THE EFFECTS OF HEAVY BROWSING PRESSURE OVER EIGHT YEARS ON A CUTOVER IN QUETICO PARK

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ABSTRACT

A 1970 browse survey on a cutover supporting a high density, unhunted moose population in Ontario's Quetico Park was repeated in 1978 to ascertain the effects on the vegetative community of intensive browsing by moose over eight years. Results of the survey indicate that while there has been an insignificant ($P \geq .05$) change in the number of living stems/ha (down 15.2%), the percentage of stems browsed, hedged and killed by browsing has increased significantly ($P \leq .01$). The 88.0% increase in the mean number of stems hedged and the 820.0% increase in the mean number of stems killed by moose browsing over eight years indicate that an average moose density of 5 km^2 ($12/mi^2$) probably exceeds the carrying capacity of this range.

Early in 1978, the authors became aware of a browse survey (Stasus 1970) which was conducted during May of 1970 on a 245 ha (605 acres) cutover (cut in 1965) northwest of Cache Lake in Quetico Provincial Park. The original survey was conducted to determine what effects a high density moose herd was having on the available food supply. The Cache Lake area of Quetico Park has supported a high density moose population (about 5 moose/km^2) for a number of years. The aim of this browse survey was to examine the vegetative changes effected in eight years by an unhunted, high density moose population.

STUDY AREA

Quetico Provincial Park (4,580 km^2, 1,768 mi^2) lies between Highway 11 and the American border (Fig. 1). The east boundary of the Park basically follows the boundary between the Ontario Ministry of Natural Resources administrative districts of Atikokan and Thunder Bay, while the western boundary is a series of lakes flowing into Lac La Croix.

Timber harvesting occurred in the Cache Lake area from 1961 to about 1970 during which time approximately 164 km^2(63 mi^2) were logged in an irregular pattern following a north-south moraine (Fig. 2). The cutting in the area of the study cutover produced good moose habitat and early winter aerial censuses have shown very high moose densities (Table 1).

Table 1. Summary of early winter observed moose densities from aerial census results for the Cache Lake study area

	1970* (winter)	1975 (Nov.28)	1976 (Dec.15)	1978** (Jan.3)	1978 (Dec.1)	1979 (Dec.20)	1980 (Nov.24)
No. of moose observed	40	49	37	18	61	38	71
Moose densities	1/km^2 (2.5 mi.^{2})	6/km^2 (15/mi.^{2})	5/km^2 (12/mi.^{2})	2/km^2 (6/mi.^{2})	7/km^2 (19/mi.^{2})	5/km^2 (12/mi.^{2})	9/km^2 (22/mi^2)

* average moose density on a 41 km^2 (16 mi^2) plot incorporating the study cutover. Subsequent surveys were standardized and done on 8.2 km^2 (3.2 mi^2) of cutover area incorporating the study cutover.

** crust conditions and the lateness of the survey contributed to the lower count

METHODS

We attempted to duplicate as closely as possible the method used in the original 1970 survey.

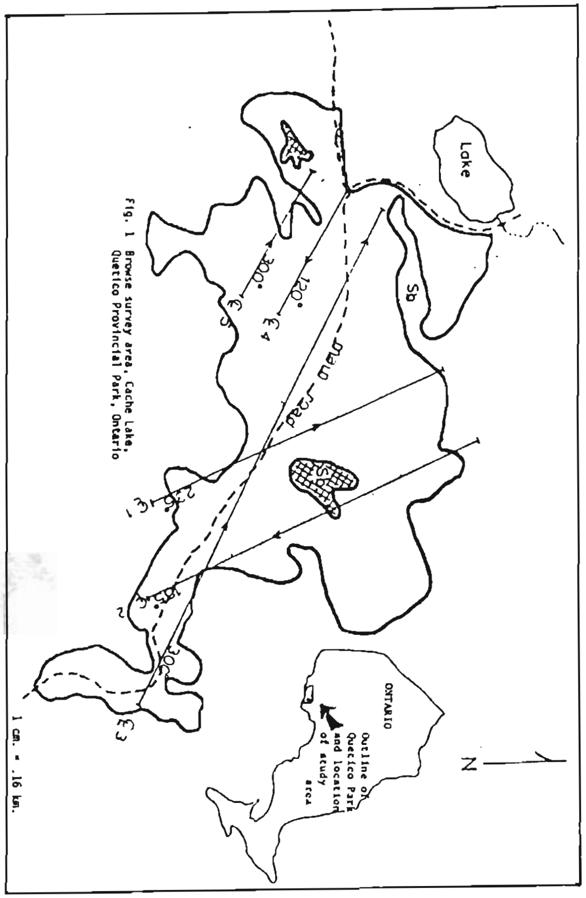

Fig. 1 Browse survey area, Cache Lake, Quetico Provincial Park, Ontario

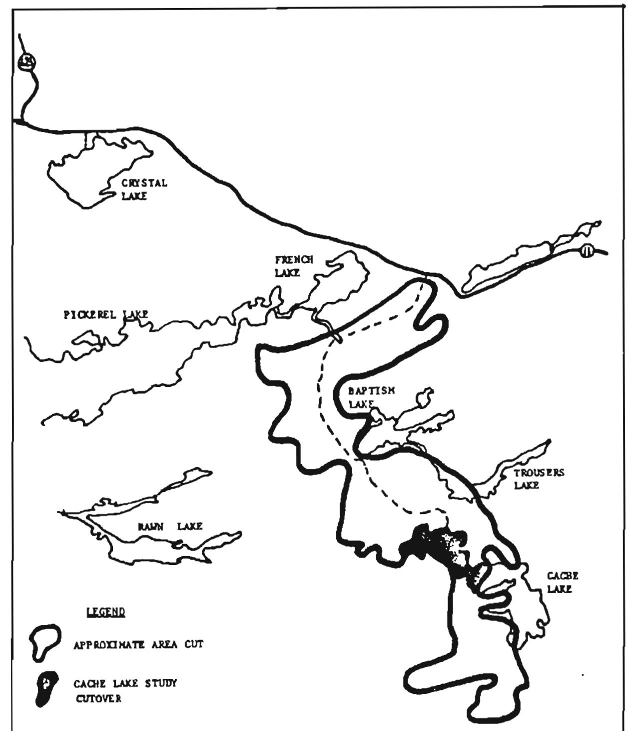

Figure 2. Map showing approximate area affected by timber harvesting, 1961-1970, including the Cache Lake study cutover. Quetico Provincial Park, Ontario.

Fortunately, the original methods description was detailed and included maps showing the whole disturbed area, the study area, and the location and direction of travel of cruiselines (see Fig. 1 & 2).

Vegetative sampling methods employed during both surveys were a modified version of the Passmore-Hepburn system (Passmore and Hepburn, 1955). Cruiselines were laid out (across topography) at 80 m (264 ft.) intervals. Plots were 20 m (66 ft.) in length and 0.6m (2 ft.) in width.

Observations were made on the utilization of browse species by moose. Available browse between 61 cm (2 ft.) and 254 cm (8.3 ft.) in height was recorded under the following categories:

1. Living stems - the number of living stems of each species that provided available browse. Included in the classification are those stems that were browsed or hedged.

2. Browsed stems - the number of stems of each species that had been browsed from the previous fall to the time of the survey.

3. Killed stems - the number of stems of each species which had been killed by past browsing.

4. Hedged stems - the number of stems of each species which showed the results of moderate to heavy browsing. This was a subjective assessment although the guideline was that at least half the available twigs on a given stem had to have been browsed in the previous eight months.

Moose pellet groups which fell within each plot were also tallied. At least half of a definable deposition had to fall within a plot before it was tallied. Pellet groups were not tallied in the 1970 survey.

RESULTS AND DISCUSSION

Changes in Browse Species Availability and Utilization by Moose

The results of the survey indicate that beaked hazelnut (*Corylus cornuta*) is still the most prevalent browse species on the study area. Species such as pincherry (*Prunus pensylvanica* L.) and juneberry (*Amelanchier stolonifera*) have increased their frequency indices by 50.0% and 59.0% respectively while white birch (*Betula papyrifera*) has increased it's prevalence by about 96.0% (Table 2).

All browse species except juneberry and white birch have decreased in availability since 1970. The most noticeable decreases have occurred with trembling aspen (*Populus tremuloides*), mountain ash (*Sorbus americana*) and pincherry which have decreased by 73.0%, 56.4% and 38.0% respectively (Table 2).

Trembling aspen does not appear to be very resistant to heavy browsing pressure since 50.5% of all aspen stems tallied had been killed as a result of moose utilization. Bergerud and Manuel (1968) reported that in Newfoundland trembling aspen could not withstand even moderate browsing pressure. This would account for the dramatic decrease in the availability of this species. A high number of stems killed by browsing was also evident for hazel (31.8%) and willow (*Salix* spp.) (21.9%) (Table 2). However, these two species, perhaps because they have a better ability to reproduce vegetatively, and can withstand browsing pressure, have not shown as marked a decrease in availability as has trembling aspen.

Table 2: Comparison of 1970 and 1978 browse data for the Cache Lake cutover, Quetico Park, Ontario

	Frequency Index[1]		Living Stems / acre (ha)		% Available Browse Stems		% Browsed Stems		% Stems Hedged		% Stems Killed		Preference Factor[3]				Browse Importance Ranking (Actual Stems Browsed)			
	1970	1978	1970	1978	1970	1978	1970	1978	1970	1978	1970	1978	1970	Ranking[2]	1978	Ranking	1970	Ranking	1978	Ranking[2]
White Birch	.25	.49	210 (519)	378 (934)	3.1	6.5	50.0	60.7	25.0	54.4	0	8.1	16.1	4	9.3	5	105	5	229	4
Balsam Fir	0	.07	0	24 (59)	0	.4	0	100.0	0	80.0	0	0	0	-	25.0	1*	0	-	24	7
Mountain Ash	.14	.13	165 (407)	72 (178)	2.3	1.2	84.8	<u>73.3</u>	66.6	<u>73.3</u>	2.9	3.2	42.4	2	61.0	2	140	4	53	6
Willow	.28	.30	459 (1134)	392 (968)	6.7	6.7	49.5	84.1	42.5	<u>81.7</u>	0	21.9	7.3	6	12.6	3	227	3	330	3
Mountain Maple	.32	.30	1100 (2717)	866 (2139)	16.1	14.9	9.3	49.7	8.1	46.4	3.4	12.1	.6	9	3.3	6	102	5	430	2
Dogwood	.03	0	14 (34)	0 (0)	.2	0	66.7	0	33.3	0	0	0	333.5	1*	0	-	9	7	0	-
Pincherry	.26	.39	445 (1099)	277 (684)	6.5	4.8	51.6	50.0	32.2	41.4	1.1	6.4	7.9	5	10.4	4	230	3	138	5
Juneberry	.17	.27	96 (237)	359 (887)	1.4	6.2	40.0	65.3	25.0	52.0	0	3.8	28.6	3	.8	8	38	6	234	4
Trembling Aspen	.43	.38	1024 (2529)	273 (674)	14.9	4.7	48.6	89.4	35.5	64.9	5.7	50.5	3.3	7	.7	8	498	2	244	4
Beaked Hazel	.51	.54	3338 (8245)	3171 (7832)	48.8	54.6	35.4	62.3	23.5	54.6	2.1	31.8	.7	8	.9	7	1182	1	1975	1
Mean $\bar{x}$	.24	.29					43.6	63.5	29.2	54.9	1.5	13.8								
Total			6851 (16921)	5812 (14355)													2531		3657	

[1] Frequency index = $\frac{\text{No. of plots containing species X}}{\text{Total no. of plots}}$

[2] The same ranking was given to more than one species where numbers were similar.

[3] Preference factor = $\frac{\text{Percent of stems of species X browsed}}{\text{Percent of toal available stems represented by species X}}$ (Stoddard and Smith 1955)

A preference factor 1.0 indicates a species is being utilized more than it's availability would suggest.

* sample too small to be meaningful

Moose in the Cache Lake area are obviously exerting considerable pressure on the browse component of their range. The percentage of stems browsed has increased significantly ($P \leq .01$) since 1970. About 63% of all stems with available browse were utilized by moose, and about 55% of all stems browsed were hedged (Table 2). These data, coupled with the fact that the percentage of stems killed by browsing has increased to about 8 times the 1970 level, indicate a deteriorating browse component on the moose range in the Cache Lake area. Stasus (1970) predicted that if browsing pressure continued on the Cache Lake study area, "it is expected that the figure for stems killed will rise significantly". The percentage of stems hedged and the percentage of stems killed have both increased significantly (T test - $P \leq .01$) since 1970 (Table 2).

There are two possible explanations for the increase in hedging and stems killed by browsing. Theoretically, in the 13 years since the study area was cut,many of the browse species, especially the tree species, should be growing out of reach of the moose. If this occurred, it follows that moose would be browsing the fewer stems which remained within reach more intensively. It is unlikely that this is the case. The dramatic increase in hedging and stems killed by browsing since 1970 has only been accompanied by an insignificant ($P>.05$) 15% decrease in available stems/ha since 1970. A more plausable explanation is that the number of moose using the study area has increased markedly in 8 years and browsing pressure has increased accordingly. Aerial census data support this hypothesis (see Table 1).

Changes in Important Browse Species and Preferential Browsing

A browse species' importance was determined by the number of stems browsed (Table 2). The more a particular species was browsed, the more important that species was considered to be in supplying part of the local moose population's October to May nutritional requirements. Using the number of browsed stems as the criterion for importance assumes that there is neither a difference in the number of twigs produced by various species nor in the extent to which the twigs of each species are utilized. While it is not possible to assume that the number of twigs produced for each stem of each species is the same, it can be assumed that for many important browse species (except mountain ash), the twig availability/species is similar when averaged over all height classes tallied (Table 3). The degree to which available twigs of each species were utilized, as indicated by the percentage of stems for each species which were hedged, while somewhat higher for balsam fir, mountain ash and willow are similar for the other species (Table 2). Of the three aforementioned species, only willow supplies a significant portion of the browse component.

Table 3. Mean number of twigs/stem by cover type between the heights of 61 and 254 cm for five important browse species, Spruce River Road area, Thunder Bay, Ontario (from McNicol 1976)

	Mean Number of Twigs/Stem by Cover Type			
Browse Species	Scattered Residual[1]	Dense Conifer	Open Natural[1]	Open Planted
White Birch	11	10	13	12
Willow	11	5	17	10
Mountain Ash	7	4	6	10
Pincherry	11	2	16	11
Trembling Aspen	8	-	15	15
MEAN	9.7	4.2	13.4	11.6

[1] These two cover types were virtually the only cover types available (and therefore sampled) in the Cache Lake study cutover

Beaked hazelnut was the most important browse species both in 1970 and 1978. White birch and willow remained the same or similar in terms of their importance ranking, while other browse species such as mountain maple have become more important and trembling aspen less important.

There is a strong positive correlation between the importance of a browse species (ie. no. of stems browsed) and it's availability. A linear regression plotting living stems/ha against total stems browsed for each species tallied showed a significant ($P \leq .01$) positive correlation between the two variables for both 1970 ($r = .95$) and 1978 ($r = .99$) (Fig. 3).

The most consistently preferred browse species on the study area in both study periods was mountain ash (Table 2). White birch, willow and pincherry were the next most consistently preferred browse species. A preferred browse species is one which is utilized by moose more than it's availability would suggest. Unlike a browse species' "importance", no correlation was found between a browse species' preference factor and it's availability. It seems logical to assume that a preferred browse species is sought out by moose (and other ungulates) because it is either more palatable than other browse species or because it is more nutritious. McNicol and Gilbert (1979) found, as did this study, that mountain ash and white birch were among the most consistently preferred browse species on the 16 upland mixed cutovers they studied for two winters. Their study area was approximately 200 km east of the Cache Lake study area. Nutrient analysis of mountain ash, the most consistently preferred browse species in both studies, revealed that it contained less crude fibre and more crude protein, calcium and phosphorus than either of the other two preferred species, willow and white birch (McNicol 1976). Lindlof et al. (1974) working on

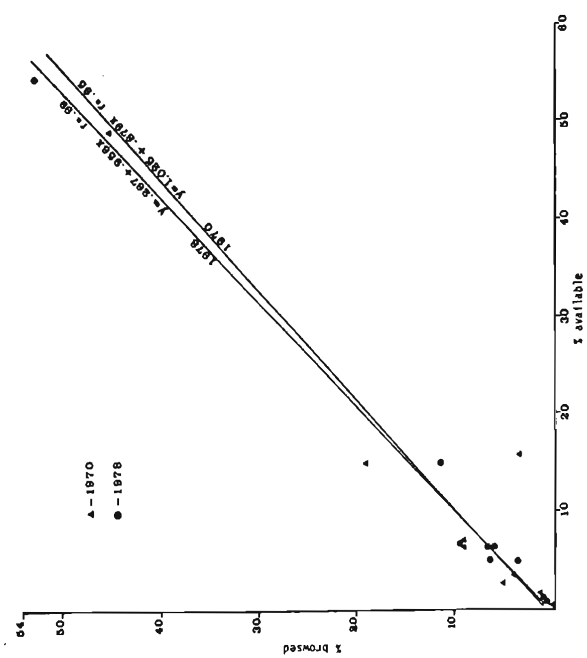

Fig. 3 Relationship between the number of stems of 9 species browsed and their availability expressed as a percentage of total.

mountain hares (*Lepus timidus*) and Anderson *et al.* (1974) working on mule deer (*Odocoileus hemionus*) also showed preferential use of browse species to be positively correlated with high crude protein levels.

Pellet Groups

Neff (1968) reported that although pellet group counts as a big game population estimator were susceptible to a number of biases, it appears to be a method which yields reliable data under most field conditions when properly conducted. A total of 80 pellet groups, deposited in the period between the completion of leaf fall and the survey (May 25), were recorded on 68 plots. At least one pellet group was recorded on 53.6% of the plots and of those plots containing pellet groups, 62.2% contained more than one pellet group. In comparison, McNicol (1976) reported that on mixedwood cutovers of the same age, in an area supporting medium moose densities (.1 - .3 moose/km^2), only 19% of the plots investigated contained pellet groups and of those, only 19% contained more than one pellet group. The plots used in the aforementioned study were three times as large as those used in the Cache Lake study. These data further demonstrate the extensive utilization of the study cutover by a high density moose population.

CONCLUSIONS

Intensive browsing pressure on the Cache Lake study cutover over an 8 year period has caused a decrease in the availability of most browse species. The 88.0% increase in the mean number of stems hedged and the 820.0% increase in the mean number of stems killed by browsing over 8 years indicate that moose densities of 5/km^2

($12/mi^2$) on this moose range probably exceed the carrying capacity. Under continued heavy browsing it is probably that the Cache Lake area moose range will experience the same loss of preferred browse species and/or browse species which cannot withstand heavy browsing pressure as has been reported for heavily utilized habitats in Newfoundland (Pimlott 1953) and Isle Royale (Krefting 1951).

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