HOW THE MOOSE CAME TO ALGONQUIN

M.L. Wilton
Ontario Ministry of Natural Resources
Huntsville, Ontario, Canada, P0A 1K0

Abstract: Possible reasons for the decline of the white-tailed deer (Odocoileus virginianus) population in Algonquin Provincial Park during the late 1960s and early 1970s and the subsequent development of a strong moose (Alces alces) population are explored. Such factors as climatic severity, declining deer habitat, wolf (Canis lupus) predation, and occurrence of meningeal worm (Parelaphostrongylus tenuis) are examined. The future of deer and moose in Algonquin Park is discussed.

ALCES 23 (1987)

Keywords: White-tailed deer (Odocoileus virginianus), moose (Alces alces), climatic severity, declining habitat, wolf (Canis lupus) predation, meningeal worm (Parelaphostrongylus tenuis).

While white-tailed deer (Odocoileus virginianus) are known to have existed in Algonquin Park at least since the 1860s (Bice pers. comm.), it is generally felt that as a result of intensive logging and subsequent slash fires, the Algonquin Park deer population reached its peak in the early 1920s, when Mark Robinson, Park Superintendent, estimated that there were "tens of thousands of deer in

the Park". A downward trend in the deer population then occurred and by 1933 Robinson estimated the total Park population to be about 3000 animals, or, 1 per square mile (0.4/km²). Subsequent fluctuations in the population ultimately gave rise to increases which culminated in 1958 with the Park deer population being estimated at approximately 30,000-36,000 or 10-12 deer per square mile (4-5/km²) (Runge and Theberge, 1974).

The severe winters of 1959 and 1960, are generally credited with having precipitated the most recent Algonquin Park deer population decline.

The Algonquin Park moose population was estimated to number about 1400 animals (0.2/km²) in the late 1950s (Pimlott et al. 1969).

RECENT TRENDS IN THE DEER AND MOOSE POPULATIONS

While deer population estimates were not conducted in Algonquin Park prior to 1969 it is generally felt by Ontario Ministry of Natural Resources staff that the deer population suffered large losses during the severe winters of 1959 and 1960, and continued to decline thereafter. Deer population estimates obtained from pellet group surveys conducted between 1969 and 1974 (Wilton and Trodd, 1969-72; Ludwig, 1974) indicated a sharp decline during that period in the Algonquin Park deer population from approximately 8000 animals (1/km²) to approximately 1600 animals (0.2/km²).

Pellet group population estimates are conducted by counting the number of deer pellet groups deposited on stratified randomly selected plots during the period between leaf fall and green-up, and multiplying by appropriate factors.

Moose aerial population surveys conducted in Algonquin Park indicated an increase in moose numbers from a low of between 1455 (0.2/km²) and 2155 (0.3/km²) (90% C.L.) in 1975 (OMNR file rept.) to a high of between 3324 (0.4/km²) and 5147 (0.7/km²) (90% C.L.) in 1983 (OMNR file rept.). Subsequent surveys up to 1987 indicate either population stability or possibly a small decrease (Oram, 1986, 1987). Moose aerial population surveys are conducted by flying over stratified randomly selected 25 km² plots during the winter period with at least 30 cm of snow on the ground, and multiplying by appropriate factors.

CLIMATIC SEVERITY

Algonquin Park, situated in south central Ontario (Fig. 1), is located on the "Algonquin Plateau", high ground (308-523 m above sea level) between Georgian Bay (178 m above sea level) and the Ottawa River valley (150-185 m above sea level).

The climate in Algonquin Park, because of its higher elevation, more closely approximates the colder climate generally associated with more northerly areas, rather than with the surrounding areas to the east, west and south.

The mean number of frost free days in Algonquin (90-100 days) is less than the frost free days (110-120 days) in adjacent areas to the east, west and south (Fig. 1) (Brown et al, 1980).

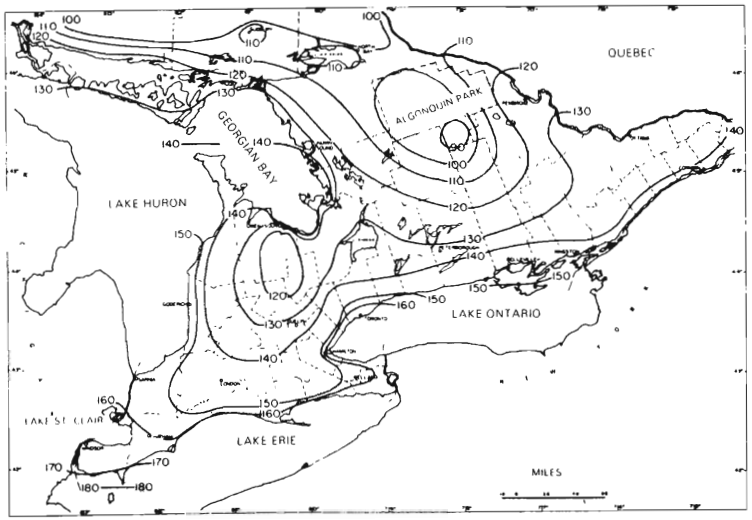

Figure 1.
Mean annual "frost free" period (days)
from "The Climate of Southern Ontario, 1980."

The mean annual precipitation across southern Ontario ranges from about 66 to 102 cm. (26 to 40 in.). This variation is closely related to the slope and elevation of the land, location relative to the Great Lakes and prevailing wind direction. The highest values are found on the slopes east of Lake Huron and Georgian Bay which receive about 102 cm. (40 in.) of precipitation annually. These areas are exposed to prevailing westerly winds arriving off Lake Huron, with greater precipitation occurring to

the west and lesser precipitation occurring in the "rain shadow" to the east.

The mean annual snowfall in western Algonquin Park accounts for about 30 percent of the total annual precipitation and ranges from 203 to 254 cm (80 to 100 in.) with lesser amounts falling east of the "Algonquin Plateau". Although much of the snowfall is caused by frontal storms, a large percentage results from the exposure of this area to winds off Lake Huron (Brown et al, 1980).

Snow depths and crust conditions have been recorded weekly by the Ontario Ministry of Natural Resources across the Algonquin Region since 1953, in an effort to assess winter severity in relation to white-tailed deer survival (Passmore, 1953). Occasionally winter conditions occur throughout southern Ontario which make survival for white-tailed deer difficult. Such conditions are usually more critical in Algonquin Park because of the more severe climatic conditions encountered there. Winter severity from 1953 to 1983 has been summarized in Figure 2.

SOILS AND TIMBER TYPES

Western Algonquin Park is characterized by uplands of moderately rolling rock ridges, shallowly to moderately deeply covered with stony silty granitic sand tills. Eastern Algonquin consists of broad upland areas and fairly broad depressions which are overlain with sandy moraines, terraces

and outwash plains, comprised of a shallow to moderately deep mantle of sand and silty sand (Anderson, 1969).

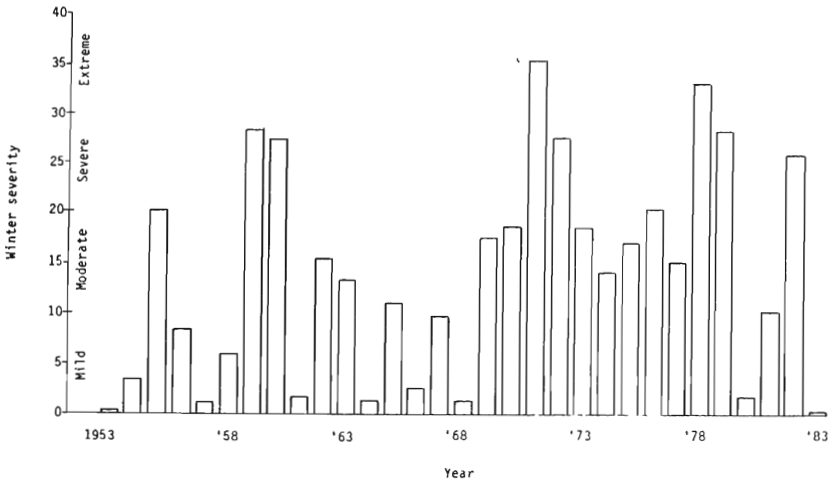

Figure 2. Winter severity in the Algonquin Region, 1953 to 1983.

The difference in soil types plus the fact that western Algonquin receives more precipitation than does eastern Algonquin has given rise to two major timber stand associations within the Park. The predominant timber stand association occurring in the western half of Algonquin Park is tolerant hardwood/hemlock, while the predominant stand association occurring in the eastern half is pine/poplar (Anderson, 1969).

DECLINING DEER HABITAT

In the central white-tailed deer range of Ontario, which includes Algonquin Park, deer will characteristically return to the same wintering area year after year (Hale pers. comm.). These areas are locally referred to as deer yards and while they may change size and shape during successive years, depending upon winter conditions, the central portion or "core" of the yard may remain of stable size and location for a period of as long as 30-50 years, barring major habitat disturbances (OMNR file repts.).

It is felt that deer are originally attracted to these yarding areas since they provide winter coniferous cover, and this minimizes snow depths allowing easier travel for food foraging and escape from predators. Deer cover is best provided in the western portion of Algonquin Park by hemlock (Tsuga canadensis), white pine (Pinus strobus), white spruce (Picea glauca), cedar (Thuja occidentalis) and balsam (Abies balsamea) in that approximate order, and in the eastern portion of the Park by white pine, cedar, red pine (Pinus resinosa), white spruce and balsam in that approximate order (Wilton, 1974; Euler and Thurston, 1980; Gates and Harman, 1980).

Deer feed in the winter by browsing the buds and branch tips of such species as hobblebush (Viburnum alnifolium), striped maple (Acer pensylvanicum), red (Acer rubrum) and hard maple (Acer sacharum), white (Betula papyrifera) and yellow birch (Betula alleghaniensis) and to a lesser extent poplar (Populus spp.), cedar and balsam in the west half

of Algonquin Park, while in the east half of the Park favourite winter feed species are hard maple, white birch, poplar, cedar, beaked hazel (Corylus cornuta), downy juneberry (Amelanchier canadensis), sweet fern (Myrica asplenifolia) and occasionally balsam and white and red pine (Wilton, 1985).

To determine the importance of changing habitat on the Algonquin Park deer population, all recorded logging and fire occurrence in Algonquin Park deer yards was assessed (Wilton, 1974), and is summarized in Table 1.

Table 1. Summary of areas cut over and burned over in Algonquin Park deer yards.

Deer Yard	Acres Cut	Acres Burned	% of* Yard Cut	% of** Yard Burned
Maple Lake	41,408	1046	55	2.1
Hogan Lake	55,168	4188	62	5.8
Lake Louisa	44,160	4476	35	4.2
Racehorse Rapids	35,658	735	63	1.5
Lake Traverse	25,216	1607	79	8.4
Nipissing River	1,856	2684	10	9.7
TOTAL	203,456	14,735	51	4.6

* 20 year period (1952-1971 inclusive)
**51 year period (1921-1972 inclusive)

In the 20 year period between 1952 and 1971 logging affected between 10% and 79% of the available winter deer habitat within the 6 major Algonquin Park deer yards. Harvest records yielded volume by species cut. While much of the cutting consisted of deciduous species and therefore gave rise to regeneration of desirable deer feed, large volumes of coniferous species such as hemlock, white pine and spruce in the west, and white pine, red pine and spruce in the east were also cut, thereby removing much needed winter cover from the deer yards.

In the 51 year period between 1921 and 1972 wildfire affected between 2% and 10% of the available winter deer habitat within the 6 major Algonquin Park deer yards. There is no record of either the intensity of these fires or the volumes and species destroyed (Wilton 1974).

Ontario Department of Lands and Forests staff members killed 675 wolves between 1945 and 1958 (30-92/yr) in Algonquin Park (OMNR files - Pembroke District). Subsequently wolf control was discontinued within the Park. During the years 1964 and 1965, 80 and 26 wolves respectively were trapped and killed in the Park as part of a wolf research program (Pimlott et al., 1969). No further wolf control measures have since occurred within Algonquin Park.

After 1959 and with the exceptions of 1964 and 1965, the wolf population within Algonquin Park was allowed to find its own level in an uncontrolled fashion. This was

during the period when deer numbers were documented as declining subsequent to the severe winters of 1959 and 1960. Algonquin wolves have been referred to as the "Algonquin type", differing somewhat from the subspecies Canis lupus lycaon (Kolenosky and Standfield, 1975; Schmitz and Kolenosky, 1985). This smaller Algonquin type occurs mainly in the mixed coniferous-deciduous forests and preys principally on deer and smaller mammals (Pimlott et al. 1969; Kolenosky, 1972) but seldom on moose (Kolenosky, unpublished data). Pimlott et al, 1969, found 676 deer and 4 moose killed or utilized by wolves in Algonquin Park between 1958 and 1965.

In spite of the rapid decline in deer numbers between 1969 and 1974, the Algonquin wolves were still (in 1974) at about 75% of the levels they had been at prior to the deer decline (Theberge and Strickland, 1978). The real decline in wolf numbers occurred subsequent to 1974, but was never documented in the literature (Strickland pers. comm.; Regan pers. comm.; Bice pers. comm.).

MENINGEAL WORM

Anderson (1964) demonstrated that the nematode parasite of white-tailed deer (Parelaphostrongylus tenuis), is the causal agent of (fatal) neurologic disease in wild moose. P. tenuis was found throughout the year in the cranium of 41% of 172 adult deer examined in Algonquin Park (Anderson, 1963).

Karns (1967) found an infection rate in Minnesota of 49% of 140 deer heads examined and concluded that infection is greater in areas of greater deer density. He further speculated that P. tenuis is the etiological agent of a neurological disease in moose and that it was likely responsible for the major population decline in Minnesota moose in the 1920s and 1930s.

Saunders (1973) found that the prevalence of P. tenuis in faeces of white-tailed deer was inversely related to moose population densities. Gilbert (1974) speculated that P. tenuis is apparently a limiting factor to the growth of the moose population in Maine, and the extent of influence is evidently a function of deer density; the prevalence in moose being directly related to deer density.

SUMMARY AND DISCUSSION

The deer population in Algonquin Park declined from approximately 8000 animals (1/km^2) in 1969 to approximately 1600 animals (0.2/km^2) by 1974. Moose numbered about 1400 (0.2/km^2) animals in the late 1950s, between 1455 (0.2/km^2) and 2155 (0.3/km^2) in 1975, and between 3324 (0.4/km^2) and 5147 (0.7/km^2) by 1983. This implies that a major increase took place in the moose population subsequent to the major decrease in the deer population.

The western slopes of the Algonquin Uplands (or Plateau) ascend rather sharply from Georgian Bay to elevations of

523 m above sea level near Cache Lake and tend to gradually decrease to levels of about 215 m above sea level as the eastern boundary of the Park is approached. This pattern of relief causes the moisture laden westerly winds to release their moisture in the western uplands causing a rain shadow effect in eastern sections which are thus influenced by relatively drier winds (Gordon, 1955; Anderson, 1969).

The most severe climatic conditions encountered in southern Ontario are to be found in Algonquin Park and actually more closely approximate the conditions found north of the 46th parallel of latitude. Average summer and winter temperatures are cooler than those found elsewhere in southern Ontario and in addition snow depths in the Park often restrict deer movement, and are usually more critical in the western upland area because of the moisture laden westerly winds off Lake Huron. Between the years 1953 and 1983 at least 9 winters (28%) were classed as severe for deer survival in the Algonquin Region.

The moister granitic tills in western Algonquin have given rise to a predominantly tolerant hardwood/hemlock timber stand association, while the drier sandier soils in eastern Algonquin support a predominantly pine/poplar timber stand association.

Logging is felt to have had an important detrimental effect on the Algonquin Park deer population since as much as 79% of deer yards were cut over in the 20 year period

between 1952 and 1971, removing much of the coniferous cover.

The cutting of deciduous species can be beneficial to deer in that regeneration of these species provides deer feed, but the cutting of such coniferous species as hemlock in western Algonquin or white pine in eastern Algonquin can remove important winter deer shelter. While there has long been a strong market for white pine which was used for ship's masts during the 1700s and 1800s and more recently for quality building products, hemlock was long regarded as a trash species and other than for use in the tan bark industry during the late 1800s and early 1900s, was largely disregarded by the logging industry (Macfie, pers. comm.).

During the 1960's however, hemlock markets were developed for shoring timber in such projects as the James Bay Hydro Quebec power development and the Toronto subway system. In addition, hemlock is now used in the thriving mushroom growing industry since it is moisture resistant and imparts no flavour or odour to the food product (Murray, pers. comm.).

Deer managers in central Ontario did not realize the importance of hemlock as a deer cover species and indeed the Ontario Department of Lands and Forests encouraged the cutting of hemlock even into the late 1950s, to stimulate the growth of more merchantable species such as yellow birch (Macfie, pers. comm.).

The loss of many large hemlock stands from western Algonquin Park could mean that deer may never again be able to winter in that portion of the Park in large numbers, since winter cover is more important in western Algonquin than in eastern Algonquin because of the greater snow depths experienced there.

Wildfire did not adversely affect Algonquin Park deer yards since less than 10% of the yards were burned over in the 51 year period between 1921 and 1972.

During the time when the Algonquin deer population was declining (1959-1974), control of wolves within the Park was stopped - with the exception of 1964 and 1965. This in effect meant that the wolf population was allowed to find its own level unchecked, at a time when deer numbers were declining due to deteriorating habitat and severe winters. If a wolf population is uncontrolled while its chief winter prey species is declining, then this has the effect of accelerating the decline.

Perhaps because of their smaller size, the Algonquin wolves were not able to make the transition from deer to moose as their chief winter prey species, since a decline in wolf numbers was observed subsequent to the decline of the deer population. This could imply fewer predation losses to the moose population which began building after the deer population declined.

Since it appears that the prevalence of P. tenuis in moose is directly related to deer density, then it is

probable that the decline in the Algonquin Park deer population which took place between 1959 and 1974 reduced the incidence of P. tenuis to the point where the moose population could expand toward its present level.

The future of deer and moose in Algonquin Park is uncertain. The removal of many large hemlock stands from the western portion of the Park will make it difficult for large numbers of deer to winter there, in view of the more severe winter conditions, and this may mean that the western Algonquin moose population can continue to expand. Deer numbers as well as wolf numbers (Strickland and Tozer, pers. comm.), may be increasing in the southern and eastern portions of the Park however, which could imply an eventual increase in P. tenuis with associated declining moose numbers in those areas.

ACKNOWLEDGEMENTS

Sincerest thanks are extended to the following employees of the Ontario Ministry of Natural Resources who shared their experiences and knowledge; J.A. Macfie (ret.), T.W. Regan (ret.), D. Strickland and R. Tozer. I am also most grateful to Mr. Ralph Bice, guide and trapper, to Mr. Doug Hale, deer feeder and behaviourist, and to Mr. Dowdall Murray of Murray Bros. Lbr. Co., all of whom filled in many gaps. Thanks also to M.D. Payne for typing the manuscript.

REFERENCES

ANDERSON, H.W. 1969. Ecology of Algonquin Park. Unpub. OMNR File Rept. Ont. Tree Improvement and Forest Biomass Institute.

ANDERSON, R.C. 1963. The incidence, development, and experimental transmission of Pneumostrongylus tenuis Dougherty (Metastrongyloidea:Protostrongylidae) of the meninges of the white-tailed deer (Odocoileus virginianus borealis) in Ontario. Can. J. Zool. 41:775-792.

ANDERSON, R.C. 1964. Neurologic disease in moose infected experimentally with Pneumostrongylus tenuis from white-tailed deer. Path. Vet. 1:289-332.

BROWN, D.M., G.A. McKAY and L.J. CHAPMAN. 1980. The climate of southern Ontario. Climatological studies No. 5. Environment Canada.

EULER, D. and L. THURSTON. 1980. Characteristics of hemlock stands related to deer use in east-central Ontario. J. Appl. Ecol. 17:1-6.

GATES, J.E. and D.M. HARMAN. 1980. White-tailed deer wintering area in a hemlock-northern hardwood forest. Can. Field-Nat. 94:259-268.

GILBERT, F.F. 1974. Parelaphostrongylus tenuis in Maine: - prevalence in moose. J. Wildl. Manage. 38:42-46.

GORDON, A.G. 1955. Comparison of climate and cover types of the Algonquin Uplands of Ontario and similar areas in the Maritime provinces and N.E. United States. Proc., 8th Annual Northeastern Forest Soils Conference.

KARNS, P.D. 1967. Pneumostronglus tenuis in deer in Minnesota and implications for moose. J. Wildl. Manage. 31:299-303.

KOLENOSKY, G.B. 1972. Wolf predation on wintering deer in east-central Ontario. J. Wildl. Manage. 36:357-369.

KOLENOSKY, G.B., and R.D. STANDFIELD, 1975. Morphological and ecological variation among gray wolves (Canis lupus) of Ontario, Canada. In The Wild Canids. M.W. Fox, Ed. Van Nostrand Reinhold Company. pp. 62-72.

LUDWIG, J. 1974. The 1974 pellet group and dead deer surveys in Ontario. Ont. Min. of Nat. Res., Wildl. Branch, Unpubl. Rept. 35 pp.

ORAM, G. 1986. Aerial moose survey report Management Unit 52. Ont. Min. of Nat. Res., Algonquin Park Dist., Unpubl. Rept. 8 pp.

ORAM, G. 1987. Aerial moose survey report Management Unit 51. Ont. Min. of Nat. Res., Algonquin Park Dist., Unpubl. Rept. 8 pp.

PASSMORE, R.C. 1953. Snow conditions in relation to big game in Ontario. Ont. Dept. of Lands and Forests, Wildl. Res. Rep. No. 2.

PIMLOTT, D.H., J.A. SHANNON and G.B. KOLENOSKY, 1969. The ecology of the timber wolf in Algonquin Provincial Park. Ont. Dept. of Lands and Forests, Wildl. Res. Rept. No. 87.

RUNGE, R.R., and J.B. THEBERGE, 1974. Algonquin decline: of the deer. Ontario Naturalist, June, 1974.

SAUNDERS, B.P. 1973. Meningeal worm in white-tailed deer in northwestern Ontario and moose population densities. J. Wildl. Management. 37(3):327-330.

SCHMITZ, O.J., and G.B. KOLENOSKY, 1985. Wolves and coyotes in Ontario: morphological relationships and origins. Can. J. Zool. Vol. 63.

THEBERGE, J.B. and D.R. STRICKLAND. 1978. Changes in wolf numbers, Algonquin Provincial Park, Ontario. Can. Field-Nat. 92:395-398.

WILTON, M.L. 1974. The possible effects of logging and fire on the Algonquin Park deer population. Ont. Min. of Nat. Res. Algonquin Region, Unpubl. Rept. 26 pp.

WILTON, M.L. 1985. Specific habitat needs for deer in the Algonquin Region, considering possible areas of greater cooperation between forestry and wildlife management as seen through the eyes of a wildlife manager. Ont. Min. of Nat. Res. Algonquin Region, Unpubl. Rept. 10 pp.

WILTON, M.L. and L.L. TRODD. 1969. Deer population estimate Pembroke District. Ont. Dept. of Lands and Forests. Pembroke District, Unpubl. Rept. 17 pp.

WILTON, M.L. and L.L. TRODD. 1970. Deer population estimate Pembroke District. Ont. Dept. of Lands and Forests. Pembroke District, Unpubl. Rept. 14 pp.

WILTON, M.L. and L.L. TRODD, 1971. Deer population estimate Pembroke District. Ont. Dept. of Lands and Forests. Pembroke District, Unpubl. Rept. 13 pp.

WILTON, M.L. and L.L. TRODD. 1972. Deer population estimate Pembroke District. Ont. Dept. of Lands and Forests. Pembroke District, Unpubl. Rept. 7 pp.