MOOSE DISTRIBUTION AND WINTER HABITAT ON THE LOWER NORTH SHORE OF THE ST. LAWRENCE RIVER - QUEBEC

Guertin, G., Vice-présidence Environnement, Hydro-Québec
870, boul. de Maisonneuve, Montréal, Québec H2L 4S8

Doucet, G.J., Dept. Renewable Resources, Macdonald College
Ste-Anne de Bellevue, Québec H9X 1C0

Weary, G.C., André Marsan & Assoc. Inc.
1210 Sherbrooke St. W., Montréal, Québec H3A 2R5

RESUME

Dans le cadre de l'étude des impacts sur l'environnement de l'aménagement hydroélectrique du bassin de la rivière Romaine sur la Basse Côte Nord du St-Laurent, nous avons depuis 6 ans étudié l'interrelation entre l'orignal (Alces alces) et son habitat d'hiver. Des inventaires aériens, couplés à l'analyse de l'habitat par photointerprétation et par des relevés au sol, nous ont permis de dresser un portrait de l'habitat d'hiver de cet ongulé à sa limite nord-est de distribution au Québec. Un total de 92 ravages furent observés renfermant en moyenne chacun 1,7 orignal. Nos données montrent la très grande importance de la vallée principale où nous retrouvons 75 (82%) ravages. Ces derniers sont surtout situés à mi-versant, au bas des versants ainsi que sur les replats ou les iles boisées. L'orignal, qui semble se déplacer de ravage en ravage au cours de l'hiver, y trouve une nourriture abondante et un couvert adéquat. Les vallées secondaires et les interfluves montrent peu d'utilisation malgré une abondance de nourriture. Tous les ravages observés étaient situés dans des milieux plats ou à faible pente et la grande majorité (98%) des ravages étaient situés dans des aires bien drainées. La plupart des ravages étaient caractérisés par des associations d'épinettes noires (Picea mariana), de bouleaux blancs (Betula papyrifera), de jeunes sapins baumiers (Abies balsamea) et d'aulnes (Alnus spp.). Les expositions sont à très forte proportion (97%) orientées vers le sud, le sud-est et le sud-ouest. Les conditions climatiques rigoureuses (température, exposition au vent, ensoleillement, neige) pourraient être les facteurs sélectifs qui limitent les densités d'orignaux. Le micro-climat hivernal des vallées permettrait la survie et le maintien d'une population locale. Le rôle possible des éléments nutritifs dans l'interrelation entre l'orignal et son habitat d'hiver est également discuté.

ABSTRACT

This paper presents the results of a 6-year study of the relationship between moose (Alces alces) and their winter habitat in the Romaine River watershed on the Lower North Shore of the St. Lawrence River.

Winter surveys, photointerpretation and summer field work carried out as part of an environmental analysis performed prior to the development of a hydroelectric complex have provided valuable information concerning winter habitat use by moose at the northeastern limit of their distribution. A total of 92 yards were observed and the mean number of moose per yard was 1.7. The most striking result is the importance of the main river valley to moose as winter habitat. A total of 75 yards (82%) were located in the main valley. Moose find shelter, better food supplies, and opportunities to move between food and cover patches in large river valleys. This is particularly evident in the case of forested islands and river terraces which are prime winter habitats. Secondary valleys and higher areas showed limited use, despite the apparent presence of abundant food. All yards were located on flat areas or gentle slopes and the great majority (98%) were located in well drained areas. Most yards were characterized by pure or mixed stands of black spruce (Picea mariana) with adjacent patches of white birch (Betula papyrifera), young balsam fir (Abies balsamea) and alder (Alnus spp.). Practically all winter yards (97%) were located at least partially on a southern exposure. It appears that critical limiting factors are climatic in nature (temperature, exposure, snow conditions). The availability of southern exposures could be acting as a selective factor to limit the size of the population at the northern limit of moose distribution. Survivors and breeders would be those that exploit the winter habitat resources in the valleys of large rivers. The possible role of nutrients in the moose-winter habitat interactions is also discussed.

The scheme to develop hydroelectric complexes on rivers draining the Lower North Shore of the St. Lawrence River has generated a series of studies concerned with the biophysical resources of that vast area. This framework created an excellent opportunity to study moose (Alces alces) habitat utilisation at the northeastern limit of their range in Quebec. Several authors (Phillips et al. 1973; Berg and Phillips 1974; Brassard et al. 1974; Krefting 1974; Peek et al. 1976; Taylor and Ballard 1979; Addison et al. 1980; Doerr 1983) have discussed winter habitat use by moose in various localities. The present paper discusses winter habitat

selection and use by moose in a harsh environment, under very low population densities and near the northern limit of its range. The objectives of the study were to: 1) determine distribution and winter habitat utilisation patterns of moose in the Romaine River watershed, 2) determine the critical components of winter habitats, 3) elaborate the basis for the formulation of a moose winter habitat classification applicable to other areas of the Lower North Shore of the St. Lawrence River.

STUDY AREA

The study area encompasses the major portion of the Romaine River watershed, located in the Lower North Shore of the St. Lawrence River in northeastern Quebec (Figs. 1 and 2). The study area belongs to the Chibougamau-Natashquan Section of the Boreal Forest (Rowe 1972). It is dominated by black spruce (Picea mariana) forests, with numerous open stands where fire has often played an important role in shaping the plant communities. The climate is very harsh and the influence of the maritime climate is reduced towards the headwaters. The average annual snowfall exceeds 500 cm and the mean number of days of snow accumulation and freeze-up is approximately 220. The average January temperature is -20^{0}C, and strong winds mainly from the south and southeast are common during winter (Wilson 1971; Rolland 1975).

The area presents a mosaic of very heterogeneous habitats. Audet (1978) identified five different natural regions, each presenting very different habitat conditions for moose. These five physiographic regions

are: 1) the coastal plain, 2) the Piedmont (foothills), 3) the Contreforts, 4) the Laurentian Plateau, and 5) the Romaine-Mécatina Basin (Fig. 2). Near the Romaine River delta, the flat coastal plain is approximately 20 km wide, bog-laden and largely devoid of trees. The coastal plain is practically unused by moose. The Piedmont region is 30 km wide, the climate is still coastal marine, the topography is undulating and summits are usually rock outcrops. Terraces and lower slopes present pure and mixed stands of balsam fir (Abies balsamea), black spruce and trembling aspen (Populus tremuloides). Willows (Salix spp.) and alders (Alnus spp.) are found in valley bottoms. The Contreforts consist of a 90 km wide plateau with very rugged topography where elevations can reach 900 m. Stands of black spruce are virtually continuous except where destroyed by recent fires, and replaced by pioneer species such as trembling aspen and birch. Slopes are often characterized by rocky facades and bottom terraces are usually occupied by stands of balsam fir (Audet 1978). The Laurentian Plateau is approximately 60 km wide, and is characterized by well drained sandy soils. Open stands of black spruce with lichen mats occur in higher areas and denser stands of spruce and balsam fir are found in valleys and on islands. Shorelines of slow running sections of large streams and rivers are generally occupied by a narrow band of rough alder (Alnus rugosa), green alder (A. crispa) and willows (Salix spp.). Fire plays an important role in habitat development in this region; it creates large tracts where cover and food are interspersed. The Romaine-Mécatina basin is a vast flat plain where large tracts of black spruce are broken by large lakes, bogs and fens (Audet 1978).

METHODS AND MATERIALS

The approach used in the present study was tailored to the vast hinterlands of the Lower North Shore. Wildlife surveys in this area have been relatively few and in general little is known about its potential. To determine the use of winter habitats by moose and obtain preliminary population estimates, aerial surveys were conducted: a) on the Lower North Shore in general during March 1978 (Audet 1979) and 1979 (Bérubé 1980), and b) in the Romaine watershed specifically during February and March 1980 (Bérubé 1980). The 1980 surveys were carried out by helicopter (Bell 206 Long Ranger) at a speed of 160 km/hr and at an altitude of 100 m. The 1978 and 1979 transects were located 10-40 km apart and yielded general information on the regional distribution of moose on the Lower North Shore. On the other hand, the 1980 transects were concentrated in the lower and mid portion of the Romaine river watershed (Fig. 2). The transect lines were oriented north-south, 1 km apart and provided a total coverage of the survey zone. Observations in the uppermost section of the watershed were limited to a single flight along the shores of large lakes (Fig. 2). During these surveys, observations of moose and old or fresh track networks determined the location and surface area of moose yards. The biophysical characteristics of the yards were also noted during the surveys. Although numerous other characteristics were noted at the time (Audet and Guertin 1981), only landform, exposure, slope, drainage and vegetation type and structure were retained in the present analysis (Table 1).

Prior to the 1982 and 1983 field studies, air photo

interpretation was used to integrate information on forest cover and potential winter habitat, with the data on moose yard distribution obtained during the 1978-1980 winter inventories. Interpretation criteria used to select potentially good moose wintering habitat included: large valleys, islands, slopes with southern exposure, mixed stands (with regeneration of white birch, balsam fir, alder and willow), proximity of water and good drainage. The photointerpretation analysis identified all potential winter habitats in a large area of the watershed on each side of the main river. A total of 205 such potential moose wintering areas were identified in the area totally covered by aerial surveys. The final step was to undertake summer field investigations in 1982 and 1983 of areas covered by the 1980 winter surveys. The goal of these summer surveys was to verify the photointerpretation and confirm moose use of identified (winter surveys) and potential (photointerpretation) yards. During these summer surveys, qualitative information was gathered on browsing intensity, repeated browsing over the years, pellet groups, slope constraints, understory vegetation, and changes in vegetation since the last aerial photos (i.e. fires). This report presents an analysis of the above studies, and discusses winter habitat use by moose in the Romaine River watershed.

RESULTS AND DISCUSSION

Distribution

Brassard et al. (1974) attributed the extension of moose range in the northeastern part of Québec to disturbances resulting from forest fires. Recent surveys show that moose range extends beyond the limits

(Fig. 1) identified by Brassard et al. (1974). These authors suggested that moose density was higher in the western portion of the Lower North Shore than further east. Our surveys indicate the same trend but show a much lower density (1.5/100 km^2) in the Romaine watershed than the overall mean density (6.0/100 km^2) estimated by Brassard et al. (1974) for the St. Lawrence North Shore in general.

Our observations on behaviour and movement point to a possible colonization of the Romaine river study area from the north where individuals migrate from west to east in the flat Laurentian Plateau region. Individual moose then disperse southward along major valleys; some of this dispersal probably takes place in the winter since the majority of yards are located in large valleys.

Despite the lack of uniform survey coverage within the entire Romaine river watershed, our observations strongly suggest that moose densities are higher in the Laurentian Plateau and the Contreforts than in the coastal plain and the Piedmont.

Yards

The total area surveyed in the Romaine watershed in 1980 was 3,990 km^2. A total of 38 recently used (fresh tracks) winter yards were observed and 54 old ones (sun-eroded tracks) were identified. Of the 63 moose seen, 34 were female, 10 male and 19 unidentified. Several observations (28.6%) were of calves or yearlings. In February 1980, most yards were 0.10 to 0.20 km^2 in area, more than 97% were less than 0.50 km^2 (Fig. 3a) and the mean area of 91 winter yards was 0.20 ($\pm$ 0.02) km^2. This

represents half the size of the mean area (0.44 km^2) observed by Proulx and Joyal (1981) in La Vérendrye Reserve and only 6% of the area of a typical winter yard (3.25 km^2) as described by Potvin (1972). The average number of animals per occupied yard was 1.7 moose and the moose population of the entire Romaine watershed was estimated at approximately 200 individuals (Lavalin 1983).

Most wintering areas observed were located in the main valley (82%), on flat areas or gentle slopes (100%), southern exposures (97%) and well drained areas (98%) (Fig. 3). Most of the yards were characterized by a black spruce canopy with adjacent young stands of white birch, balsam fir and alders (Fig. 4). The great majority of moose yards were observed near riparian habitats associated with islands, river terraces and gentle slopes of the large Romaine River valley itself. Tributary watersheds were used to a lesser extent and adjacent uplands were practically unused in mid-winter (Fig. 3). It appears that the large Romaine valley offered the best combination of browse and cover for overwintering moose and provided abundant browse and protection against the rigorous climate which includes long winters, cold temperatures, heavy snowfall and high winds. Berg and Phillips (1974), Peek (1974), Sumanik and Demarchi (1977) and Doerr (1983) have noted high moose activity in riparian habitats during winter months. Several other authors (Edwards and Ritcey 1956; Klein 1965; Leopold and Leonard 1966; Leresche et al. 1974) have also observed relatively high moose activity in valley bottoms during winter.

A total of 205 potential yards were identified by

photointerpretation in the mid-portion of the Romaine watershed (Fig. 2). No moose activity was detected in these potential yards during the 1980 winter surveys despite the fact that these areas presented similar characteristics as active yards. The major difference between active yards and potential yards resides in the fact that very few of the latter were located in the major river valley. The 1982 and 1983 summer surveys indicated that several potential yards had sustained browsing, some even presented evidence of repeated browsing over the years. Since the 1980 winter surveys showed no moose activity in these potential yards, it is likely that their use is limited to summer and fall and perhaps to mild winters. Otherwise, moose migrate down into the sheltered valley when severe winter conditions make the uplands inhospitable.

The moose in the Romaine River watershed are practically at the northeast limit of their distribution and it is likely that climate has a great influence on survival. This is supported by the fact that 82% of winter yards were located in the main river valley and that 97% were located on slopes with south exposure, where climatic factors are attenuated. Brassard et al. (1974) and Proulx (1983) showed that moose did not require a south-facing slope in the Mauricie area in southern Quebec. It is possible that the availability of south-facing yards could be one of the factors which limit the moose population of the Romaine watershed. Natural selection would favour the individuals that occupy south-facing yards while moose in other areas (except islands) could be at a relative disadvantage in the competition for winter survival.

Nutrients

The Romaine River watershed is nutrient-poor with lakes showing total dissolved solids values of 6.3 to 20.8 mg/l (Lavalin 1979). Forest fires in the upper reaches liberate nutrients which are washed towards the main valley at snowmelt and carried downstream where they may be deposited on terraces, floodplains and islands. Lower riparian habitats of the main valley are likely to be relatively nutrient-rich compared to the highlands. The better plant growth and abundant browse available in these areas are likely due to this concentration of nutrients.

Belovsky (1978) and Westoby (1974, 1978) have suggested that nutrients could be a major factor in the exploitation strategy of food resources by moose. The prevalent influence of fire on plant ecology in the Romaine watershed, coupled with the winter habitat use data constitutes supporting evidence that migrating to the large valley in winter could provide an advantage to moose from a nutrition point of view. However climate is most likely the overriding factor which dictates the winter migration into the valley. The role of nutrients as a selective factor in this winter habitat use pattern can only be determined through empirical research.

Movements

Winter movements of moose in river valleys have been reported by Mould (1979) and Knowlton (1960). Track patterns indicate that moose in the Romaine watershed move to the valley in early winter and from yard to yard and from cover to feeding areas during the winter months. Moose appear to move among islands and between islands and forested river

terraces, suggesting that winter browse was a critical factor for moose in the Romaine watershed. It is postulated that, unless pressured by predators, moose in this area successively exploit a relatively small patch of food (i.e. island) to a depletion point where it becomes more advantageous for an animal to move to another island or riparian terrace. These movements are greatly facilitated by travelling on the windswept frozen river. Such a pattern of habitat exploitation would fit the general theory of optimal foraging (Pyke et al. 1977).

CONCLUSIONS

Results indicate that in the Romaine river watershed, the great majority of moose winter yards were located in the main valley. Winter habitats of the Romaine valley offered better shelter and possibly provided more and better quality browse which was easily accessible through easier movements on the frozen river. Such winter movements between potential yards would be extremely difficult in the absence of a travel lane provided by a frozen river. The importance of main valleys as winter habitat emerges as a major factor in a moose habitat classification for the Lower North Shore of the St. Lawrence River.

LITERATURE CITED

Addison, R.B., J.C. Williamson, B.P. Saunders, and D. Fraser. 1980. Radiotracking of moose in the boreal forest of northwestern Ontario. Can. Field-Nat. 94: 269-276.

Audet, R. 1978. Description sommaire de la végétation de la Moyenne et de la Basse Côte Nord. Direction Environnement. Ecol. Biophysique, Hydro-Québec, Montréal. 48 pp.

Audet, R. 1979. Inventaire aérien de l'ensemble du bassin versant de la Moyenne et Basse Côte Nord. Mars 1978. Hydro-Québec. Direction Environnement. Rapp. Inter. 42 pp.

Audet, R., and G. Guertin. 1981. Habitat des ongulés de la Côte Nord, mars 1980. Hydro-Québec. Direction Environnement. Rapp. Inter. 4 pp.

Belovsky, G. 1978. Diet optimization in a generalist herbivore: the moose. Theor. Pop. Biol. 14: 105-134.

Berg, W.E., and R.L. Phillips. 1974. Habitat use by moose in northwestern Minnesota with reference to other heavily willowed areas. Nat. Can. 101: 101-116.

Bérubé, R. 1980. Inventaire aérien des ongulés. Rivières Romaine, Aguanus, Olomane, Saint Augustin et Saint Paul. Rapp. Tech. Hydro-Québec. Direction Environnement. 14 pp.

Boudreau, F., et F. Bisson. 1983. L'inventaire du Capital-Nature de la Moyenne-et-Basse-Côte-Nord: observation sur la distribution et l'habitat de l'orignal en Moyenne-et-Basse-Côte-Nord. SICN, No. 2. 40 pp.

Brassard, J.M., E. Audy, M. Crête, and P. Grenier. 1974. Distribution and winter habitat of moose in Quebec. Nat. Can. 101: 67-80.

Doerr, J.G. 1983. Home range size, movements and habitat use in two moose, Alces alces, populations in southeastern Alaska. Can. Field-Nat. 97: 79-88.

Edwards, R.Y., and R.W. Ritcey. 1956. The migration of a moose herd. J. Mammal. 37: 486-494.

Klein, D.R. 1965. Postglacial distribution patterns of mammals in the southern coastal regions of Alaska. Arctic 18: 7-20.

Knowlton, F.F. 1960. Food habits, movements, and population of Moose in the Gravelly Mountain, Montana. J. Wildl. Manage. 24: 162-170.

Krefting, L.W. 1974. Moose distribution and habitat selection in north-central North America. Nat. Can. 101: 81-100.

Lavalin, Inc. 1979. Rivière Romaine: limnologie et ichthyofaune des bassins des rivières Saint-Jean et Romaine. Rapp. Tech. Hydro-Québec, Direction Environnement. 84 pp.

Lavalin, Inc. 1983. Etude intégrée d'environnement de la Romaine. Milieu terrestre: répercussions des réservoirs R03 et Saint Jean et mesures d'insertion correspondantes. Rapp. Prélim. Hydro-Québec, Vice-

présidence Environnement. 139 pp.

Leopold, A.S., and J.W. Leonard. 1966. Effects of the proposed Rampart dam on wildlife and fisheries. Trans. North Am. Wildl. and Nat. Resour. Conf. 31: 454-459.

LeResche, R.E., R.H. Bishop, and J.W. Coady. 1974. Distribution and habitats of moose in Alaska. Nat. Can. 101: 143-178.

Mould, E. 1979. Seasonal movement related to habitat of moose along the Colville River, Alaska. Murrelet 60: 6-11.

Peek, J.M. 1974. On the nature of winter habitats of Shiras moose. Nat. Can. 101: 131-141.

Peek, J.M., D.L. Urich, and R.J. Mackie. 1976. Moose habitat selection and relationships to forest management in northeastern Minnesota. Wildl. Monogr. 48. 65 pp.

Peek J.M., R.E. LeResche, and D.R. Stevens. 1974. Dynamics of moose aggregations in Alaska, Minnesota, and Montana. J. Mammal. 55: 126-137.

Phillips, R.L., W.E. Berg, and D.B. Siniff. 1973. Moose movement patterns and range use in northwestern Minnesota. J. Wildl. Manage. 37: 266-278.

Potvin, F. (ed.). 1972. L'aménagement intégré de la faune et de la forêt au Québec: normes générales. Ministère du tourisme, de la chasse et de la pêche. Faune du Québec Bull. Numéro 16. 48 pp.

Proulx, G. 1983. Characteristics of moose (Alces alces) winter yards on different exposures and slopes in southern Quebec. Can. J. Zool. 61: 112-118.

Proulx, G., and R. Joyal. 1981. Forestry maps as an information source for description of moose winter yards. Can. J. Zool. 59: 75-80.

Pyke, G.H., H.R. Pulliam, and E.L. Charnov. 1977. Optimal foraging: a selective review of theory and tests. Q. Rev. Biol. 52: 137-154.

Rolland, R. 1975. Côte-Nord: aspect climatique du bassin versant de la Romaine. Hydro-Québec, Projet de Centrale.

Rowe, J.S. 1972. Les régions forestières du Canada. Information Canada, Ottawa. 172 pp.

Sumanik, K.M., and D. Demarchi. 1977. Dispersion and relative abundance of Moose in northern British Columbia. Proc. N.A. Moose Conf. Worksh. 13: 252-257.

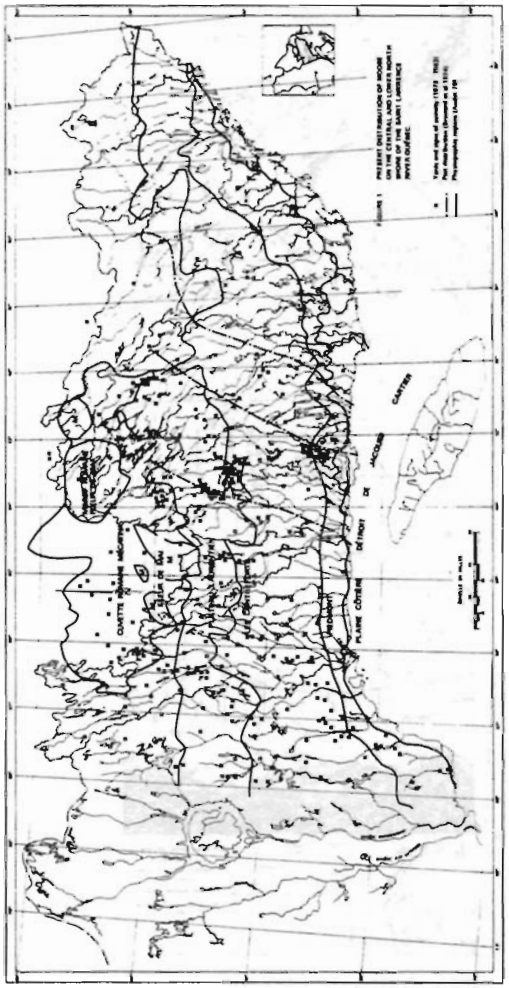
Taylor, K.P., and W.B. Ballard. 1979. Moose movements and habitat use along the Susitna River near Devil's Canyon. Proc. N.A. Moose Conf. Worksh. 15: 169-186.

Westoby, M. 1978. What are the biological bases of varied diets? Am. Nat. 112: 627-631.

Westoby, M. 1974. An analysis of diet selection by large generalist herbivores. Am. Nat. 108: 290-304.

Wilson, C.V. 1971. Le climat du Québec: atlas climatique. Services Météorologiques du Canada (Maps).

41



42

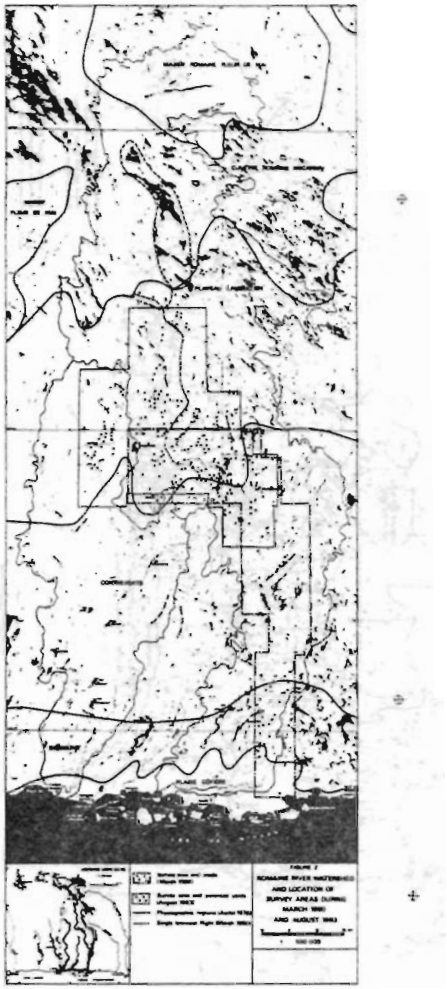


Table 1 CHARACTERISTICS USED TO DESCRIBE MOOSE YARDS IN THE ROMAINE WATERSHED

CODE	LAND FORM
Vt	Valley Terrace
Vs	Valley Slope
Vi	Valley Island
L	Lake
S	Summit
D	Depression
P	Plateau
T	Bog or Fen

CODE	VEGETATION
EPN	Black spruce
BOP	White birch
AUC	Green alder
SAB	Balsam fir
PET	Trembling aspen
AUR	Rough alder
MU	Moss
LI	Lichen

CODE	DRAINAGE
1	Good
2	Average
3	Bad
4	None

CODE	SLOPE
1	None
2	1 to 8%
3	9 to 15%
4	16 to 30%
5	31% and more

CODE	EXPOSURE
S	South
SE	South east
S-W	South west
E	East
N	North
NE	North east

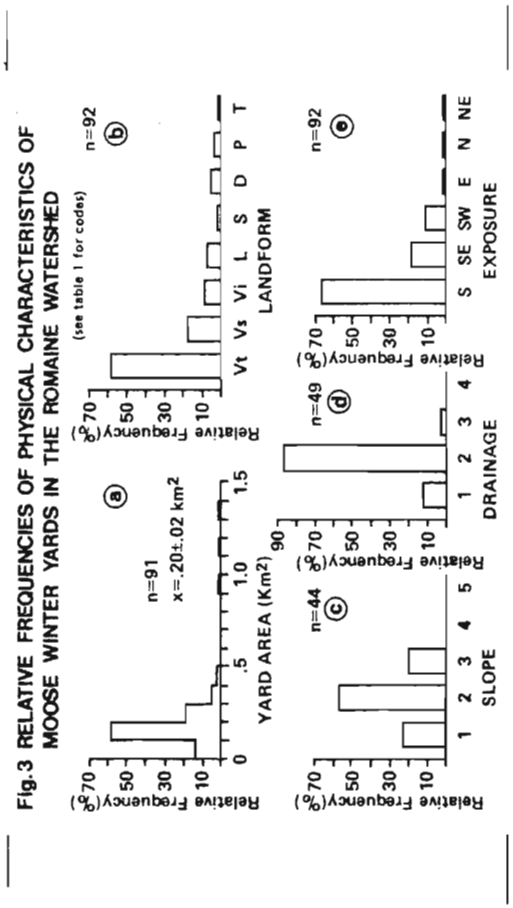


Fig.3 RELATIVE FREQUENCIES OF PHYSICAL CHARACTERISTICS OF MOOSE WINTER YARDS IN THE ROMAINE WATERSHED

Fig.4 RELATIVE FREQUENCIES OF VEGETATION CHARACTERISTICS OF MOOSE WINTER YARDS IN THE ROMAINE WATERSHED

(see table 1 for codes)