elevations within 2 hours drive from Calgary. Specific recommendations offered address two scenarios: (1) assuming that the McLean Creek Area will be abandoned in favour of a more suitable location, and (2) assuming that McLean Creek Area will remain as a select snowmobiling area.

key words: snowmobilers, moose, habitat relations.

depths there reached 89 cm. If deep accumulations stimulate moose to search out more sheltered areas (Singer, 1979) such as forested stands, compensation can be achieved for deep snow only if such stands are found to be available. If they are not available, the moose becomes theoretically more vulnerable to predation, which is an actual threat only if the local ecosystem contains appropriate predators. Telfer (1978b) reported greater utilization of "shrub-meadow/stream-bottoms" than either "Mature Spruce-Fir" or "logged and scarified" types, even though snow depths in the latter two areas was only 51 to 59 cm as compared to 65 cm in the shrub-meadow/ stream bottoms.

4.4 Overlap in resource demand between snowmobilers and moose.

Table 18 compares the habitat preference data obtained from snowmobilers with corresponding information inferred from the moose studies that were reviewed. With respect to selection for slopes specifically as a landform characteristic, insufficient data for moose are available from the literature, and overlap in demand for this characteristic can be neither claimed nor disclaimed with any certainty. With respect to the majority of habitat characteristics addressed there is found to be no overlap in demand; these include "mountain highlands", "creeks or rivers", "flat fields", "frozen lakes", slopes of 14 degrees or less, slopes in excess of 35 degrees, "tall conifer" stands, "open non-vegetated" terrain, "tall deciduous" stands, stands of trees having low density (0-99 stems/ha), stands of trees having high density (2000^+ stems/ha), "deep powder", "crusty snow", snowdepths of 0-30 cm, snowdepth of 61^+ cm. Definite overlap in habitat demand occurs for "short deciduous" stands, stands of trees having densities of 100-1000 stems/ha, and "thin powder".

Table 18. Comparison of snowmobiler and moose habitat preferences to determine demand overlap.

	snowmobiler preference	moose preference	demand overlap	relative abundance (%)
habitat type:				
slopes and hills	37 % of sample	(insufficient data)	—	undetermined
roads and trails	26.8 %	3 rd choice	maybe	
mountain highlands	21.4 %	4 th	no	
creeks or rivers	4.3 %	1 st	no	
flat fields	2.3 %	2 nd	no	
frozen lakes	1.4 %	3 rd	no	
slope angle:				
15 - 35 degrees	high preference	1 st choice	maybe	30.8
14 or less	low	1 st	no	67.8
36 or more	low	2 nd	no	3.6
vegetation type:				
tall conifer	6.8 rating	5 th choice	no	74.4
open non-vegetated	5.8	6 th	no	1.6
short deciduous	4.3 - 5.9	2 nd	yes	3.1
tall deciduous	3.9 - 5.4	1 st	no	6.6
mixed	4.9 - 5.1	4 th	no	14.1
tree stand density:				
0 - 99 stems/ha	5.8 rating	4 th choice	no	20.2
100 - 1000	4.3 - 6.8	1 st	yes	
1001 - 2000	3.9 - 5.5	2 nd	maybe	79.8
2000 or more	2.6 - 3.8	3rd	no	
snow type:				
deep powder	37.5 % of sample	4 th choice	no	undetermined
thin powder	26.2 %	1 st	yes	
powder on base	20.7 %	3 rd	maybe	
old packed snow	13.1 %	2 nd	maybe	
crusty snow	2.5 %	5 th	no	
snow depth:				
0-30 cm ideal depth	5.0 % of sample	1 st choice	no	undetermined
31 - 60	46.8 %	2 nd	maybe	
61 or more	48.2 %	3 rd	no	

4.4.1 Can snowmobilers and moose co-exist?

The results clearly show that with reference to the habitat parameters considered, moose and snowmobilers can coexist. However, this question must address their compatibility not only in space (i.e. in a given area such as McLean Creek Area), but also in time. Such a projection is theoretically possible within the broader context of resource strategies for both these species. Although the current distributions of wintering moose and snowmobilers in the Area may suggest minimum conflict, it must be postulated that these may also reflect active spatial and temporal avoidance by moose of snowmobilers and/or snowmobile noise. White-tailed deer were found to respond in this manner to snowmobiling activity (Eckstein et al, 1975; Kopischke, 1972). Such avoidance was observed by Geist (1959) who noted that in undisturbed habitat, moose diurnal feeding activity patterns included a mid-afternoon peak. Similarly, Goddard (1970) found that moose under pressure of hunting in Ontario quickly responded by daytime avoidance of exposed areas and by increased nighttime feeding. Both moose and snowmobilers are responsive, dynamic organisms; under pressure of changing environmental conditions their behaviours and preferences may change significantly. The McLean Creek study collected no data on moose response to human presence or human-related noise. However, their potential to impact moose behaviour must be duly acknowledged.

Assessment of potential conflict, as opposed to current conflict, between two organisms is likely to defy quantification. However, this should not discourage attempts to make such assessments; it is particularly challenging to attempt comparison of projected human with non-human resource requirements because of the much advanced neural/sociological/technological complexity of

the human organism. Such comparison must be considered possible on the premise that no organism can be defined without reference to some environment to which it relates according to its evolved relationship sensory and delivery capabilities. A theory of evolution could not have been conceived except on the assumption that there is some generic relationship between organisms and the environments with which they interact.

The priority aspiration of the genome is reproductive fitness (Geist, 1978; Geist, 1982). The "enemy" that perpetually conspires to frustrate increased fitness consists of (a) environmental change, and (b) a limited nutrient supply in the biosphere. In order to combat this frustration the genome, including that of an individual human who snowmobiles, has at its disposal three broad strategic ploys:

(1) to remember a maximum number of past environmental conditions which may recur in the future, and thus anticipate undesirable fluctuations;

(2) to maximize its ability to influence the organization of its umwelt, thus minimizing the effective force of undesirable fluctuations, by creating desirable conditions;

(3) to minimize the amount of energy expended (a) in gathering and storing information, and (b) in maximizing response abilities.

According to this theoretical approach an unintentional behaviourism is a contradiction in terms; each individual organism either actively competes to improve its resource security or, by relaxing an aggressive attitude, loses competitive position to others who have not become relaxed.

This leads to the conclusion that the activity of snowmobiling at McLean Creek must be expected to enhance reproductive fitness of snowmobilers.

However such a conclusion is also simplistic; the questions that need to be addressed are, (1) How may snowmobiling be expected to contribute to enhanced fitness?; and, (2) Within the total snowmobiler umwelt, how indispensible is snowmobiling to his continued fitness? Answers to these questions contribute fundamentally to a realistic projected impact of snowmobiling on moose.

4.4.2 Snowmobiling and enhanced fitness.

The beginnings of an answer to the above question can be formulated on the basis of the data obtained from snowmobilers sampled. Throughout this section of the discussion arguments will be presented to describe a functional relationship between snowmobiling and human physical fitness which would probably enhance the snowmobiler's reproductive fitness. To begin with we consider the following: 93.8 % of the sample consists of Calgarians; a large proportion are employed as construction workers or equipment mechanics/operators, are seriously understimulated in their working environments (i.e. are required to interact by way of a limited set of muscles and a small group of people, do daily repetitive tasks, and are confined at best to one building during the day); the largest proportion (71.8%) are in the prime of life (16-35 years of age), and have one or two children with whom, for the most part, they are able to interact with only after working hours when their own physical and emotional energy levels are depressed. It is in this context that this same sample has identified "exploring", "escaping city crowds", "interacting with your companions", "escaping city noise and smell", "getting away from it all", "challenging your handling skills", "feeling the sensations of motion",

"escaping work boredom", and "exercising" to be highly associated with snowmobiling. These data strongly suggest that snowmobiling is experienced as anti-work activity in an anti-work setting. It is desired as an antidote to an urban environment that is excessively structured, routine, and impersonal. Two questions asked of McLean Creek snowmobilers were to rate the importance of "getting away from it all" and of "going somewhere in particular". These were placed in apposition to one another in the questionnaire, and it is significant that the mean response obtained places much more importance on getting away than on going somewhere in particular.

In anticipation of the above, Nash (1960) noted that leisure activity "...may well be the antidote to fatiguing and distracting elements which seem inherent in our urban life." Similarly, Dubin (1956) demonstrated that work was not a central life interest for industrial workers, when he studied the informal group experiences and the general social experiences that have some value for them. He concluded that,

> "...industrial man seems to perceive his life history as having its center outside of work for his intimate human relationships, and for his feelings of enjoyment, happiness, and worth."

Of his respondents, 91 % indicated that their preferred informal human interactions were found in the community, among friends, and in the family. Again, Heron (1957) reported that subjects experimentally confined to near stimulus free, monotonous environments for prolonged periods of time began to show "increasing signs of restlessness", and "appeared eager for stimulation". Grubb (1975) observed that the bored assembly line worker often feels that he will overcome his unpleasant feelings by escaping the external situation or

setting. The need to maintain a 'family economic level makes true, permanent escape an unrealistic fantasy for most people; but weekend escape is not only feasible in our society, it has become virtually institutionalized.

Segregation of human waking time into work and anti-work (i.e. play) time has not escaped the attention of sociologists and psychologists. Although most earlier attempts to understand "recreation" and "leisure" resulted in definitions that assumed this dichotomy as a given (for examples see, Reisman, 1956; Bregha, 1980), recent attempts are pushing beyond such restrictive definitions. Piaget (1951) suggested that play may well be viewed as an end in itself; he supported this by the observation that the time required by the human child to differentiate between its capability of "mental assimilation" and "behavioural accommodation" of environmental variables generally corresponds to the time it begins to separate its play behaviour from non-play behaviour. His implicit argument is that the fundamental component of play is purposeful: to manipulate environmental variables so that their information can become neurally assimilated.

After Ellis (1971) extensively reviewed play theory and proposed an integrated approach, new advances were made. Day (1972,1978) pointed to the fact that any given activity may include both work and play elements, and suggested that a workfulness-playfulness continuum approaches reality better than a simple dichotomy of them. He noted that play is motivated intrinsically, whereas work is motivated extrinsically. B.L. Driver has become in recent years a leading proponent of the experiential importance of recreation behaviour. He (Driver, 1972, 1975) emphasized the intrinsic nature of play, and stressed that more attention should be paid to discovering the value of recreation to the individual and why he participates. He concluded

(Driver, 1975) that,

> "...recreation activities are selected to realize a variety of experiences simultaneously, and that specific activities are selected by recreationists, within bounds of their constraints, to realize those experiences that are of highest relative importance at any particular time."

Csikszentmihalyi (1975) also proposed that an optimum level of stimulation is most pleasing to the individual: one's choice of recreation activities is a function of both opportunities for interaction perceived as well as the level of capability for interaction perceived. He identified a "flow channel" as that emotional state wherein satisfying leisure occurs; it circumscribes a mid-zone between anxiety resulting either from boredom (i.e. too little stimulation and/or relatively high perceived abilities) or from worry (i.e. too much stimulation and/or relatively low perceived ability). Csikszentmihalyi concluded that the following qualities are characteristic of the "flow" experience:

-the person is able to concentrate on a limited stimulus field;

-the person can use skills to meet clear demands;

-problems are forgotten about;

-the person is not conscious of his separate identity;

-the person feels in control over the environment;

-psychic integration with meta-personal systems generally occurs.

The mean responses obtained from McLean Creek snowmobilers support the experiential nature of snowmobiling against the backdrop of urban weekday environment. The lives of the non-mobile mass today are highly

institutionalized; not only does the job require compartmentalization of time into discreet, regularly recurring units, but also most work requires the worker to report daily to the same four walls, to perform the same daily (sometimes hourly) tasks, with the same set of people. The stress generated by such economy of time, tasks, and habitat are bound to spill over into primary relationships, and compensating activity is constantly required to deflate continuous generation of anxiety.

The only important characteristic which Csikszentmihalyi neglected to include in his list is the desirable element of "surprise" generated by the discovery of some unknowns in the environment. The high ratings obtained for "exploring" suggest that the presence of unknowns is important for maximum enjoyment; however it is likely that such unknowns must be perceived by the recreationist to present only challenge and surprise, and not real threat. A sense of adventure and exploration of otherwise less accessible backcountry is a valued available experience for snowmobilers.

Exploration may be viewed as a means by which the organism enlarges his "experience" (i.e. information) bank. A larger menu of remembered experiences available to the organism gives it advantage on two fronts: (1) it provides for greater accuracy in predicting environmental fluctuations, and (2) improves its chance of discovering new, available resource opportunities. This interpretation is supported by Glickman and Stroges, (1966) who experimentally placed the same set of novel objects in zoo animals' cages and recorded their responses. They reported not only an overall positive correlation between brain size and the complexity or degree of visible reaction of the animals, but also that the degree of reaction related surprisingly well to such environmental factors as the need to search actively for food and to be guarded

against the danger of predators in their natural habitats. As result of this study they concluded that among contemporary mammals there can be seen an evolution in the direction of freeing, psychologically, the species from the disadvantage of restriction to a limited environment in which a sudden change (for example, of climate) may lead to extinction. On this basis they postulate that,

> "It seems almost inevitable that one function of curiosity is to provide the organism with just such species preserving information about the world. This information might be used, either immediately or at some later time, and would apply equally to the acquisition of "perceptual knowledge" and the refinement of motor skills."

These authors suggest that the process of evolution from simpler to more complex forms corresponds to increased complexity of the nervous system in order to enable the organism to anticipate more efficiently a broader range (both spatially and temporally) of environmental changes. If fitness is a direct function of the genome's ability to accurately predict its environment, then it is reasonable to conclude that the greater the difference that occurs between actual and expected environment, the more unfit the organism is. This should hold true not only with respect to anticipating the kinds of interactions required for that environment, but also their frequencies (i.e. amount of stimulation). Unexpected frequencies of interaction equally betray unfitness. Berlyne (1966) noted in this regard that a given organism, which has a nervous system evolved to anticipate a certain intensity of stimulation (i.e. disturbance) from the environment, evidently feels uncomfortable with both under-stimulation as well as over-stimulation:

> "It seems that the central nervous system of a higher animal is designed to cope with environments that produce a certain rate of influx of stimulation, information, and challenge to its capacities. It will naturally not perform at its best in an environment that overstresses or overloads it, but we also have evidence that prolonged subjection to an inordinately monotonous or understimulating environment is detrimental to a variety of psychological functions."

McLean Creek snowmobilers highly valued companionship or interpersonal contact. It appears from the responses obtained to questions that snowmobiling is very much a family activity. Joint family recreation has become increasingly popular in modern post-industrial society (Kando, 1980), especially among middle class strata which, he notes, are less traditional than the lower working classes. Of the 306 people interviewed only one person was found to be snowmobiling by himself.

There is however a further benefit of group snowmobiling which should be noted, which is to diminish real threat. The real risk of suffering mechanical breakdown in deep snow at great distance from roads is minimized not only by the highly protective clothing available, but more important, by group participation. A look at the responses obtained in age categories reinforces the proposition that play enhances fitness. Age has been shown to be a most reliable determinant of recreation behaviour in general (Laplante, 1969; Dottavio et al. 1980). However, Laplante (1969) observed that teenagers tend to be most active in outdoor activities and physical sports in comparison with other age groups. This is expected in light of results of other research,

which demonstrate that play behaviour is itself much more characteristic of juveniles than of adults. Glickman et al. (1966) noted that in 12 of their 17 adults/sub-adults comparisons, the sub-adults showed greater mean response scores to novel objects than their matched counterparts. Similarly Fagen and George (1977) reported that play behaviour made up to two thirds of the total running exercise of ten young ponies they studied; they offered this correlation in support of their view that play makes an important contribution to adult condition and longevity. Miller and Gunn (1981) reported that Peary caribou calves very often resorted to play behaviour when, having become anxious of helicopter overflights, their inclination to flee was not reinforced by adult behaviour. Psychologist Frank (1963) pointed out that play is especially important during childhood years when one is buffered, by parental intervention, from constant demands made by basic necessities, and thus has much free time. He interpreted child's play as ,

> "...the way he explores and orients himself to the actual world of space and time, of things, animals, structures, and people. Through play he learns to live in our symbolic world of meaning and values, of progressive striving for deferred goals... Through play the child endlessly rehearses the complicated and subtle patterns of human living and communication which he must master if he is to become a participating adult in our social life."

It is not surprising, considering the importance of play and exploration especially for younger age groups, that the largest majority of respondents are between 16 and 35 years old.

In summary, given the socialization process that directs young people to adopt snowmobiling as an outdoor escape recreation, this activity can clearly provide a very essential, indispensible contribution to continued physical fitness for a large number of people.

4.4.3 How indispensible is snowmobiling to snowmobiler fitness?

A number of related questions can be identified: (1) In the face of other conflicting resource demands, how flexible is the snowmobiler in his need to pursue snowmobiling activity?, and (2) How strongly will the snowmobiler resist managerial constraints to his snowmobiling activity?

This cluster of questions is partially answered by responses obtained in the questionnaire. When asked to rank the relative importance of snowmobiling, grazing, gas/oil extraction, and wildlife well-being, the very greatest majority accredited least priority to snowmobiling. Gas/oil extraction and grazing were given greatest priority, followed by wildlife well-being. Although the possibility of redirecting the snowmobiler to adopt other, more environmentally compatible forms of winter outdoor recreation was not addressed in this research, it may well be that this approach can successfully be pursued.

4.4.4 The behavioural response of moose to snowmobiling.

This study, conducted in the McLean Creek Area on the relationship

between moose and snowmobilers, is restricted to demand for habitat characteristics. Although the results suggest that overlap in demand for habitat features exists definitely in only two categories, it cannot be thereby concluded that minimal overall conflict exists. In order to make this assessment other factors must be addressed, an important factor being the behavioural response of moose and snowmobilers to one another.

The direct behavioural response of moose to snowmobilers has not, as far as can be determined, been the subject of experimental study. However, a number of studies have addressed the disturbance of other species of ungulates by a variety of human activities, including snowmobiling. These studies are generally inconclusive in demonstrating that disturbance responses ultimately result in a deterioration of health of the population. Moen et al (1982) proved that the heart rates of penned white-tailed deer increased by a mean 2.5 times the pre-stimulus rate if a snowmobile was directed tangential to the enclosure, and a mean 2.9 times if it was directed straight toward the subjects. Their data indicated that there was no habituation during the study period which extended from December through the following month of March. Such physiological response may or may not be translated into avoidance behaviour, and the decisive criteria appear as yet to be unknown.

Geist (1971c, 1975) illustrated how stress induced by aircraft harrassment of caribou, places a costly stress load on the total energy budget of an individual animal. Hudson and Stelfox (1976) listed the following potential results of undefined degrees of stress: myopathy, shock, hypothermia, pulmonary emphysema, prolapsed rectum, lowered conception rates, fetal resorption, abortion, impaired lactation, weight loss, and lowered resistance to diseases. Stress must be seen as a normal component of daily experience of organisms,

and it should be expected that populations have a built-in threshold of stress tolerance. However no studies have been done to assess the ability of a population to absorb certain degrees of stress on its individual members.

Dorrance et al (1975) found a significant negative correlation between the number of deer observations along a snowmobile trail and the volume of traffic on that trail. They noted, however, that the deer readily re-occupied trail-side habitat within two hours after snowmobiling stopped. On the other hand, Eckstein et al (1973), also studying white-tailed deer, could find no significant alteration in deer home-range size comparing the presence of regular snowmobiling with the absence of regular snowmobiling. Similar results were obtained by Bollinger et al (1973) who reported that snowmobiling activity did not significantly alter either the home-range size of white-tailed deer or their rate of travel. They noted that snowmobiles had to be within sight of the deer to stimulate immediate avoidance behaviour. Richens and Lavigne ((1978) concluded that snow supportability was a more significant determinant of white-tailed deer activity patterns related to snowmobile trails, than was snowmobiling. They observed that deer consistently bedded near snowmobile trails and fed alongside them even when those trails were used for snowmobiling several times per day.

Rost and Bailey (1979) found that mule deer and elk avoid roads, and that heavily used roads were avoided more strongly than were lightly used roads. Schultz and Bailey (1979), however, found that bi-weekly harrassment of elk had no significant effect on their distribution or observability on winter ranges. Knight (1981) used radio-collared elk to demonstrate a significant negative correlation between an elk's mean daily distance of movement and its proximity to seismic activity. However, no similar correlation could be

obtained with proximity to oil well activity, and neither seismic or oil well activity appeared to effect the distribution of the elk.

Ferguson and Keith (1982) concluded that moose in Alberta showed greater avoidance of nordic ski trails than did elk, and moose may therefore be more sensitive to human activity than other ungulates. They noted that day-to-day movements away from the ski trails occurred after skiing use commenced, but that increased volume of skiers did not induce further movement. however, it should be cautioned here that a control group of moose was not monitored in this study, and their results may be predicated by the fact that moose generally move into trees after early morning feeding, and that such timing would probably coincide with increased skiing activity. In contrast to what could be deduced from the findings of Ferguson and Keith, Shank (1979) observed that moose appear to be generally accommodating of human activity and disturbance. However Hancock (1976) found that moose density, in habitats of equal suitability in Newfoundland, correlated negatively with the degree of human disturbance and access.

The studies referenced above are inconclusive about whether snowmobiling is or is not harmful to a resident moose population. Several authors (Dorrance et al, 1975; Schultz and Bailey, 1979) have observed that habituation to continued disturbance occurs. However, it is also noted that such habituation occurs more readily among non-hunted populations than among hunted ones. Knight (1981) concluded that elk habituated quickly to oil well activity because such activity is stationary and predictable, whereas seismic activity involves moving machinery at times and in directions that are unpredictable to the animals. Furthermore, Richens and Lavigne (1978) reported that deer learned quickly to approach the sound of chainsaws where this sound was

consistently associated with a fresh supply of felled cedar forage. A similar response was reported by Young and Boyce (1971) of whitetailed deer approaching the sound of snowmobiles in anticipation of food. My own observations of 3 moose feeding within sight and sound of a snowmobile at McLean Creek Area were that the moose responded with flight into the trees only if a snowmobile approached them directly within approximately 200 metres distance.

At the other end of the potential disturbance relationship between moose and snowmobilers, is the snowmobiler. Snowmobiler responses to sighting of moose may vary, and it appears probable that the human response to a specific sighting will be a major determinant of whether or not, and how quickly, the moose will habituate to a snowmobiler's presence and activity. Direct and deliberate approach and harrassment is certain to reinforce the maximum and earliest avoidance response. Such human behaviour has been reported (Stace-Smith, 1975). However, most snowmobilers are today highly sensitized to the issue of wildlife harrassment, and it appears that the largest majority of them will attempt to avoid sighted animals rather than approach them or chase them. This suggestion is supported by the fact that concern for wildlife rated very high among the McLean Creek snowmobilers studied.

4.5 Recommendations for further research.

Recommendations for further research are presented as questions that should be addressed by researchers, and around which designs for research can be constructed. The questions are presented in four categories: snowmobiler habitat, moose habitat, moose/human interaction, and mitigation procedures.

Snowmobiler habitat:

(1) What is the relative importance of desired snowmobiling habitat features?

(2) What economic sacrifices will snowmobilers make in order to snowmobile in specified habitat conditions?

(3) What types of man-made features, or how much human interference in habitat development, will snowmobilers accept as enhancing snowmobiling habitat?

(4) Do snowmobiler habitat preferences evolve in time, in tandem with changes in community values? If so, what psycho-social operants determine the directions that such changes will follow?

Moose habitat:

(1) What sites in, or near, the McLean Creek Area are critical for calving, rutting, and for other seasonal activities that are essential to the health of the resident moose population?

(2) What habitat features do moose seek for calving, rutting, and other seasonally important activities?

(3) How rigid, or how flexible, is the individual moose in its demand for specified habitat features as settings for specified behavioural requirements?

Moose/human interaction:

(1) Do individual moose habituate to specified human-directed activities such as snowmobiling? If so, how quickly?

(2) Does a population of moose habituate to specified human-directed activity? If so, how quickly?

(3) What are the parameters of a specified human activitythat trigger thresholds of stress at which a moose population's health begins to decline?

(4) What measurements, when applied to a population of moose, can accurately assess a current level of stress on the population that will result in the population's decline?

(5) What mechanisms operate within a population of moose that enable it to buffer or absorb degrees of human-generated stress?

(6) What is the range and what are the frequencies of snowmobilers' responses to moose sightings while snowmobiling?

(7) What is the range and what are the frequencies of snowmobilers' responses to seeing other snowmobilers' encounters with moose? How do these responses compare with responses observed following (6)?

(8) What measures can accurately assess environmental damage?

Mitigation procedures:

(1) Can quieter motors be engineered for snowmobiles?

(2) Will specified managerial controls, such as restricted snowmobile hours, be perceived by snowmobilers to detract from snowmobiling enjoyment?

(3) What habitat manipulations are effective in indirectly controlling snowmobilers' use of habitat types (example: felling trees and leaving high stumps to obstruct entrances to habitats where snowmobiling in undesirable)?

(4) What criteria can/should be established in law to provide for minimum habitat requirements for featured species?

(5) Is a democratic system of government ultimately able to safeguard wildlife