1961 WILDLIFE MANAGEMENT PAPERS

Delivered in Ottawa at the

TWENTY-FIFTH
FEDERAL-PROVINCIAL
WILDLIFE CONFERENCE

CANADIAN WILDLIFE SERVICE
NATIONAL PARKS BRANCH
DEPARTMENT OF NORTHERN AFFAIRS
AND NATIONAL RESOURCES

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Canadian Wildlife Service

National Parks Branch

Department of Northern Affairs and National Resources

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PRELIMINARY STUDY OF WOODLAND CARIBOU RANGE IN ONTARIO

by

Teuvo Ahti and R. L. Hepburn
Research Branch
Ontario Department of Lands and Forests

(A synopsis of parts of a Research Report in preparation)

Introduction

A major decline in North American woodland caribou Rangifer caribou occurred during the period 1750-1950. In Ontario not only did number of caribou diminish, but their range contracted in size (de Vos and Peterson 1951). The caribou was formerly an important big-game animal and even at present is of considerable practical value to Indians in the Patricia district.

The range survey that is the subject of this paper was conducted in the summer of 1958. The purpose of the survey was to make a preliminary assessment of range conditions for woodland caribou over most of northern Ontario and in particular to investigate lichen resources.

Methods

Aerial reconnaissance usually preceded detailed ground work, and for an experienced observer is the most valuable survey method. During June, July, and August, approximately 4800 air miles were flown and a total of 26 principal localities was studied intensively. This survey included the Chapleau, Cochrane, Kapuskasing, Geraldton, White River, Port Arthur, Kenora, and Sioux Lookout forest districts, and all three Patricia districts. A reference collection of important macro-lichens was prepared for the herbarium of the Research Branch.

Results and Discussion

Food Habits of Woodland Caribou

This study contributes little to the available information on caribou food habits; however, it is helpful to review what is known.

Many authors agree that lichens form the bulk of the winter food. Palatable vascular plants may be more or less important in the diet according to their abundance, and the relative abundance of lichens, which are preferred (Cringan 1957) in spite of their lower nutritive quality (Andreev 1957). Although tree lichens are readily utilized where they are more common (near Lake Superior), ground lichens, mainly Cladonia mitis Sandst., C. rangiferina (L.) G. H. Web., C. alpestris (L.) Rabh., C. uncialis (L.) G. H. Web., C. pseudorangiferina Asah. and C. amaurocraea (Flk.) Schaer. apparently are the mainstay of the winter diet. Among the important tree lichens are Evernia mesomorpha Nyl., Usnea cavernosa Tuck., U. comosa (Ach.) Rohl. coll., Alectoria jubata (L.) Ach. Nyl. and A. nidulifera Norrl. Of the vascular plants normally eaten with lichens, the most common over the Ontario range are probably willows, alder, swamp birch, white birch, balsam poplar, sweet gale, labrador tea (Latin names of vascular plants are given in Appendix I). Certain dwarf shrubs (e.g. blueberries), grasses, and sedges may be important locally.

The summer diet of caribou is almost entirely made up of vascular plants (Hadwen and Palmer 1922), Vassiliev 1936, Banfield 1954, Cringan 1957, Andreev 1957, Skuncke 1958, Bergerud pers. comm. 1958), and may be divided into five groups: sedges, grasses, forbs, shrubs, and mushrooms. The role of each group varies as the summer season progresses.

Division of Caribou Range and Estimated Carrying Capacities

Fig. 1 shows seven proposed divisions of the present range of caribou in Ontario. This partitioning is based on vegetation, topography, soil, and climate. The boundaries shown may need adjusting in the light of more detailed study.

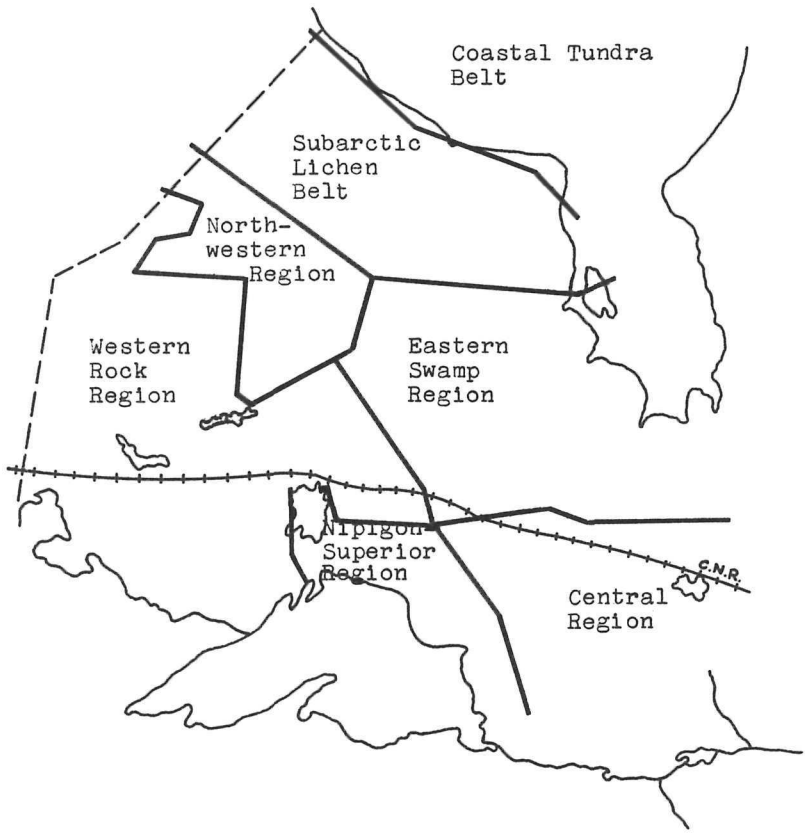

FIG. 1 DIVISIONS OF WOODLAND CARIBOU RANGE IN ONTARIO.

Estimates of the carrying capacity are based on present population estimates made by Department of Lands and Forests' field personnel, food supply available (and degree to which it is being grazed), and the criteria developed by those working with known numbers of domestic reindeer in Europe and Russia.

1. Tundra Region. This is a narrow coastal strip (up to 20 miles across) along the shore of Hudson and James Bays, best represented at Cape Henrietta Maria. The topography is extremely flat; differences in elevation rarely exceed 10 feet. The climate is colder and windier than in the other divisions (wind is a favourable feature in summer).

   Lichens are plentiful on dry sites, but the dominant species Alectoria ochroleuca (Ehrh.) Nyl. is not a palatable one. Growth is slow. The widely spaced trees on the edge of the tundra are extraordinarily rich in Evernia mesomorpha Alectoria jubata and A. Simplicior (Vain.) Lynge. This region is really excellent summer range. Good forage resources are present and sea water provides a rich source of minerals. The Tundra Region could support 1,000 caribou.

2. Subarctic Lichen Belt. This belt lies across the northern halves of the Patricia Central and Patricia East districts south of the coastal tundra strips, plus part of Akimiski Island. The topography is very flat, except for a small area of high ridges and rocky outcrops around Sutton Lake. River levees may rise 10-12 feet from the country behind them. This belt is warmer and less windy than the Tundra Region; summer is somewhat longer, consequently growth rates are better.

   As winter range, the Subarctic Lichen Belt is excellent. The lichen range mainly consists of dryish peatlands (cf. Appendix II), to a less degree of lichen woodlands proper. Cladonia alpestris is the climax ground lichen, but C. rangiferina, C. mitis, and C. pseudorangiferina are present in great

abundance. Ground cover rich in lichen amounts to 54 per cent of the total. Sedge swamps and fens, most of which support a heavy growth of Carex and Scirpus, are the most important summer habitat types. The thin spruce forest provides good cover and arboreal lichens. Indeed the only poor vegetation complex is the "small pox" muskeg and infrequent string bogs.

The Subarctic Lichen Belt is the best caribou range in Ontario. A cautious estimate of carrying capacity would be 50,000 animals.

3. Northwestern Region. This is an area occupying southwestern Patricia Central and the northernmost corner of Patricia West district. Although it is outside the true Hudson Bay lowlands, the topography is quite flat with few low hills and rocky outcrops. Lakes are fairly abundant. The climate is similar to the Subarctic Lichen Belt. In the eastern part of this region (the authors did not see the Bearskin Lake - Sachigo Lake section) lichenous ground cover comprises only 15 per cent of the total, making this area poor winter range, although ground lichens are locally plentiful in jack pine woodlands and old burns. Tree lichen supplies are rather poor, although swamps and bogs are fairly productive of green winter forage. Black spruce-sedge swamps along with riverside and lakeshore vegetation provide a fair summer food supply.

This region is inferior lichen range to the Subarctic Lichen Belt because its better drained substratum favours strong competition from vascular plants, especially trees, while the open areas are mostly bog. Thus, it is able to support only a relatively small number of caribou - approximately 5,000.

4. Western Rock Region. This area includes the Sioux Lookout and Kenora Forest districts, most of Patricia West, northern Port Arthur, and northwestern Geraldton Forest districts. Its very rolling topography is characterized by rocky outcrops averaging 60 feet in height and very numerous lakes. Occasional large flats of water-laid sand occur. The climate (especially in summer) is considerably warmer and

drier than the Subarctic Lichen Belt. Jack pine is the dominant forest cover.

As winter range for caribou, this region varies from fair to excellent. There are luxuriant stands of Cladonia mitis, C. rangiferina, C. alpestris, C. amaurocraea and C. uncialis in most of the open rocky areas that have not been recently burned, in certain swampy burns, and in about 10 per cent of the jack pine forest. Tree lichens are not generally plentiful. This area is not as good summer range as winter range. Suitable browse is found only on brooksides and lakeshores. A small percentage of the swamp types are suitable summer habitat.

The carrying capacity of the Western Rock Region is limited by the large number of recent burns, cut-overs, and lakes, but could support 10,000 caribou at present.

5. Eastern Swamp Region. The southeastern part of Patricia Central, southern half of Patricia East, northern Geraldton, northern Kapuskasing, and northern Cochrane forest districts lie in this region. The topography is very flat and poorly drained. Rock outcrops are rare, found only in the southernmost parts. Sandy ridges and levees occur on or near riversides and especially between the Abitibi and Mattagami Rivers in the Coral Rapids-Smoky Falls-Fraserdale country. The climate is apparently colder and more moist than the Western Rock Region, with great local variations.

The Eastern Swamp Region is poor winter range. Ground lichens (Cladonia pseudorangiferina, C. mitis, C. rangiferina) are scattered, chiefly in dry bogs. Overall ground lichen coverage is under 10 per cent. As summer range it is good, especially where large tamarack swamps occur, since those swamps are rich in sedges, shrubs, and forbs. The extensive black spruce muskegs are poor habitat.

Carrying capacity is low, providing only about 5,000 animals.

6. Nipigon-Superior Region. This region occupies southern Geraldton, White River, and probably northern Sault Ste. Marie and southern Chapleau forest districts. It is quite mountainous, especially near Lake Superior, grading into rolling hills with some sand flats further inland. The climate is slightly oceanic compared to the other regions.

   The winter range here is fair to good in the immediate vicinity of the lakes because of the abundance of tree lichens. Usnea cavernosa and Usnea comosa are more common than the more northerly distributed Alectoria. Where bogs occur they provide dense stands of highly palatable sedge rhizomes. The forests are moderately rich in forbs and browse. Logging and fire, however, have broken up the range into small usually inadequate patches. Remnants of the original range survive only on offshore islands.

   Carrying capacity of the region is therefore small - estimated at 500 caribou.

7. Central Region. Included here are the southern halves of the Kapuskasing and Swastika forest districts and parts of the Chapleau and Gogama forest districts. The southern border of this region was not investigated. The topography is rolling. Rock outcroppings are common.

   This region is poor winter and summer range. Ground lichens are sparse, found only in certain jack pine stands and on rocks. Here, too, logging and fire have reduced the suitability of the region for caribou.

   Carrying capacity is estimated at 1,000 animals.

   Combining estimates for all seven regions gives a total estimated carrying capacity of 70,000 caribou.

   The present population estimate is 10,000.

It is unfortunate that numerical estimates of carrying capacity must be derived mainly from work on barren-ground caribou and reindeer husbandry, since comparable

observations of woodland caribou are so few. Hustich (1951) quotes eight authors who give from 21 acres to 296 acres as the area required per adult caribou. Andreev's (1957) results, obtained experimentally near the Ob River in northwestern Siberia, seem to be the most reliable. They average 173 to 198 acres per adult for year-long grazing. Three hundred acres per animal is given as a maximum requirement in poor range; however, the poorest Ob River range would be judged fair to good in Ontario.

In Newfoundland approximately 29,000 square miles are occupied by about 5,000 woodland caribou, and the range is thought to be understocked. The optimum Newfoundland range (Ahti, 1959) is no better than the best in Ontario, but Newfoundland's "modal" range is superior to ours.

It is felt that one caribou per 1 square mile to 2 square miles would constitute adequate stocking on good Ontario range. By comparison the total estimated carrying capacity of 70,000 caribou (1 per 42 square miles) is modest.

The discrepancy between estimated potential (70,000) and estimated present population (10,000) is as yet unexplained. It must be emphasized that carrying capacity in this paper is based on food supply almost entirely. Almost every location examined showed very light grazing or none at all. Although it seems clear, therefore, that food is not a limiting factor at present, other factors may be preventing full utilization of the existing food (especially lichen) resources. Snow depth and type may exert a strong influence. Areas of poor range may act as barriers to migrating bands of caribou. These subsidiary factors must be investigated before the food relationships can be placed in their true perspective.

This preliminary survey of range characteristics is the first step in a comprehensive study of the ecology of woodland caribou in Ontario, one of the most challenging of Canadian wildlife problems.

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APPENDIX I

COMMON AND LATIN NAMES OF VASCULAR PLANTS

Terminology follows Fernald (1950)

Common Name	Latin Name
Black spruce	*Picea mariana* (Mill.) BSP
Tamarack	*Larix laricina* (DuRoi) K. Koch
Jack pine	*Pinus banksiana* Lamb.
Sedges	*Scirpus* L.
	Eriophorum L.
	Carex L.
Willows	*Salix* L.
Balsam poplar	*Populus balsamifera* L.
Sweet gale	*Myrica Gale* L.
White birch	*Betula papyrifera* Marsh
Swamp birch	*Betula pumila* L.
Alder	*Alnus crispa* (Ait.) Pursh
Labrador tea	*Ledum* L.
Blueberry	*Vaccinium* L.

APPENDIX II

TERMINOLOGY OF PEATLANDS

1. Fen is a treeless, wet, meadow-like peat flat. Vegetation is composed mainly of sedges, herbs, and the so-called "brown mosses" (Campylium stellatum, Drepanocladus revolvens, Tomentypnum nitens, Scorpidium scorpidioides, Palludella squarrosa, Calliergon giganteum).

2. Bog is a more acid treeless peatland with the ground cover dominated by Sphagnum spp. Sparse covering of vascular plants. Bogs can be wet to dry.

3. Muskeg is a swampy to dryish stunted forest with a thick mat of Sphagnum and feather-mosses underlain by rather thick peat (2 ft. - 5 ft.).

4. Swamp is a wet, open, wooded peatland more or less rich in sedges and forbs. The ground cover is composed either of Sphagnum or the brown mosses. The underlying peat is usually rather thick.

5. Swamp forest is a moist site forest with much Sphagnum in the ground cover growing on shallow peat (6 in. - 2 ft.)

TEN YEARS OF WILDLIFE RESEARCH IN NEWFOUNDLAND

by

A.T. Bergerud
Wildlife Branch
Department of Mines, Agriculture and Resources

The paper which I shall present here is not intended to be a scientific paper; it is rather a presentation of the general aspects of wildlife research conducted in Newfoundland over a period of ten years, as seen by an administrator.

In introducing the subject, a look at the history of game laws in Newfoundland is informative. Prior to 1832, when Newfoundland was given representative government, all laws were promulgated from England, and I have not been able to find reference to any game law that applied to Newfoundland. It was not too long before wildlife laws began to appear; the first was passed in 1839. This law provided for a bounty of £5 to be paid for the skin of each wolf taken. On April 23, 1845, an Act entitled "An Act for the protection of the breeding of wildfowl in this colony" was passed. This Act protected all wildfowl between May 10 and August 31 in each year. In 1859, partridge, snipe, and hares were added. Imported hares and quail were also mentioned in this Act. The hares were likely the beginning of the introduction of the varying hare from Nova Scotia. The quail species is unknown. It is significant to me that even as far back as 100 years ago, the Island's government realized that the few wildlife species available would be heavily harvested and tried to do something about it.

Progress was undoubtedly slow throughout the latter half of the century, but the accomplishments of making a successful introduction of the varying hare and the first of two introductions of moose took place. Those two animals are now the most important of the game species found on the Island.

In the first half of the 20th century game management in Newfoundland, as in many other areas, consisted of law enforcement coupled with some attempt to obtain a knowledge of the populations of the economic species. Game research in its present-day meaning was unknown. If a population was low, a closed season was placed on it to allow it to build up. If the species could be trapped and transferred from one area to another, it was done. Examples of this method of management were closed season on caribou 1925 to 1935, and intermittent closed seasons on beaver 1900 to 1920 and a closed season period from

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1923 to 1946. In 1935 a management plan to trap and transfer live beaver was put into effect. After some trial and error a net-trapping method was successfully developed, and during a period of ten years the Island was repopulated by the transfer of 1,000 live beaver and the first open season was declared in 1946. Since that time some 40,000 beaver valued at three-quarters of a million dollars have been taken.

I mention this fact only to show that for over a century the Newfoundland Government has shown a continuing interest in wildlife and an appreciation of its value to the Province's economy and to its people.

From the middle 1940's I was accorded the privilege of attending these annual conferences and through them associated with some of the present heads of the provincial game branches and such men as Dr. Ira N. Gabrielson, Dr. Harrison Lewis, and Dr. Oliver Hewitt who introduced me to the value of the then young science of game management, when it is backed up by a sound research program. Our entry into Confederation and our desire to become an equal partner helped us to inaugurate a research program in 1950, when Dr. D.H. Pimlott was asked to conduct moose research.

In assessing a decade of game research, it is difficult to select a yardstick by which to measure the accomplishments. Probably the most progressive initial step in the field of wildlife conservation in Newfoundland was to have the Wildlife Management Institute of Washington, D.C., conduct an impartial survey in 1953 and 1954. The survey was conducted by Dr. Gabrielson himself, thus giving us the advice of one of the most eminent conservation authorities in the world. The survey helped Newfoundland immensely in conservation. It was proof that the Newfoundland Government continued to recognize the importance of her wildlife resources, and subsequent introduction of most of the Institute's recommendations has strengthened Newfoundland's position in the general field of conservation. I am pleased to say that our relations with the Institute today are most cordial, and the advice of Dr. Gabrielson and his staff is given freely on request.

During the intervening years, expensive research has been conducted on moose, caribou, varying hare, ptarmigan, beaver, muskrat, lynx, and fox. And, in addition, a summer study of lichens was carried out, and a study of the flora of Newfoundland has, with the assistance of the Wildlife Division, been in progress for the past five years. The results of these

investigations have appeared in several interim and final reports, a number of which have been published and recognized as major contributions to the field of wildlife research and game management.

In conducting these programs we sought to engage dedicated graduates, interested in furthering their education, whose university professors would continue to maintain a watchful eye over their research work. The results have been all that we could have hoped for. The investigations provided data resulting in the awarding of two Ph.D. degrees, four M.Sc. degrees, and two more Ph.D. theses and three M.Sc. theses are currently being prepared. During the past decade, fifteen trained biologists have been employed (five part time, eight contractual) to conduct these investigations. At the present time we have a permanent professional biological staff of five, and one vacancy to be filled. Three graduate biologists are engaged part time.

The preparation of the final reports of the research completed and currently under way might be referred to as the termination of the first phase of the Division's investigation into the most important problems dealing with our game and fur-bearing mammals. The next step is the inauguration of management practices based on assessment of the research data. In our case, management practices were instituted as the research for each year indicated. A report of each year's work was prepared and given critical assessment to determine whether some management application might be made. Indeed, the desire to inaugurate practices which would serve both the management of the species and the procurement of research data was foremost in the minds of all participating biologists.

It is our hope that within a year or two we can close out this basic research phase of our program and arrange for such work to be done by the Newfoundland Memorial University. We consider this procedure, in fact, an important step in developing an up-to-date wildlife program. At the present time the duties and responsibilities of our biologists are very broad and embrace a wide variety of work, including the general supervision of all field staff. It was inevitable and proper that we should have proceeded up to this time on a generalized, biological work plan, but we have now reached the point where more specialization must evolve. The biologist and his staff should engage mainly in management, and the work of law enforcement and other duties should be given to staff trained in that phase of the work.

We have, we believe, progressed further in the overall objective of our Division by the method we have followed than we could have under any other arrangement with the same expenditure of funds.

Many people consider wildlife research and management only with the sportsman's demands in view. Delegates at this Conference are well aware that our responsibilities are much broader, and rightfully so. We must be aware of the various recreational needs of other groups whose interests are not in the harvest of game, fish, and fur-bearing species, but in the aesthetic value of wildlife, the sights and sounds of nature. We must recognize, more than at present, that considering the whole concept of the investigational programs of a wildlife service or division, there are few problems that are completely unrelated to other interests. We must seek to serve all in the best interests of conservation.

The following sections present a brief, but reasonably complete, description of the investigations on the most important individual species:

Moose

The moose research program, under the direction of D.H. Pimlott, commenced in 1950 with active field work continuing over a period of seven years. This program designed as a life history, ecological study, had emphasis on reproduction, food habits, and the effects of browsing on the economy of forest interests and the possible interspecific competition with caribou. In addition to this "fact-finding" investigation, a live-trapping experiment was initiated, which in 1953 resulted in the transfer and release of 12 moose from the Humber River area of Newfoundland Island to the St. Lewis River area of Labrador.

The introduction of moose into the Island of Newfoundland presents a classical picture of what happens when a pre-adapted animal is introduced into optimum habitat with virtually no competition. The phenomenal growth from a small introduction into a large, healthy population in a relatively short time is documented in Departmental files and in subsequent reports prepared by D.H. Pimlott during the course of his investigations. It might be of interest to review some of these facts by way of providing background information.

In 1878 two moose, a bull and a cow from Nova Scotia, were released at Gander Bay, in the northeastern section of the Island. In 1904 two bulls and two cows from New Brunswick were released near Howley in the northwestern section of the Island. The subsequent reports of moose lead us to believe that the 1904 introductions are the ancestors of the greater part of the moose population. There are, however, well-documented records of moose in the Gander River area between 1912 and 1920 which, when other occurrence records are considered, seem to indicate that they were progeny of the pair introduced in 1878.

By the mid-thirties moose were being reported from the Gambo and Terra Nova watersheds on the east coast and from a number of locations on the south coast. By the early 1940's the first reports were being received from the Avalon Peninsula and by then occasional reports were being received from all sections of the Island.

Restricted hunting began in 1935, but by 1945 there was large-scale hunting with an unlimited number of licences, although the kill was restricted to bulls only until 1952. During the latter seven-year period the annual kill increased from 750 in 1945 to 3,500 in 1951. In 1953 the first "any moose" season was proclaimed, and it is anticipated that this type of regulation will continue. The licence sales and annual moose harvest have continued to increase, with licence sales now approaching 16,000 and the harvest up to 8,000 annually.

There are, at least, twenty shrub and tree species which moose are known to browse; the two species of greatest importance in Newfoundland are white birch and balsam fir. In cut-over or burned areas which have moderate- to low-density moose populations, white birch is by far the most important species, often providing 50 to 75 per cent of the total winter diet. As the density of the population rises, the utilization of balsam fir increases greatly. In areas which are carrying high-density populations, or in which mature timber-stands predominate, balsam fir becomes the most important winter browse species.

In Newfoundland there are only four tree species - balsam fir, black spruce, white spruce, and white birch - of economic importance to forest interests at the present time. The two of these that moose eat are usually the dominant species in the secondary succession following pulpwood operations. In a forest-damage survey which was conducted in cut-over areas it was found that fir and birch made up 85 per cent of the available browse. In the western and central sections the two

species made up 60 to 80 per cent of the total reproduction of woody species, and on the east coast they comprised 50 per cent of the total tree reproduction in cut-overs.

There is generally a large quantity of winter food available to moose in the cut-over areas which are widely dispersed throughout our best moose range.

The factors affecting the use of browse species by moose are seasonal palatability and innate feeding habits. White birch is palatable at all seasons of the year, while balsam fir is generally browsed only after leaf fall. This seasonal palatability is an important factor in the spotty nature of the browsing on fir which is often found in over populated areas. It also appears that fir on poor sites, showing a pale green (chlorotic) foliage is not palatable to the same degree as the dark green foliage. Moose prefer areas where they can move freely, and, therefore, tree reproduction in moderately stocked or understocked stands is generally more heavily browsed than in densely stocked stands.

The original survey report was presented to the Royal Commission on Forestry in 1954 for their assessment. In the final report of the Commission, browse damage was recognized, but not stressed as any limiting factor in the regeneration of pulpwood forests, and it was felt that the matter could be corrected by opening up logging roads to hunters. There moose-damage investigations rested for a period of five years.

Pimlott's study has provided very important background information on the breeding potential of Newfoundland moose. When the program began we believed that a moose herd increased at a very slow rate. Basing our thoughts on what was then known for North American moose, we believed (1) that yearling moose did not breed; (2) that 50 per cent of adult cows were barren; (3) that a 15 to 20 per cent annual increment was all that could be expected from a moose herd.

The reproduction study has shown us that all three of these beliefs are erroneous. We have learned (1) that on the average 40 per cent of the yearlings are breeding; (2) that in excess of 80 per cent of the adult cows bear calves every year, (3) that the average annual increment to the herd may be close to 30 per cent.

The moose, knowing their own capacity for increase long before we did, continued to increase, and by 1959 we were aware that in certain isolated logged areas the forest damage

had been almost complete. We have been unfortunate enough to have experienced a complete setback of balsam fir in a few areas. An example is the Snowshoe Road logging area of the A.N.D. Company limits, an area approximately 20 miles long by three miles wide. The cut was completed there in 1950 totalling 60,000 cords. Extensive sampling of the area in 1959 by Ellis (Federal Research Forester) indicated that two-thirds of the new forest had been destroyed by moose, comprising 90 per cent of the most productive types. Twenty per cent of the destroyed fir stands were stocked to white spruce. The other areas had reverted to grass mats which effectively prohibit the germination of fir and spruce seeds.

With this further evidence the Wildlife Division carried out a browse survey in the adjacent areas of the A.N.D. Company limits. The survey indicated that we had a possible period of three years to reduce the moose population in the area of Noel Paul, about 100 square miles, if the area was to retain the 60 per cent stocking deemed necessary to the next crop of trees. Air survey had indicated a winter population of 12 moose per square mile.

The area was declared a moose removal area and hunters were permitted to make three hunting trips to the area and to take a moose on each trip. The company repaired the unused roads, the Division renovated a number of abandoned logging camps, and with a crew of six men instituted controls necessary to the safety of both loggers and hunters. The experiment was successful up to a point. Of the 1500 moose taken within a hunting area of 300 square miles, 425 were taken in the 100-square-mile area that had carried a winter population of 12 animals per square mile in the winter of 1959-60. In January 1961 the area was again surveyed and we found 12 animals per square mile. Air surveys prior to this indicated an extensive build-up after snow-fall in the cut-overs as animals moved to the area. We have not yet reached a decision as to how to deal with the problem of removing the animals in winter. We will continue to allow three moose to a hunter, but we fear that it will be necessary to continue removal during January and February without the benefit of the licensed hunters, because of the difficulty of getting them to and from the area when roads are blocked with snow.

I have dealt at some length with moose damage because it is a problem that can affect isolated areas of any province where pulpwood has been, or is being, harvested. In the accessible areas hunting is keeping the population to a safe level. In recent talks to representatives of the paper companies, I have stressed the need to attract hunters to logged-over

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areas as soon as the safety of the loggers will permit and suggested that the abandoned company roads should be kept in good repair for a period of at least five years after the cut is complete in order to induce hunters to use them and thereby control the moose population.

I am of the opinion that very few foresters working in industry would recognize serious moose damage, and wherever in an isolated, unhunted area a moose population is present which feeds upon balsam fir or a like economic species occurring after logging, they should make periodic close examination of the cut-overs to ascertain that moose browsing is not severely restricting the growth of the trees.

Caribou

Our first investigations on caribou began in 1952 in connection with the moose survey and covered possible moose-caribou competitive interrelationships, but it was 1956 before a caribou research program was undertaken by biologist A.T. Bergerud. In that year Mr. Bergerud investigated a small isolated herd on the Avalon Peninsula and the following year the program was expanded into a three-year federal-provincial co-operative investigation which included both insular Newfoundland and Labrador.

The scope of the caribou work has been all-inclusive and involved detailed investigation on the life history and ecology of the animal. The life history and ecology is confined to the woodland caribou of the Island of Newfoundland. Population census, calf survival, etc., have been obtained for Labrador and also the eastern Quebec herds. The latter herds were surveyed at the request of the Game Department of Quebec. There have been many interim reports of great value, and a final report is in the process of preparation. The final report promises to be an exhaustive and detailed study, and I am informed by Mr. Bergerud that he has completed five chapters of the twenty that will be required to document the study.

During the autumn of 1956 the Department secured the services of a Finnish lichenologist to conduct a study of the lichens, an important food source for caribou. His report entitled "Newfoundland Lichen Stands and the Wintering Range of Caribou" presents a very detailed picture of his findings. The most important conclusion derived from his report is that, while insular Newfoundland is not capable of supporting a large caribou herd, the lichen stands are more than adequate for present numbers.

Since the caribou survey is not yet complete, the most I can do in this paper is to tabulate the major areas of investigation and under each develop a few points in which pertinent information has been secured. They will not necessarily be in order of importance nor is it possible at this stage to include all the significant facts. As with all other investigations, the caribou study has been regularly supplemented by a thorough search of all current literature available. To digress for a moment I should say that the lack of literature in our libraries is one of the difficulties we have to contend with in Newfoundland. For this reason we have always found it necessary for our research biologists to return to university to complete their final reports.

Historical Review

An attempt is being made to estimate the original numbers of Newfoundland caribou. The estimate will be based on carrying-capacity figures for optimum as well as sub-optimum habitat and will be correlated with, among other data, both past and present migration information. The importance of hunting as a mortality factor in reducing former and present herds is being studied. Original migration routes will be determined where possible, and data on the disappearance from unknown ranges will be determined.

Calving Studies

In connection with the calving studies, it has been determined that the fertility of adult does in 1958 was 87%, for 1959 - 94%, and for 1960 - 82%. We have established that the peak period of calving is between May 29 and June 5. The earliest calving date recorded was May 17 on the Avalon Peninsula. An evaluation and tabulation of all calf mortality factors is being done including disease, predation and inclement weather. Predation appears to be insignificant. The abscess disease which claimed an estimated 75 to 80 per cent of the calves in 1958 does not now appear to be as serious a limiting factor as was at first thought. A small number of the calves appears to be affected each year, but it probably takes a combination of circumstances to bring about a heavy infection throughout the herd. The bacterial infection has been identified as "pasteurella multocida", but the method of infection has not been determined. The service of a helicopter is necessary to the completion of the studies, and we have not yet been able to secure the necessary time because of more important commitments dealing with health services and forest fire fighting. It is doubtful too whether the vector could be determined except in a year of heavy infection.

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We have captured several calves and raised them in captivity for the purpose of studying their growth and feeding habits. The data thus obtained would have been impossible to obtain in any other manner. Holding the calves in natural areas has allowed observance of their early feeding habits with particular regard to what foods are first eaten and how often they attempt to eat items rejected as food before they leave them alone.

Breeding Behaviour

Features of this work include an evaluation of hunter disturbance at the breeding time as affecting fertility. Basic data necessary to such an evaluation are to determine the extent of the homing instinct of caribou. These data are being obtained through the use of the Cap-Chur gun to mark animals that can later be identified from the air. Success with the use of the guns has been only mediocre up to the present year, but as personnel become more adept at stalking and shooting I see no reason why it should not give reasonable success. An appraisal of the most desirable sex ratios for continued high fertilities is in process. It appears that we could harvest considerably more stags than at present and not lower the doe fertility percentages. Adult sex ratios in 1952 were 67 males to 100 females. Today they are 45 males to 100 females. It appears that our calf mortality in recent years has been selective toward males. Sex ratios at birth are 50:50, but by autumn they are 65 males to 100 females. We have no explanation for this unbalanced calf mortality at present, but the fact that we know of its existence helps us to evaluate hunter selection as a factor in adult ratios. Mr. Bergerud's study of the Mount Albert herd in Gaspé established that mortality among stags during breeding is in the neighbourhood of two to three per cent. This percentage projected to our total herd would amount to 100 to 150 stags yearly. This is as important as the annual hunter kill.

Distribution and Migration

The present-day migration routes have been determined. Behaviour of caribou crossing roads has also been studied. Spring crossing of roads is considerably more critical than autumn crossings. The angle at which the animals strike the road is an important factor. A projected road from the vicinity of Bishops Falls to the south coast of the Island at Bay D'Espoir will probably seriously curtail the spring movement of the herds into the eastern section of the Island south of Gander airport. The factors of temperature and snow-fall on the initiating of the autumn migration have been recorded and positive correlation has been noted. The location of the herds has been determined for all seasons of the year.

Habitat Requirements

The summer and winter habitat preferences have been studied. The primary requirement of forest cover in summer is to give the animals relief from flies. The high, bare ridges are also used in areas where forest cover is absent. It has been noted that caribou have reoccupied the Louse Lake and Pot Hill cut-over areas and are also using the Red Indian Lake cut-overs in increasing numbers. It appears that the areas must be relatively free of human disturbance before they are reoccupied by caribou.

Food Habits

The contents of more than 100 rumens collected at all seasons of the year have been examined and analysed. Several other methods have also been used to determine food and species preferences for correlation with rumen analysis information. These methods have included:

(1) The examination of several hundred winter feeding craters;

(2) Feeding experiments with captive calves;

(3) Following the movements of captives released in suitable habitat and recording by means of a stop-watch the time spent in eating various plant species;

(4) Establishing metre quadrants in areas heavily used by caribou and comparing the percentage of species utilized against the percentage available.

Studies on snow cover show that when the snow is sufficiently dense, and therefore has the strength to support the animal's weight, the animal will not seek food in that vicinity. Snow crusts are, then, limiting factors to feeding and are selective to the light animals (calves); also, the animals will not seek food if the snow is of such a depth that the vegetation is completely covered. The shrub strata are very important as a winter food item, especially mountain laurel and leather leaf. Arborial lichens are also important to their diet. Cladonia lichens are of less importance than was formerly thought. In the winter of 1958-59 caribou were found to have eaten balsam fir. During this past winter captive

animals removed the bark from both spruce and fir trees in their corral even though plenty of cattle feed was available to them at all times, and large quantities were eaten as they required.

Range Studies

The range survey has been completed for the Island of Newfoundland. It has been found that availability of food is of major consideration in evaluating caribou range. During the winter of 1958-59, which records reveal was the severest winter in the study up to that time, the caribou wintered on the Partridge Berry Hills where forest cover was not available, but snow conditions were such that the plants were, to some extent, exposed. Such winters are potentially very serious to caribou, and the destruction by fire of such critical wintering areas could in the right circumstances cause severe mortality. Some of our early range work is of little value because availability of the food was not understood. The past winter was even more severe from the point of view of temperatures, but continuous frost without mild days kept the snow in a powdery condition and unable to bear the weight of the animals. Thus the animals were encouraged to dig for food much more readily than if the snow had been crusted.

Population Dynamics

It is planned to construct a life table and life equation from the herd composition counts of the past four years. These tables will depict the structure of the herd as affected by calf increments and mortality factors. The autumn calf crops since 1950 show a cyclic trend. This may only be the reaction of the herd to the disease outbreak, as the trend does not show in the gross production figures, as is usual with true cyclic patterns.

The effect of parasitism, and in particular lungworms as an added stress on caribou calves during critical periods of food shortage, is planned as a necessary investigation to the understanding of winter calf mortality.

The illegal kill factor is believed to be responsible for the reduction of the smaller herds at Mount Sylvester, Hall Bay, Topsails, and the Northern Peninsula. Aircraft detection has now been brought into frequent use, and it is hoped that this factor can be eradicated.

Disease

The evaluation of the disease investigation has been very interesting. It has involved many discussions with top authorities in the fields of domestic and wildlife disease in both Canada and the United States. Much information was gathered during the two seasons of field work, and it is unfortunate, but yet understandable, that the problem has not yet been solved. How many pieces of this complex puzzle are yet to be found is hard to say. We hope not very many more. Investigations included a complete pathological study which revealed over twenty pathological conditions, including parasites, affecting both adults and calves. A section of the report prepared on the investigations deals with the internal anatomy of the caribou, including the weights and measurements of organs and the haematological values. Caribou, like many other animals, live a life of association with parasites. A total of seven parasites was identified from the small number of animals collected. The symptoms of the disease which are responsible for the mortality of calves suggest a possible relation to a parasitic fly. However, recent information suggests that in Finland a similar disease was found to be carried by rodents. This puts the field-mouse under suspicion, and trapping and testing for presence of the bacteria are being undertaken also.

Aerial Surveys

Aerial censuses have been a main feature of our investigations both in Newfoundland and in Labrador. The surveys are done from Beaver aircraft at an altitude of 500 feet. The caribou are located from preliminary flight transects which reveal the herd areas. These are then revisited, and an intense coverage of the herd is made with flight lines spaced so as to sample as much of the population as possible. In general, a 20 per cent coverage is needed to obtain a statistically sound figure for caribou per square mile. In Newfoundland in 1959 the eastern section of the interior herd was covered with flight lines only one-half mile apart to give 100 per cent coverage, and the western herds in the same year received 60 per cent coverage. The Labrador survey, giving 20-25 per cent coverage, required 132 hours of flying and took six weeks to complete.

The total population of caribou in the Province is estimated at 19,000, of which 14,000 are in the Labrador area, 4,500 in the central Island herd and 500 in four small isolated herds on the Island. Management promises to be a simple problem

compared with moose, and we consider the future well-being of the caribou population in Newfoundland assured, particularly the central herd, where the economic development possibilities are at a minimum.

Snowshoe Hare

The snowshoe hare (lepus Americanus) introduced to Newfoundland from Nova Scotia about a century ago has the distinction of being the most important game animal of the Island. Its distribution and ease of capture made it an important component in the meat diet of the Newfoundland people for the past seventy-five years or more, and only recently has the moose kill topped the meat supply from the rabbit population. Even though other forms of meat are available, the people still consider the "rabbit" a tasty dish, and during the autumn and winter seasons they can still be found on sale in the supermarkets competing very successfully with the best beef, pork, and lamb cuts. Salt fish has been termed "Newfoundland turkey", but I would say that the name more rightfully belongs to the snowshoe hare. In recent years the Island supply has not been large enough to fill the needs in the larger communities, such as St. John's, and Corner Brook, and supplies numbering upwards of 25,000 pairs have been brought in from New Brunswick and Nova Scotia.

In the early 1950's, Newfoundland experienced an unprecedented low in the hare population, and because of its economic importance the animal was chosen for a research project. The task was assigned to Mr. now Dr. D.G. Dodds, a graduate of Cornell University, who had been employed as Western District biologist.

The research was initiated in an attempt to determine the cause or causes of snowshoe hare fluctuations in Newfoundland. A second objective was the development of a method of predicting population increases or decreases in advance. The general objective was to obtain enough information to enable the Department to manage the species for optimum utilization.

The study started in 1954 under D.H. Pimlott and was taken over by Dr. Dodds in the spring of 1955 and continued through November 1959 as a continuous study. In 1960, summer work was again undertaken by Dr. Dodds, and certain phases considered necessary to management information continue on an annual basis.

Intensive investigations of reproduction and productivity were carried out in western Newfoundland and supplemented with data from other regions. All aspects believed to affect hare populations were considered. In the process much incidental information was obtained which added to the thoroughness of the study.

Hares were kept in captivity, live-trapped, tagged, and released and resnared. Questionnaires were used and the range- and food-habit studies were carried out in the field, and both predator and buffer species were collected and studied. The methods used were both original and adapted from other studies.

Dr. Dodds' work was completed in 1960 in the form of a Ph.D. thesis, and a quick tabulation of the chapter headings will indicate the scope of the work.

Chapter 1. Geography of Newfoundland, climate and weather, geology and soils, vegetation and land mammals.

Chapter 2. Place of wild mammals in the Newfoundland economy.

Chapter 3. Introduction and status of the snowshoe hare.

Chapter 4. Description, pelage, etc.

Chapter 5. Activity, movement, and behaviour.

Chapter 6. Breeding behaviour and parental care.

Chapter 7. Growth

Chapter 8. Reproduction - male cycle, female cycle, breeding season, litters per year, litter size, minimum and maximum breeding age, and breeding potential.

Chapter 9. Productivity by regions, average productivity, and the mechanics of population increase.

Chapter 10. Decimating factors and popular opinion.

Chapter 11. Disease and parasites - stress, listeriosis, trematodes, nematodes, cestodes, acarina, siphonaptera, and other disease or parasitic conditions. Summary in relation to hare density.

Chapter 12. Food competition and range relationships of moose and snowshoe hare.

Chapter 13. Predator-prey relationships - lynx, fox, weasel, and avian predators.

Chapter 14. Other decimating factors - hunting, weather, forest fire.

Chapter 15. Discussion and theory.

Chapter 16. Management suggestions, research needs, and public relations.

A short resumé of results and statement of continued research plans follows:

The study of the snowshoe hare in Newfoundland from the autumn of 1954 through the autumn of 1960 indicated a general increase in the hare population densities. The increase was the result of, or was characterized by the following phenomena:

(a) An increase in productivity due, in part, to increased litter sizes. Although it is probable that the number of litters per year also increased, such data did not show up in the studies.

(b) Adult sex ratios approximated 50:50 or favoured females slightly until higher densities were approached.

(c) In areas hit by late summer epidemics, productivity increased in the year following the decline, to bring all areas studied into approximately equal positions in the rising population curve.

(d) By 1959 densities were the highest for several years in most areas, but productivity had levelled off or dropped, litter size decreased, the percentage of adult males increased, that of juvenile males increased even more, and embyro resorption increased.

(e) Adrenal gland weight to body-weight ratios increased during a late summer decline in some areas in 1957 and in captive hares which died of unknown causes in captivity. No weight differences were

found in adrenal glands from areas of differing densities. Histological examination of the adrenals has been in progress, but has not been the subject of a report.

It seems certain that the populations studied have reached a peak in relative density and that a decrease very probably begun in 1960 will continue. Since all the work done to date has been on a rising population, we need to know the litter sizes, embryo resorption, and sex ratios for a declining population. We will continue to examine adrenal glands for evidence of density-dependent stress and continue to autopsy hares for lesions and parasites. Productivity studies will continue in the autumn and will be related to information on breeding potential.

The data obtained so far concerning an increasing density up to the levelling-off point, which appears to have been reached in the period 1959-60, have been illuminating and of broad significance. We consider it important that the picture for the decreasing stage of the fluctuation be obtained and we hope to be able to do this.

Ptarmigan

A further research study has been that on ptarmigan which, as you know, is our only native upland game bird. The population has been rising for a period of years, but there are, however, large areas that formerly produced these birds that have not come back into production. Our investigations reveal that an apparent deterioration of habitat due to plant succession is the most plausible explanation for the decline.

Excluding bog areas, Vaccinium augustifolium (the common blueberry) and Kalmia angustifolia (the common laurel or lambkill) are the two most abundant plants and the two most widely distributed over the ptarmigan range. Although they occur together, there are vast areas that seem to favour the growth of Kalmia. Some of these sites indicate that only fairly recently did the Kalmia reach this dominant stage of suppressing the Vaccinium species and other less abundant but desirable ptarmigan food species.

No part of the Kalmia plant is used by ptarmigan. In fact, it has been impossible to trick captive ptarmigan, either young or adult, into taking this plant when mixed with other species. It is used on occasion as nesting cover, but since the birds show little preference for nest-site cover,

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the species is unimportant. The plant is the most difficult to eradicate of all the shrubs we have.

The blueberry plant on the other hand is the most important food source available to ptarmigan. Ptarmigan utilize the leaves, blossoms, fruit, buds, and twigs throughout the year.

Following food-habits studies and a vegetative survey, information was sought to control Kalmia. Fire seemed to be the most likely way, and to determine the effects of fire a survey of known burns was carried out over a two-year period. A great deal of valuable information was secured from this survey which included the identification of plants in over 1,000 sample plots ranging in age from a few months to 30 years. The amount of coverage for each plant in the sample plot was also estimated.

The results of this survey show that from two to five years following a fire the blueberries have a definite advantage over Kalmia in both the number of plants and the area covered. In this age class 98 per cent of the plots contained blueberries, whereas only 67 per cent contained Kalmia. Thirty-six per cent of the ground area was covered with blueberries, but only 11 per cent with Kalmia. After six years Kalmia exhibits a trend toward dominance, surpassing blueberries in about 20 years. These were uncontrolled fires and therefore severe. There is evidence to suggest that controlled fires used for the pruning of blueberries have little effect on Kalmia. As you can understand it would be very difficult to set up any controlled fire program that would give the severe burn necessary for the eradication of Kalmia.

The study has been in progress for some five years, but on a smaller scale than for the economic species, and there has been a great deal of information collected which must be subjected to analysis before any conclusions can be reached. The study has included nesting, brood hatching, brood survival, disease, and parasites.

It might be pertinent to note here that beginning in 1956, ruffed grouse were obtained from Wisconsin, and over a period of three years some 150 birds were released in four different areas. Investigations by drumming counts this year indicated survival and spread of the species sufficient to give us reasonable optimism that the introduction may be successful. Although a program such as this was fairly expensive, we consider the need of a second non-migratory species of game bird most important to the future sport of the Province.

Lynx

A three-year study was conducted on lynx to determine its position as a predator on game species and small livestock. A report on this study is in preparation as a Ph.D. thesis by Mr. Jack Saunders, formerly Western biologist with the Wildlife Division.

Beaver

Beaver too has had continuous study over a period of five years. This study, designed more as a management study for a selected area, has provided much information on management under the trap-line system, and the trap-line method of control is being extended annually and should eventually include the whole Province.

In addition to wildlife, the Division has also undertaken a botanical research program over the past six summers. This program is being carried out by Dr. Ernest Rouleau, Curator of the Marie-Victorin Herbarium, and now President of the Botanical Institute. His studies are providing detailed information on the taxonomy and distribution of hundreds of our species, native and introduced. This detailed information has already added to our understanding of wildlife problems, and we believe that when completed the study will have great interest, not only to botanists, but to the related fields of wildlife, forestry, and agriculture. It is hoped within a period of three years to arrange for the publication of a popular type field guide to the flora of Newfoundland.

As a conclusion to this paper I have attached a list of the published and unpublished reports that have emanated from the more important of these surveys.

The following is a list of published and unpublished reports that has resulted from these researches:

Moose

Pimlott, D.H.
1953 Newfoundland moose. Trans. N.A. Wildl. Conf. 18:563-581.

Pimlott, D.H.
1953 A survey of moose damage to forest reproduction. Nfld. For. Prot. Assoc. Ann. Rep. 9:19-23.

Pimlott, D.H.
1954 Deer range conditions on Anticosti Island. Unpub. rep. Nfld. Dept. of Mines and Resources, St. John's. 22 pp.

Pimlott, D.H., and S.J. Hall.
1954 Moose browsing on forest reproduction. Nfld. For. Prot. Assoc. Ann. Rep. 10:85-90.

Pimlott, D.H.
1955 Moose populations and range conditions in Newfoundland. Unpub. rep. Nfld. Dept. of Mines and Resources. 10 pp.

Pimlott, D.H.
1955 Moose and the Newfoundland forests. Unpub. rep. Nfld. Dept. of Mines and Resources, St. John's. 26 pp. 9 tables.

Pimlott, D.H.
1956 Moose reproduction study, a preliminary report. Unpub. rep. Nfld. Dept. of Mines and Resources. 38 pp. mimeo.

Pimlott, D.H., and W.J. Carberry.
1958 North American moose transplantations and handling techniques. J. of Wildl. Mgt. 22(1):51-62.

Dodds, D.G.
1958 Observations of the pre-rutting behaviour in Newfoundland moose. J. of Mamm. 39(3):412-416.

Pimlott, D.H.
1959 Moose harvests in Newfoundland and Fennoscandian countries. Trans. N.A. Wildl. Conf. 24:422-448.

Dodds, D.G.
1959 Feeding and growth of a captive moose calf. J. of Wildl. Mgt. Vol. 23, No. 2, pp. 231-232.

Sergeant, D.E. and D.H. Pimlott.
1959 Age determination in moose from sectioned incisor teeth. J. of Wildl. Mgt. 23(3):315-321.

Pimlott, D.H.
1959 Reproduction and productivity of Newfoundland moose. J. of Wildl. Mgt. 23(4):381-401.

Caribou

Bergerud, A.T.
1957 Preliminary report of the Avalon caribou herd. Unpub. rep. Nfld. Dept. of Mines and Resources. 37 pp.

Bergerud, A.T.
1957 An aerial caribou survey of the interior of Newfoundland. Unpub. rep. Nfld. Dept. of Mines and Resources. 30 pp. 14 tables.

Bergerud, A.T.
1957 Spring caribou calving study. Unpub. rep. Nfld. Dept. of Mines and Resources. 41 pp.

Bergerud, A.T.
1957 Fall breeding behaviour of Newfoundland caribou. Unpub. rep. Nfld. Dept. of Mines and Resources. 45 pp.

Bergerud, A.T.
1958 Distribution, movement and population dynamics of Newfoundland caribou. Unpub. rep. Nfld. Dept. of Mines and Resources. 138 pp.

Bergerud, A.T.
1958 Aerial caribou census of Labrador, March and April. Unpub. rep. Nfld. Dept. of Mines and Resources. 35 pp.

Hall, S.J.
1953 Report of trip to open country, Sandy Lake. Unpub. rep. Dept. of Mines and Resources. 6 pp.

Hall, S.J.
1958 Caribou crossings in the Big Falls and Birchy Lake areas during November. Unpub. rep. Nfld. Dept. of Mines and Resources. 17 pp.

Hall, S.J.
1959 Caribou fall migration in the Victoria Lake district. Unpub. rep. Nfld. Dept. of Mines and Resources. 12 pp.

Jackson, B.S.
1959 The rearing of Newfoundland caribou calves, 1958-59. Unpub. rep. Nfld. Dept. of Mines and Resources. 29 pp.

Peters, S.S. and J.M. King.
1958 Newfoundland caribou disease investigation. Unpub. rep. Nfld. Dept. of Mines and Resources.

Wilmar, H.
1952 Caribou observations. Unpub. rep. Nfld. Dept. of Mines and Resources. 41 pp.

The Economics, Biology, and Management of the Snowshoe Hare in Newfoundland.

Dodds, D.G.
1956 Snowshoe rabbit research program, preliminary report. Unpub. rep. Dept. of Mines and Resources. 25 pp.

Dodds, D.G.
1956 A review of three recent papers concerning parasites of the order Lagomorpha. Unpub. rep. Nfld. Dept. of Mines and Resources. 20 pp.

Dodds, D.G.
1957 Preliminary and quarterly rabbit reports. Unpub. rep. Nfld. Dept. of Mines and Resources. 36 pp.

Dodds, D.G.
1958 Snowshoe hare research in Newfoundland. Trans. N.E. Wildl. Conf. 10:271-276.

PROFESSIONAL RESPONSIBILITY IN ASSOCIATION WITH PESTICIDE USE

by

H. Hurtig
Program Directorate, Research Branch
Canada Department of Agriculture
Ottawa

In Canada we have been relatively fortunate in that pest control practices involving the use of chemicals have not drawn the violent public attacks that have been unleashed in the United States. This has been due partially to good luck and in some particular problem areas, due to good management. However, since the Canadian public is being constantly exposed to mass communication media of U.S. origin, it is inevitable that there will be more public concern and anxiety about the control of pesticide use.

In recent years, well intentioned but only partially informed scientists and laymen have become alarmed about possible hazards that pesticides may represent to man, animals, fish, and wildlife. Many of these people or groups have been uncritical and passionate in their attacks on pesticide use, resulting in disturbing public statements and writings of highly subjective content. On the other hand, there is a temptation for agricultural production agencies working at the technology level of pest control to consider the resulting poor public relations as a threat to the performance of their duties. Frequently, they enter the controversy in public and weaken their position with statements just as questionable as those of their critics.

Fortunately, we have been relatively free of the controversial mass pesticide application schemes that have plagued our colleagues to the south. We have not had to embark on huge fire-ant and gypsy-moth control programs. Also, since on the whole our agriculture is more scattered into smaller specialized production zones, our growing season shorter, and the number of pests fewer, in Canada we use proportionately much less pesticide per year than in the U.S.A. The main exception may possibly be in our large-scale use of chemicals in connection with the maintenance of our high-quality cereal production in the Prairie Provinces. Another point working in our favour as a result of our smaller population is the potential for freer communication between the different agencies in government and industry that may be concerned with this matter. We should be prepared to take

advantage of this favourable situation to anticipate and avoid problems before they reach serious proportions.

An examination of the minutes of the Canadian Federal-Provincial Wildlife Conferences of the past ten years reveals the tone of changing opinion among Canadian wildlife workers. In 1953 a highly appropriate resolution was passed:

> "WHEREAS chemicals are coming continually more into use for the destruction of insects, as well as weeds, brush and other vegetation, this development being of great economic value, and
>
> "WHEREAS many of these chemicals are poisonous to wildlife, and destruction to vegetation may be detrimental to wildlife, and
>
> "WHEREAS it has been shown that chemicals may be used without harm to wildlife and at times even to the benefit of wildlife,
>
> "THEREFORE BE IT RESOLVED that this Conference recommends that the appropriate federal department take the lead in bringing together manufacturers and users of chemicals and wildlife authorities, with the objective of bringing about the greatest benefit from these chemicals with no damage to wildlife resources, or where this is not feasible with as little damage as possible, and that steps may be taken to make such investigations as may be needed and to disseminate information where it is needed."

In 1960, despite lack of objective documentation of specific Canadian problems in the minutes, the mood and effect of stepped-up sensation-seeking publicity are reflected by the following resolution:

> "WHEREAS very discouraging reports are continually being received in respect to great damage being done to most if not all forms of wildlife, including fish, and more important to public health from the more or less uncontrolled use of various herbicides and insecticides,

> "THEREFORE IT IS RECOMMENDED that immediate and appropriate action be taken by all game management agencies in Canada and the United States of America to thoroughly investigate and ascertain the actual effect on human life and wildlife in the use of these insecticides and to take, if found warranted, immediate steps to stop, modify, or in some way control the use thereof in order to ensure that said use will not be harmful to human life, wildlife or fish."

It is important now to appreciate that we are in a scientific age in which few citizens are either qualified or capable of judging the value or safety of a new scientific discovery or its employment in the technology of agricultural production, forest conservation, or wildlife management. The use of new pesticides does not provide an unmixed blessing. Many of the new pesticides are poisonous to man and animals; some leave residues; this, in part, is why they are effective. But this does not necessarily mean that they present a hazard to man or animals. There is a tendency by many to confuse poisonous with hazardous. The terms are not synonomous. A poison is a substance that has the capacity of producing injury; hazard is the probability that injury will result from the use of the substance in the quantity and the manner recommended. If there is a question of hazard involved, the hazard should be described qualitatively and quantitatively and the choice of action to be taken becomes a matter of determination of how much good will be achieved by the use of the chemical, weighed against the hazard involved in its use. This guiding principle is particularly applicable in the approach to wildlife conservation problems.

The public will rely more and more upon authoritative scientific opinions for guidance in this matter, but unfortunately the average citizen cannot distinguish between the pseudo-scientist, fraud, and the genuine article.

The public is not generally aware of the comprehensive nature of the pattern of decision-making required in the establishment of safeguards for allowing the use of new compounds in pest control operation. Sometimes, I am more than just suspicious that there are many among our own group of professional biologists who are not aware of the necessity for this comprehensive approach today. So, good as our operation may be now, it will have to be even better in the future.

Modern pesticides are valuable tools in plant and animal production, forest conservation, and wildlife management. If some compounds are unduly prone to abuse, professionally, we should be just as concerned about how to prevent abuse of these valuable tools as we are about their proper use. I submit that a biologist's professional and moral responsibility does not end, nor is research complete, if professional advice is restricted to time, rate, and dose of pesticide applied to obtain a desired level of pest control. No pest control recommendation can be considered to be complete today unless pertinent accompanying information is provided on safety and economy of use, as well as efficiency.

At this time I hope it will be appropriate to briefly speak to your 1960 resolution and outline the protective devices that are now in operation. Firm steps have been taken to ensure that pesticides can be usefully employed in agriculture, public health, and forestry in a way that will not be harmful to humans, wildlife, or fish. There are several federal government agencies concerned with this matter, but legal responsibility for the registration of pesticides for sale in Canada rests with the Department of Agriculture. The Plant Products Division of the Production and Marketing Branch administers the Pest Control Products Act. Every pesticide product and formulation offered for sale must be registered under this Act. The package labelling, displaying precautions and instructions for use, must be approved and registered before the product can be sold. The seller of the product must provide extensive reports of scientific investigations of all aspects of the properties of the pesticide to verify claims that, if used in accordance with the instructions on the label, the chemical can be used effectively and safely. The data required must also prove that the requirements of the Food and Drugs Act with respect to pesticide residue tolerances can be met before registration will be granted. This agency also provides inspection, analytical, and enforcement services to ensure the purchaser that the package contains the amount and quality of product claimed on the label.

The legal authority for establishing the allowable limits for pesticide residues in human food is administered by the Food and Drug Directorate of the Department of National Health and Welfare, under the Food and Drugs Act. This agency also maintains inspection and analytical services to ensure that the limits established are not exceeded in human food. It is important to understand that these legal limits for residues in food are not set at the maximum safe level. Instead, they are set at some figure <u>below</u> this value, and never in excess of the amount

that has been demonstrated by sound investigation by agricultural scientists as unavoidable as the result of a reasonable requirement for use of the chemical in pest control. Consequently, our legal residue tolerances are usually considered to be well below the maximum safe levels as established by recognized experts in human health and nutrition.

The Occupational Health Division of the Department of National Health and Welfare is also involved in this decision-making operation, with responsibility for advice on the control of the occupational hazard involved in pesticide manufacture, distribution, and use. This Division acts as adviser and consultant to the Department of Agriculture in the matter of safe handling and application at the user level. The Forest Biology Division of the newly formed Department of Forestry is concerned with forest insect and disease control. The Department of Transport regulates the licensing of aircraft used for pesticide applications from the air.

The Research Branch of the Department of Agriculture plays an important role by virtue of its responsibility for the research on pesticides and their use in the production, preservation, and distribution of agricultural products, and in the control of insects affecting the health and comfort of man and animals. Our several research institutes and research stations in Ottawa and across Canada contain the largest body of scientific experts on pesticides and their use, in Canada. Close liaison is maintained with the other government agencies already mentioned, the chemical industry, and provincial extension authorities.

Since part of our interest lies in discovering new, safe, effective, and economical tools in plant and animal production, our research staff usually has from one to three years of critical experience with a new chemical before the manufacturer will attempt to obtain registration under the Pest Control Products Act or petition to establish residue tolerances under the Food and Drugs Act if residues are involved. Owing to this continuously growing background and experience in pesticide performance, behaviour, effectiveness, and economy of use, our staff involved in this type of research is called upon to act as consultants and advisers in evaluating the adequacy and applicability to Canadian conditions of use of the data submitted by the manufacturer to the regulatory authorities. Equally important, while the health authorities establish the limits for pesticide residues, it is the responsibility of agricultural research workers to define how pesticides can be used within these limits. Here our staff plays an important role at the local level

by actively participating in the work of provincial committees that are set up all across Canada in order to annually review and revise recommendations for pest control involving the use of both new and old chemicals.

In order to facilitate liaison in our role as advisers and consultants to the regulatory agencies, and to promote the prompt communication of information to provincial groups, we have recently taken two important steps. In 1959 we set up a Pesticide Technical Information Office in Ottawa that is already providing good dividends in promoting liaison and information services to all interested parties. Within the next few weeks a formal announcement will be made of the creation of a new "National Advisory Committee on Pesticide Use in Agriculture". This Committee will be made up of representatives from federal research and regulatory agencies, provincial governments, and universities. We hope that this new group will define problem areas, stimulate research, and facilitate the compilation of new information arising from research on pesticides and their use, for the many local committees that are concerned with drafting recommendations.

In the field of pest control, in which entomologists, plant pathologists, and weed control specialists are making recommendations involving the use of pesticides to lay administrative bodies at the provincial or regional level, to industry, or the public at large, we feel that it is no longer adequate to be able to state that the chemical concerned will provide the degree of pest control required. We advise the public to "read the label and follow the instructions and precautions outlined". The manufacturer has spent huge sums of money to develop the information backing up the few lines on his particular label which pertains to his formulation of an active compound. How many of us are familiar with the literature pertinent to all aspects of use, and are prepared to modify a label recommendation for regional or local requirements on a basis of a personal appraisal of data?

It is not suggested that it is an individual biologist's responsibility to produce all the pertinent data before a recommendation is made. Rather, there is a professional and moral responsibility to ensure that the data exist and that qualified experts have made an objective appraisal of the adequacy of existing information that should accompany the recommendation, in order to ensure that the chemical can be used in a <u>safe</u>, <u>economical</u>, and <u>efficient</u> fashion.

It is easy to be sophisticated and critical with hindsight, but it requires professional honesty and responsibility to constantly review current pest-control recommendations in the light of new scientific information and revise them accordingly. The same type of objective appraisal of both utility and hazard, with an unbiased scientific approach and professional dignity, should be the objective of wildlife biologists interested in correcting situations judged menacing to wildlife populations.

There is ample evidence that there are needs for collaborative research. These should be pointed out by the submission of findings, first of all to fellow scientists, rather than to the sensation-seeking press. Your local provincial committees on pest-control problems are largely made up of biologists. I am certain that you will find them willing to co-operate with you, if your fears concerning pesticide use are brought to their attention. Similarly, I will welcome the development of this type of collaboration at the national level. I hope that the facilities that are being provided can minimize any risk that may arise to wildlife by virtue of the expansion of pesticide use in agriculture and public health.

The establishment in 1958 of the Interdepartmental Committee on Forest Spraying Operations, and the program of work resulting from this approach exemplify what can be done through scientific channels. A technical conference sponsored by the Department of Agriculture and the Department of Fisheries was attended by 46 representatives of federal and provincial departments, industrial associations, and agencies concerned with forest protection, fish, and wildlife resources in regions where extensive spraying operations had been carried out. After a full and frank exchange of information, the Inderdepartmental Committee was formed with representatives from the Fisheries Research Board, Conservation and Development Service of the Department of Fisheries, and Forestry Branch and the Canadian Wildlife Service of the Department of Northern Affairs and National Resources, and the then Forest Biology Division of the Department of Agriculture. The responsibilities of the Committee include:

(1) review of forest insect outbreaks, the probability of damage to the forest, and the hazard to other forms of life that would result from chemical control operations;

(2) co-ordination of recommendations for control action and safeguards to be taken; and

(3) support of additional research to develop less hazardous insecticide formulations and improved methods of application.

The needs for research on principles of pesticide use in Canada are growing. The average biologist or wildlife specialist in Canada today has neither the training nor background and frequently lacks interest to cope with the more complex approach to problems that is required today. This is evident both in many control operations that are being conducted currently and in the interpretation of pertinent literature for advisory purposes. We need a new breed of specialist today for plant and animal protection research and for advisory work. As yet, our Canadian universities are not training enough of these people, even though good career opportunities exist.

Dr. E.W.R. Steacie, President of the National Research Council, recently made reference to the dilemma of the physicists early in this century when the quantum theory was introduced to them. The physicists had three choices: (a) learn, understand, and exploit it; (b) be lazy and ignore it; or (c) oppose and deride it. We are in the same position today as far as research on pesticide use is concerned. There is a relatively new field of investigation that is being largely overlooked in Canada today, but it is one in which we are going to have to invest substantial energy unless we choose to remain mere technologists. The subject area concerned is the "Ecology of Pesticide Performance and Behaviour".

Biologists are quite familiar with, and have almost a stereotyped devotion to, the ecological approach of investigation of an organism's response to its environment. Responses of whole populations is another popular area of ecological study. One frequently hears that the investigation of the effect of an insecticide on a pest population is just one more factor to be introduced into an ecological study. This is especially true where the "life table" concept is being developed, and will undoubtedly show up in the development of mathematical models for population dynamics. While as biologists we have realized the importance of the naturally occurring chemicals, we have been slow to realize that other chemicals, especially modern pesticides, are not dead molecules. If they were, we would be using blocks of concrete for insect, disease, and weed control. Modern pesticides are dynamic forces that perform according to environmental conditions; metabolize, degrade, and combine with inert and living material.

Just as scientists have discovered nuclear energy, developed it for war, and are going on to harness it for the benefit of man, so must we continue to be scientists first and understand that we have to consider the behaviour of a pesticide chemical in the several environments in which we wish to employ it - in soil, on plants, in plants, and animals, as well as inside insects and plant disease organisms. The sequence of ecological changes for a pesticide chemical in the whole range of possible alternative situations and environments is just as important as the study of the ecology of the pest. The two types of studies must be carried out to complement each other if we are ever going to achieve the desirable state of prescription pest control through all the tools now available to us.

Aesthetic chemical approaches are now being developed. The crystalline toxic inclusion body of the insect pathogen B.thuringiensis is a chemical; precise information on chemical sex attractants for insects is being developed, neurophysiologically active chemical substances are being discovered as naturally occurring in insects, and great progress is being made in the field of pesticide micro-chemistry.

The picture is bright - despite the fact that residue tolerance matters cause the average biologist to shudder in despair. I am afraid that the decision-making demands arising from regulatory matters have discouraged some biologists, largely because they have not taken the trouble to find out how these matters are dealt with and the influence that they can exert on the regulations themselves. But, if we look around the corner of this potential mental block, we will discover all the wonderful tools of micro-chemistry that have been the dividend of the recent emphasis on residues problems. Can we be smart enough to pick these tools up and put them to work to advance the frontiers of new knowledge in developing principles of effective, safe pest control? The instrumentation, automation, and computation facilities available to us today are magnificent additional developments.

We must take advantage of the new knowledge now available to develop the principles of prediction of pesticide behaviour, performance, persistence, and safety. These goals are attainable through the study of pesticide ecology, behaviour, and performance and its relation to rational approaches to pest control. I hope that we are good enough scientists to move with the times and retain leadership in our own field of responsibility.

THE CURRENT STATUS OF CROP DEPREDATION CONTROL IN WESTERN CANADA

by

R.H. Mackay
Canadian Wildlife Service

In the process of man's agricultural development throughout the centuries, wildlife displacement and consequent depredation on crops has been inevitable. The Northwest Mounted Police recorded waterfowl damage to their crops near Fort Macleod, Alberta, for many years after the building of the Fort in 1874. Even with the tremendous increase in western Canadian grain acreage in the early part of this century, however, complaints of duck damage did not become widespread until the late 1940's. During those years, combines almost replaced binders and threshing machines, and the new practice of swathing made crops far more vulnerable to waterfowl.

The Canadian Wildlife Service began work on the depredation problem in the late 1940's by using fireworks, lights, scarecrows, shotguns, and aerial bombardment with little success. Then came the disaster year of 1951 when rain and snow caught much grain in the swath and delayed the harvest until the following spring. Ducks found those conditions much to their liking and caused heavy crop damage across the prairies. Farmers held protest meetings, demanding that ducks be declared pests to be bountied or poisoned. The Canadian Wildlife Service, Provincial Game Branches, Ducks Unlimited, and Wildlife Management Institute arranged demonstrations of scarecrows, metal flashers and their use in conjunction with shotgun patrols during the late summer of 1952. However, harvest conditions were generally good that year and ducks caused little damage. The National Research Council and Canadian Wildlife Service co-operated in an experiment to repel ducks by using the high intensity sound of an air-raid siren in the autumns of 1952 and 1953. That technique also proved impracticable.

In 1953 the Canadian Migratory Bird Regulations were amended to include a section on "Damage by Birds". The amendments provided for scaring ducks from crops and for killing them under local and general permits. Those regulations have worked fairly well, but there are still places and conditions where they are inadequate.

Acetylene exploders, exploding shotgun shells, ordinary shells, revolving searchlights, and coloured material to make grain less attractive were tested.

Acetylene exploders were found to offer the most promise in alleviating depredations, but many exploders developed mechanical defects.

Adverse weather conditions prevented an evaluation of crop losses due to ducks by the proposed interview questionnaire.

A more intensive testing program in a large district was recommended and initiated in 1960. An area of some 200 square miles near Meadow Lake, Saskatchewan, was worked by a crew of two provincial, seven state, three United States Fish and Wildlife Service, two Ducks Unlimited, and four Canadian Wildlife Service officers from August 2 until October 11.

The field men used 150 exploders which were deployed from field to field wherever ducks were seen to land. Ducks were bait-trapped and banded in the area in order to determine the effects of harassment.

Exploders were found to be effective in keeping ducks out of crops - one exploder protected 58 acres on the average (49 acres within 1.5 miles of loafing areas). There was a significant reduction in the number of claims on the Saskatchewan Government Wildlife Damage Insurance in the study area when compared with those in the adjoining area. The average cost of operating an exploder was between 50 and 60 cents a day, with the total cost for the mean duration of operation (15 days) averaging between $7.00 and $9.00.

Many mechanical failures of the exploders in the course of the study, however, precluded recommendation of the machine for use by individual farmers.

The Meadow Lake tests also indicated that prevention of duck damage can be facilitated if alternate feeding areas are available to ducks.

Sandhill cranes have also been responsible for crop damage in Saskatchewan and Manitoba. Their depredations have been concentrated about the north end of Last Mountain Lake, Saskatchewan, and Big Grass Marsh in Manitoba for the most part. Investigations were carried out in those areas by eight Canadian Wildlife Service, two Manitoba Game Branch, two Saskatchewan Museum, one Saskatchewan

Natural History Society, and one National Audubon Society officers from August 12 through October 23. Two to four workers investigated the problem at Last Mountain Lake continuously from August 15 until September 5 and for one or two days per week thereafter. Most of the 1960 effort was expended in the Last Mountain Lake area rather than the Big Grass area owing to shortage of personnel and equipment.

The program objectives were to test the effectiveness of aerial crane herding and of automatic exploders. Regular aerial and ground crane counts, observations of crane movements between roosting and feeding areas, and measures of crop conditions were made throughout the study period.

One plane was used in first attempts to herd cranes in the air. Two and three planes were used later with little success. The technique was found partially successful in moving cranes from fields close to water to the roosting areas, but attempts to move cranes from roosting areas proved futile.

Seventeen automatic exploders, loaned by Ducks Unlimited and the Saskatchewan Wildlife Branch, were used on six of the smaller roosting areas to try to concentrate the cranes on the main roosting area at the north end of Last Mountain Lake. This was done to facilitate the aerial herding experiment. The exploders were successful in repelling cranes, but again mechanical defects made their use impracticable.

Because of the earliest harvest on record in that district in 1960, cranes caused little damage. The experiments could not, therefore, be evaluated on the basis of damage prevented.

It has become quite evident that exploders presently available are not satisfactory because of mechanical defects. Mr. W.J.D. Stephen, Canadian Wildlife Service, Saskatoon, has, therefore, been working with the Engineering Faculty at the University of Saskatchewan and members of the National Research Council to develop a mechanically sound exploder. Three prototypes have been investigated and one, an electrically-operated type, seems satisfactory. Mr. Stephen plans to modify most of the 150 Canadian Wildlife Service exploders for intensive testing this season.

As the Meadow Lake experiments have been completed, it is planned to test the improved exploder mechanism in the Last Mountain Lake area this year on both sandhill cranes and

ducks. The program there will be intensified this year with a crew in attendance from July until the end of the season.

A cover map of the area will be prepared during July in order to record crane and duck movements in relation to the various crops and bodies of water. Techniques for making crane observations, both aerial and ground, will be investigated further. A marking program is planned to distinguish individuals or groups of cranes.

The Saskatchewan Wildlife Branch has managed one hundred acres of lure crop in the damage area in the past. This acreage has been doubled this year through the co-operation of that Branch and the Canadian Wildlife Service. An additional 100 acres is being broken for use next year. Plans call for an evaluation of the lure crop, some of it artificially flooded, in conjunction with the use of the exploders. If damage conditions warrant it, there is also the possibility that some crops in strategic areas may be purchased outright from farmers for use by cranes and ducks.

Throughout the past winter, Mr. J.B. Gollop, Canadian Wildlife Service, Saskatoon, with the help of the Economics Division, Department of Agriculture, has obtained data on land productivity ratings, proportions of usable acreage per quarter section and assessed values of land within five miles of the north end of Last Mountain Lake. Submarginal agricultural land can, therefore, be delineated and evaluated should future purchase for wildlife management be considered. More detailed knowledge of the area and the birds is required before such a step is recommended, but the information already accumulated could form the basis for further co-operation between the Department of Agriculture and the Saskatchewan Government.

In addition to the Saskatchewan study, a plan has also been prepared for sandhill crane investigations near Big Grass Marsh, Manitoba. Dr. F.G. Cooch, Canadian Wildlife Service, Winnipeg, and a representative of the Manitoba Wildlife Branch, with the help of Ducks Unlimited personnel plan to carry out studies along the lines of those planned for Saskatchewan. Personnel and equipment available will limit the extent of the Manitoba investigation, but it is felt that enough local information will be gained so that findings from the Saskatchewan study can be modified to meet conditions near Big Grass Marsh.

The Canadian Wildlife Service and various Provincial Game Branches have continued to investigate other techniques for the prevention of damage. Manitoba officials have carried out a feeding program with considerable success. Saskatchewan officials have operated a wildlife crop damage insurance scheme since 1954 in order to determine its usefulness in the program.

The Waterfowl Advisory Committee, meeting in Washington, D.C., in August 1958, proposed a program for the inspection and assessment of duck damage to cereal crops that autumn. Its objects were to obtain quantitative information on the extent of loss of grain to ducks, to determine farmer attitudes with respect to waterfowl, and to evaluate current control techniques such as feeding stations, early hunting, wildlife insurance, and pre-season crop protection permits. Five, two-man crews, composed of three provincial, three state, two United States Fish and Wildlife Service, two Ducks Unlimited, and two Canadian Wildlife Service representatives covered the area adjoining the north end of Last Mountain Lake in Saskatchewan and the Whitewater and Oak Lakes and Delta Marsh feeding stations in Manitoba from August 27 to September 13.

They made field observations for signs of depredation, located swathed fields, and interviewed owners. Farmers' estimations of waterfowl crop damage were compared with those of trained crop adjusters. Specific observations were made at each of the six feeding stations in Manitoba in the course of the study.

Although the extent and duration of the 1958 study was limited, many valuable data were gathered to form a basis for the more intensive 1959 study.

The 1958 objectives of the depredation investigation were shifted somewhat in 1959 to emphasize the testing of various devices for the prevention of waterfowl depredations. Plans were also made to evaluate the extent of losses owing to waterfowl depredations by means of an interview questionnaire.

Fourteen officers - two provincial, five state, three United States Fish and Wildlife Service, two Ducks Unlimited, and two Canadian Wildlife Service - participated in the project at Meadow Lake, Saskatchewan, and Russell and Newdale, Manitoba, between August 25 and September 14.

While Alberta has received little mention in this paper, waterfowl depredation has been severe in some areas in the past. We expect that the techniques of depredation control being developed for the most part in Saskatchewan will be applicable in Alberta as well, with minor modifications. The main crane migration routes miss Alberta for the most part and there has been little if any crane depredation reported. The crop damage section of the Migratory Bird Regulations has been used quite successfully in alleviating complaints in most areas. However, that Province has taken further alleviating action by passing an Act respecting a Wildlife Crop Damage Insurance Plan on April 12, 1961. The Alberta Hail Insurance Board has been made the General Agent for the Alberta Government in the administration of the Act. A premium of 5 per cent payable on application has been set, with a maximum insurability of $10.00 per acre. The application must be made before July 31 and must cover all of one kind of insurable crop in any legal quarter section. No indemnity will be paid if the damage is less than 10 per cent, or for stacked or threshed crops. Neither will an indemnity be paid after November 30 unless harvesting is delayed by bad weather. The policy can be cancelled and a refund granted if the crop is damaged by other than wildlife. The effectiveness of this Act will be followed with much interest.

A brief summary of past depredation control work, obtained from earlier reports by J.B. Gollop and W.J.D. Stephen, together with plans for intensive investigations in 1961, has been outlined here. With the passing of the new Agricultural Rehabilitation and Development Act, it is hoped that new avenues will be provided for the alleviation of wildlife damage to crops.

WOLF CONTROL IN ONTARIO - PAST, PRESENT AND FUTURE

by

Douglas H. Pimlott
Fish and Wildlife Branch
Department of Lands and Forests

Fifteen years ago the system of wolf and coyote control was relatively uniform wherever wolves (Canis lupus) and coyotes (Canis latrans) were found. The bounty system was in vogue, and the differences of opinion were largely centred around the amount of bounty that should be paid, how fraudulent practices could be prevented, or how uniformity could be attained in the system across the country.

The situation changed very rapidly and now the system of predator control varies markedly across the country. A few examples will illustrate the present situation. Ontario maintains the bounty system. Alberta, by legislative action, branded coyotes as pests and placed control in settled areas under the jurisdiction of the Department of Agriculture. British Columbia has established within the Game Branch a Predator Control Division which has 12 permanent staff members.

Ontario, obviously, has not been in the vanguard of the change toward new ways and means of predator control. However, changes, perhaps better called "mental reappraisals", have been taking place. Perspective is gradually being gained on the management of the big predators and on their relationships to game and to livestock. The realization grows that these predators have positive as well as negative attributes - that the negative side is not as seamy as was once believed.

My objectives in this paper are: to review the past history of wolves and coyotes and their control in Ontario; to tell you of the work on wolves and coyotes which is presently being conducted in the province; finally, to look into the future and, in the course of this, to point out how our actions are being conditioned by the way control programs that have been developed are being conducted in other provinces.

In Ontario, coyotes are usually referred to as "brush wolves", hence references to Ontario "wolf" control will generally refer to both species. In other areas of the discussion I am specific in my references to these animals.

The Past

We are in the process of making a detailed analysis of the bounty data at the district and county level. In the following account I do not attempt to make such an analysis, but simply try to present a general review of the salient points pertaining to rates of payment, cost of the system, annual kills of the two species, and value of the system.

Since Omand (1950) gave considerable detail on historical background, I give this aspect only enough attention to provide background details. Wolf bounty payments have been made in Ontario for over 100 years. Omand (1950) traced the history of the system and found that bounty was paid as far back as 1859. Madigan (verbal communication) more recently found records of an "Act to Encourage the Destruction of Wolves and Bears" dated 1793. This probably gives Ontario the "honour" of having the longest established bounty system in Canada.

History of Coyotes and Wolves

The coyote is a newcomer to much of the province. In the early part of the century it appears that they were restricted to a relatively small part of northwestern Ontario adjacent to the Manitoba border (Cross, 1937). The first documented record for southern Ontario was in 1919. The animals' spread across the southeastern part of the province has been relatively slow and they were not reported from parts of the Ottawa Valley until the 1940's. They are, to a very large extent, associated with the broken habitat of agricultural areas. In the eastern part of the province they are rare north of Algonquin Park. In the central part of the province they occupy a narrow zone along parts of Lake Huron and Lake Superior. In western Ontario the range swings north along the Manitoba border where they reach the most northerly point in their Ontario range.

The timber wolf still occurs over much of the province, the exception being the heavily populated counties of southern Ontario. (Recently we obtained a litter of timber wolf pups about fifty miles west of Ottawa.) Algonquin Park, which is less than 200 miles from Ottawa and Toronto, has a high-density wolf population.

Rates of Payment

With the exception of the period between 1916 and 1924, the scale of bounty payments has been the same for the two species. The Ontario system has had relatively long periods during which the basic payment has been constant. The present rate of $25 per adult has been in effect since 1941. The rate of $15 per pup has been in effect since 1950.

The province is divided into provisional judicial districts and into counties. In the districts the government pays 100 per cent of the bounty. In the counties of southern Ontario, the government pays 40 per cent; the remainder is paid by the respective counties. In eight cases supplementary payments of $5 to $25 are made by the counties. There are also a number of townships which pay additional supplementary sums. The combination of basic and supplementary payments has occasionally brought the total bounty to over $100.

Cost of the Bounty System

Omand (1950) gave the total cost of the bounty system for the period 1905 to 1948. In the 36-year period from 1925 (the first year after the government ceased selling the pelts and began to return them to the claimant) to 1960, a total of approximately $1,600,000 was expended by the Provincial Government. The average annual cost for the 11-year period from 1950 to 1960 was approximately $42,000 (Table 1). In the same period, an average of 293 adult wolves was taken in the counties of southern Ontario. In these areas, as was previously mentioned, the Provincial Government pays only 40 per cent of the basic rate. The supplementary township or county payments are also added to the total. The costs quoted, for the last 11 years, probably represent about 80 per cent of the total expenditures for the maintenance of the system for the period.

The Annual Kill of Wolves and Coyotes

The annual kill of timber wolves has generally been between 1,000 and 1,500 animals (Table 1), with the occasional year when it was slightly above or below these limits. The highest peak in numbers since 1925 was reached in the period from 1947 to 1951, when for five consecutive years over 1,400 timber wolves were bountied.

The bounty records suggest that there was a tremendous upsurge in coyotes in western Ontario in the late 1920's. The number of coyotes bountied for the province increased from 1,066 in 1925 to 4,878 in 1928 and then declined rapidly to 1,458 in 1930, and to 812 in 1934. Omand (1950) pointed out that during the two peak years of 1927 and 1928, more than 80 per cent of the claims for the province were made in the districts of Kenora, Rainy River, and Thunder Bay. The first two districts border on Manitoba. During the past 20 years the annual kill of coyotes has exceeded 1,000 only twice, and in two other years it dropped to less than 500.

We are interested in the possible use of the bounty data as an indicator of population trends. However, many problems exist in making interpretations. For example, in working with the coyote data I am faced with the fact that in the late 1920's most of the animals were being bountied in districts that bordered on, or were close to, Manitoba. I find myself asking, "How much bounty was being paid on coyotes in Manitoba at that time?" and, "Is it possible that enterprising citizens of the two provinces may have developed a lucrative inter-provincial business?" Among the other factors to be considered is the possibility that the low in the timber wolf kill in the early 1940's was a result of war-time conditions.

The Bounty System and Wolf Control

Both Cross (1937) and Omand (1950) pointed out the inadequacies of the bounty system as a means of controlling Ontario's wolves. Certainly the fluctuations in the numbers of animals that are bountied from year to year indicate that the annual kill has had little influence on numbers. Cross (1950) stated, "To diminish the wolf population of this province, it would be necessary to kill a total number of animals each year which would exceed the number of young wolves reaching maturity. This would require for Ontario an annual kill of more than thirty thousand wolves...." I doubt that this is actually the case. Cowan's (1947) work, and other work still not reported, suggest that one timber wolf per 10 square miles constitutes a very high-density population. I am certain that the average density of timber wolves in Ontario is much lower than this figure. I believe that an educated guess would place the timber wolf population for the province below 10,000 animals.

Table 1

Ontario Bounty Data - 1925 to 1960[1]

Year or Period	Animals Killed[1] Wolves	Coyotes	Pups	Total	Bounty and Expenses[2]
					$
1925-29[3]	1057	3088	57	4202	61,045
1930-34[3]	1192	1250	41	2483	48,589
1936-39[3]	1075	1120	34	2229	32,148
1940-44[3]	1056	564	26	1646	31,856
1945-49[3]	1423	929	48	2400	52,634
1950	1613	890	41	2544	56,927
1951	1405	651	44	2100	46,457
1952	1198	634	63	1895	41,803
1953	1313	739	68	2120	46,550
1954	1101	720	70	1891	41,853
1955	1075	620	41	1736	38,703
1956	1088	559	28	1675	37,550
1957	1195	486	71	1752	38,950
1958	1047	574	34	1655	37,255
1959	1169	606	49	1824	41,589
1960	939	528	42	1509	33,619

[1]Does not include data for 1935 - a year when no separation was made between wolves and coyotes

[2]Covers expenditures by Provincial Government only

[3]Figures are averages for the period

In the case of coyotes, it is apparent that we have a relatively low-density population. To make an estimate of coyote numbers is even more difficult than for timber wolves. However, the relatively small area occupied by coyotes (less than 75,000 square miles), the low-density nature of the population, and the annual bounty returns suggest to me that the population does not exceed, and is probably well below, the maximum figure I suggested for timber wolves, that is, 10,000 animals.

In summation, I believe that the present total population of the two species is less than the number of animals that Cross suggested would have to be killed annually to control wolves in the province.

Functions of a Predator Control System

We sometimes speak as if the reduction of a population is the only function of a predator control system. This is an erroneous impression. I consider that the alleviation of specific problems of predation on livestock is just as valid a function. How well has the bounty system provided this function, or service, in Ontario? During the past few years there have been several instances of problems of livestock predation in various parts of the province. To the best of my knowledge, in only one of these areas, Manitoulin Island, have local trappers actually responded by taking up specific trapping in problem areas. Unfortunately, they have met with very limited success and a number of sheep-breeders have felt forced to discontinue sheep-raising. Many farmers continue to support the bounty system in spite of its inadequacies. In the case of Manitoulin Island, this stand is maintained, largely, owing to the fear that if the bounty system is discontinued there will be an even less adequate system of control.

The general feeling in the province about the bounty system has undergone a marked change during the past decade. More and more, organized groups and individuals are suggesting that it be discontinued. Many persons believe that there would be very little outcry if the system were discontinued now. As other sections of this paper will indicate, the question is not so much, "Can, or should, the bounty system be discontinued?" but rather, "What will take its place? Will the succeeding system be better wildlife management than is the bounty system?" I am convinced that a great deal of careful preparation and thought are necessary if the answer to the last question is to be in the affirmative.

The Present

This discussion of the "present" scene in wolf and coyote work in Ontario is of a relative nature; the "present" that I discuss actually goes back to 1957, the year in which a special appropriation of $30,000 was made by the Legislature for the inauguration of wolf investigations. It will extend up to the planned termination of the present program, in 1965.

Obtaining personnel for the program proved to be the first problem. A laboratory technician, Alex Adorjan, was employed during the late summer of 1957. In December 1957, a member of the field staff, John Shannon, who, it was envisaged, would one day become Predator Control Officer, joined the program. He immediately began investigations of control methods in use in other areas, and field investigations on timber wolf ecology in Algonquin Park. It was not until the end of the following year (1958) that the services of a biologist, myself, were procured and that the program was established on a full-scale basis.

The next year, 1959, was one of intensive review and planning. As a result, a plan was formulated which not only stated the objectives, the scope, and the span of the program, but also a general outline for field investigations.

Objectives, Scope, and Span of the Program

The principal objective of the program is to determine the influence that wolves and coyotes have, or may have, on wildlife populations and on the livestock industry. We deny that this objective is restrictive. We realize that any such determinations will be inadequate unless they are made on a very broad basis of understanding. For example, in the case of timber wolves, many factors influence the use they make of a deer population other than simply their need for food. The area over which a pack will range, the density to which the wolf population will increase under optimum food conditions, and the size-class of the animals on which they prey are but some of the factors that must be understood in considering the influence of wolves on deer. Our study is, in fact, a very broad, basic ecological study, in which we constantly keep in mind the need to provide information on which management practices will be established.

The research on wolves is centred in Algonquin Park, where the Department has established a Research Station. We are fortunate in having relatively high populations of both deer and

wolves in the Park. Last year, for example, we sometimes located as many as six packs of wolves within a 10-mile radius centred on the Research Station.

Additional studies on the food habits of wolves are being conducted in several forest districts throughout the province. Much of the work in these programs is done by members of the district staffs under work and procedural outlines that we provide.

Although aspects of the timber wolf investigation will be carried on throughout the study, it is expected that the intensive summer studies in Algonquin Park will end this year. We make considerable use of aircraft and we had the full-time use of a helicopter for part of the winter of 1957-58 and for the entire winter of 1958-59.

An investigation of coyotes will begin during 1962 and will be conducted on Manitoulin Island. It will extend over a two-year period.

The influence of wolves and coyotes in the livestock industry has been, or will be, studied in three areas of the province: the Clay Belt area of northern Ontario, Manitoulin Island, and the Rainy River area.

Secondary objectives of the program are to undertake a detailed analysis of the bounty system and to investigate ways and means of controlling wolves and coyotes most efficiently and effectively. In these programs we are studying methods of using poisons under conditions which vary from heavy forest to agricultural land. We are trying to determine the intensity of poisoning that is necessary to reduce populations, and the influence that intensive control and complete protection have on the productivity of populations. We are asking questions about the effect that the use of poison may have on fur-bearing mammals and on birds. Specific work is also being undertaken on how to set poison baits in order to prevent desirable species of birds, particularly ravens and eagles, from feeding on them.

The experimental work on the use of poisons is being conducted in various parts of the province. In common with a number of food habit studies, the greater part of this work is done for us by members of district staffs, who work under our procedural outlines.

A final aspect of the program is a plan to train key men from the various forest districts of the province in methods of wolf control. This part of the program is to be undertaken

by the Predator Control Officer, John Shannon, who is acquiring a comprehensive background knowledge of control methods. It is planned that this aspect of the work will be undertaken during the final year when most of the current investigations will have been terminated.

The Future

What does the future hold for wolves and for wolf control in Ontario? The other provinces of Canada with wolf and coyote populations are taking widely divergent courses as they move away from what was once a universal bounty system. It is obvious that there are many different courses of action from which to choose: the bounty system could be retained in its present form, or it could be retained and a government-operated poison program could be added, as has been done in Quebec. The bounty system could be replaced by a full-fledged predator control organization and program, as in British Columbia, or by a less rigid system such as the one that is well established in Saskatchewan and which has recently been achieved in Manitoba. In these latter two provinces, Municipal Governments in agricultural areas make a request for control work and contribute to the cost of the program. This parallels our system in Ontario in which County Governments pay 60 per cent of the bounty.

One of the advantages of having moved slowly toward the solution of the wolf question is that it is giving us the opportunity to look into the systems which have been established in other provinces. In our thoughts about the future we ask, "Would any of the new systems be an improvement on the bounty system if established in Ontario?" or, in other words, "Would a governmental program be closer to true wildlife management than is the bounty system?" "Would a government-operated program cost more or less than the bounty system?" "Would more value be received for the money expended?" "To what extent would public opinion dictate the nature of such a program?" In seeking the answers to these questions we are not simply going off into our own orbit; the things that have been done, or that are being done, in other provinces are influencing us and will affect the recommendations that will eventually be made about wolf control in Ontario. Annual reports, conference proceedings, miscellaneous publications, discussions, and, in some cases, letters, give us the opportunity to appraise and to criticize your systems, your approach, and your outlook on predator control.

We find that we are not always in agreement with you on the merits and advances of the new over the old. I shall bring out some of the areas of agreement and disagreement which appear to exist in our approach to a solution of the problem of predator control. In some cases it appears that we are very close in our concept of what the aims should be. However, we strongly question the compromises that in some instances are believed to have been necessary to satisfy public opinion.

To give the discussion background I shall state what I consider to be basic viewpoints on wolves which exist in our Ontario organization.

1. The use of the term wolf control, and wolf control as such should be discontinued. The goal should be wolf (or predator) management - management which connotes, (i) control when and where needed (not when and where wanted) or (ii) protection of varying degrees, depending on specific conditions of game populations and range or on livestock damage.

2. A detailed knowledge of the ecology and population dynamics is as important to predator management as it is to the management of any game species, hence intensive research is of vital importance.

3. Predators have many positive values, some economic some aesthetic. A concerted effort is necessary to establish the two-sided nature of the predator question in the public mind.

4. The bounty system is not necessarily the greatest evil. Unless directed to where specific need has been demonstrated, governmental control programs may constitute a greater abuse and a greater waste of public funds than the bounty system constitutes.

Wolf Control in British Columbia: Predator Management?

We are looking into the programs of other provinces in our attempt to gain insight into the future. Some of the factors that led to my choice of British Columbia as an illustration of such investigations are:

1. British Columbia has the oldest and the most highly organized system of predator control in Canada.

2. Much more has been published about their program, and about related work on prey species, than for any other province.

This makes it possible to gain an appreciation of the biological implications of the control work as well as of the complexities of the organization and the impact of public opinion upon their policies.

I would like to say here that I have long admired the way British Columbia has made detailed information available through annual reports and conference proceedings. I sincerely regret that most of these sources of detailed information no longer exist. I hope that they will be replaced by other media of publication.

A Chronology: British Columbia made the earliest and the most concerted attempt to discontinue the bounty system. Game Commission reports from the early 1940's make reference to the need to replace it with a system operated by trained predator control men. A Predator Control Division was formed in 1947 and a Chief Predator Control Hunter was appointed the same year. In 1949, W.W. Mair was appointed Predator Control Supervisor, and poisoning experiments with strychnine and cyanide were undertaken. The following year an extensive survey was made of coyote range and an extensive network of 1080-poison stations was established.

The intensity and coverage of the poisoning program, for both wolves and coyotes, were greatly increased in ensuing years so that by 1955 a large percentage of the total area of the province was covered and 2,101 major poison stations were established. The bounty system was the subject of intensive discussion during the 1947-55 period; finally it was discontinued for coyotes in 1954 and for timber wolves in 1955. By this time 1080 was the principal poison in use, and many of the poison stations were established by aircraft. The intensity of the poisoning program was gradually reduced in the late 1950's until, in the winters of 1959 and 1960, approximately 1,200 major poison stations were established.

The annual cost of operating the Predator Control Division from 1957 to 1960 was approximately $115,000, with about half that amount being paid in salaries. The operating cost of the Game Management Division averaged approximately $83,000 for the same period.

Predator Control Policy: At the time that the Predator Control Division was being formed in 1947, Cowan (1947) presented a paper to the First Game Conference in which he presented his views on predator control. In speaking on the justification for control he said (p. 42):

> "Predator control frequently becomes necessary. The more intensive the game management practices in use the more intensive will be the desirable predator control. In other words, the justification of expending money and effort upon the control of predators is dependent upon the demand for the game that is being taken by the predators. Where the demand is high and the predator damage proven significant, control may assume an important place in a management plan. In areas where the demand for game is low or negligible, there is no justification for such control and money and effort expended upon such control is wasted money and wasted effort."

He went on to discuss the factors that must be considered when a predator control program for any area is being considered. He stated these (p. 43) as:

> "1. The condition of the game range. Is it adequate to support the present game herd? Is there food, particularly winter range, and the other essential items for an augmented herd?
>
> 2. Is the present herd being harvested efficiently?
>
> 3. What is the position of the predators in relation to the prey? Do they constitute the sole or the most important barrier to increase?"

He summed up his remarks on predator control with the statement (p. 43):

> "Certain areas will be found in need of predator control and the question then arises as to how this may be most efficiently applied. The point has

> already been made that both the control of animals killing domestic livestock and the control of predators upon game require a control method that is applicable where the need exists."

Three years later, Mair (1950) reviewed the predation question. He discussed the three schools of thought on wolf control, namely, kill all, kill none, and control based on research. On the last point he stated (p. 89):

> "We come naturally, then, to the third division of thought - control of predators based on need determined by research. Here is where our many problems arise. How much control is required, and where? The lessons learned in other countries have taught us the penalty of embarking on control in advance of adequate research. And they have taught us the need for employment of men who are not only skilled in the manual details of their work, but who are pliable and searching in their thinking, so that they will see and recognize in advance the need for changes in controls and will be able to carry on research along proper lines. For in predator control, as in all wildlife fields, one faces constantly changing, living problems. There can be nothing static."

He then stated a control policy for:

1. Agricultural and settled areas, viz., 100 per cent control if possible.

2. Game ranges, viz., 100 per cent to none at all.

3. Wilderness and semi-wilderness areas, viz., first determine, in respect to the game species, if any predator control is desirable.

This statement on wilderness and semi-wilderness areas was further qualified by his comments on assistance that would be given trappers to bring about removal of predators from their trap lines. A year later, Mair (1951) recapitulated the basic policy and stated (p. 70):

> "We believe that predator control should be carried out according to need determined by research and economic necessity - not according to any preconceived ideas or dislikes of the predators generally."

At this point I realized that Cowan and Mair were saying exactly the same things about predator control that we are saying in Ontario today. But - by then I had read all the Game Commission's reports from 1944 to 1957, and everything I could find on moose in British Columbia. It seemed apparent to me that ideals and practice varied markedly as the program gained momentum.

The next statement on policy was made in 1953 (West, 1953). He stated that the reasons for controlling predators were (i) because of danger to human life, (ii) to protect livestock and game and (iii) (p. 111) "....for groups such as trappers." In a discussion about sportsmen's attitudes, he mentioned most of the points made by Cowan (1947), which have been previously quoted, on the justification for control of predators on game range. He climaxed his remarks on this point by a rather remarkable statement (p. 111):

> "In the face of public opinion sometimes it is impossible to consider the above questions. It is better to have the control first and solve the difficulties later."

My thought at this point was, "If this is the basis for a predator control program is it any closer to being good wildlife management than is the bounty system?"

Application and Impact of Predator Control: How does one go about appraising a control program for an area which he has never visited - when the area includes prey species which he has never seen - when the area has a vast livestock industry which is beyond his comprehension? These were some of my thoughts as I sought an approach to understanding the wildlife management aspects of the British Columbia wolf-control program. By this time I had gained a basic appreciation of the biogeography of the province. I realized that in many ways the Game Commission's D Division resembled northern Ontario. It is a vast, sparsely populated wilderness, or semi-wilderness area that occupies approximately 200,000 square miles in the northern part of the province. Mining, trapping, and hunting are the main pursuits of its residents. The moose is the principal big-game animal.

Since to me there seemed to be fewer intangible factors in D Division, I decided, for the purposes of this paper, to restrict my appraisal to this Division and specif-

ically to a discussion of the predator-prey relationships of wolves and moose. My sources of information were: the Annual Reports written by the Inspector of the Division (British Columbia Game Commission Annual Reports), reports by members of the Predator Control Division, and reports by members of the Game Management Division. The latter two were presented in the Annual Reports of the Game Commission and in the Proceedings of the British Columbia Game Conferences. In the following presentation I will discuss aspects of wolves and moose for three periods: the 1940's; 1950 to 1955; finally, 1956 to the present time.

The 1940's: The Annual Reports from D Division during the 1944 to 1949 period made regular reference to the depredations of wolves on game. In 1947 it was stated (p. 39) that they "...are considered a far greater menace to the game population than disease, hunters, and other predators combined." The use of predator-control hunters to establish poison bait stations began toward the end of the period, and in 1949 it was reported, "Predatory-animal hunters ... have produced very good results and have cut down the wolf population to where they are no longer a major menace in areas that can be reached by our present mode of travel."

During the same period, particularly in the area north of the 56th parallel, moose were the subject of rather gloomy reports. It was believed that the populations were declining as a result of predation and hunting. The conclusion was not entirely borne out by other reports from the Game Commission. Hatter began his moose studies during the period and reported (1946, 1948, 1949) that overpopulations, malnutrition, and range destruction were common in the Central Plateau area (C Division), which lies to the south of D Division. In 1947, the Game Commission Report (p. 7) stated, "In many parts of the Province, moose have overbrowsed their winter range to such an extent that a great number of these animals, due to malnutrition, are unable to survive the winters." The same year the report from D Division mentioned the possibility of an overpopulation of moose in the Burns Lake area. A year later (British Columbia Game Commission, 1948:51) a decrease in moose was reported for the whole division. Southward migration, the increase in the wolf population, tapeworms, and wood ticks were suggested as contributing factors. The possibility of malnutrition due to range conditions was not suggested. Ootsa and Burns Lakes were mentioned as areas where the decrease was most apparent.

In Hatter's early reports on moose (1946, 1948) he questioned the need for wide-scale wolf control. In 1946 (p. 48), he stated, "... the demonstrated need for predator-removal is quite local in British Columbia. Wolf predation on moose has been overrated, and in some areas where predation is apparent, the moose population is too large for the carrying capacity of the winter range." In 1948 (p. 31), he again discussed predation and stated, "Our predator campaigns should be modified and directed toward the problem areas as they exist within the Province." I failed to find any further reference to wolf-big game relationships by members of the Game Division during the following decade - the 1950's.

1950 to 1955: In 1950 an extensive poisoning program, in which aircraft were used to establish the bait stations, was carried out in an area that extended approximately 300 miles north and 200 miles west of Prince George. The coverage and the intensity of the program were increased from year to year. In 1953, 768 poison stations were established in D Division, an increase of 100 per cent over 1952. A year later, West (1954:61) stated, "Although a very large percentage of the province receives intensive wolf-control measures at the present time, it is intended that these measures will be expanded during the 1955 season." That year there were 1,911 major poison stations in the province and the expanded program in 1955 brought the total up to 2,101. The exact number of stations in D Division for these years was not stated. The 1955 report from D Division stated that wolves were no longer a serious menace to game and suggested that no extensive poisoning program was necessary in 1956. The same year West (1955:61) wrote, "There will be no reduction in wolf-control measures, except where the populations have been reduced to the point where the depredations are negligible, and the wolf population in these instances will be kept at a low level through reduced intensity of controls." It is also of interest that in 1953 an extensive wolf-poisoning program was carried out in the areas around Burns Lake, where it was suggested that an overpopulation of moose existed in 1947 and where a decrease in the population was reported in 1948.

During the early 1950's the annual report on moose in D Division gradually changed and they were reported as becoming more and more plentiful. In 1953, the year when 768 major poison stations were established, several moose were found dying in the spring. The Annual Report (1953:21) stated, "These animals were exceptionally heavily infested with moose-ticks." One of

the significant facts is that there was little detailed information yet available on moose range in D Division, as no biologist had yet been appointed to that region. It will be recalled that, at the start of this period, Mair (1950) had spoken of the need for research and said (p. 89), "The lessons learned in other countries have taught us the penalty of embarking on control in advance of adequate research."

1956 to 1960: In 1956, the report from D Division stated that the wolf population was at a satisfactory level and advised that the over-all poison program be discontinued. The same year West (1956:39) referred to the placing of 1080 baits by air and wrote, "This method accounted for approximately 80 per cent of the whole baiting program and enabled the placing of baits in areas which were hopelessly inaccessible by any other means." In a game-convention talk (1956b:14) he announced a modification of plans which was to permit control operations to be more fluid so that wolves could be managed on a scale of importance. He stated that in future they would receive light treatment in backwoods areas in order that they would not become too numerous. In 1958, the report of the Predator Control Division (British Columbia Department of Recreation and Conservation) pointed to the reduction in the number of major poison stations (1,437) in the province and stated (p. 23):

> "This represented a reduction of numbers by some 21.2 per cent and is a direct reflection of efforts directed at a form of wolf management in the outlying or non-hunted areas. This step is essential as there are large areas where wolves are the only check that game herds must contend with. To at least slow the threat of overpopulation, wolves must be left on their own within reason."

The next year, 1959, major emphasis on baiting was on Indian hunting territory to protect the property of trappers, and on sheep and deer ranges. No specific mention, however, was made of the poisoning program being discontinued in moose range where the productivity of the range was being affected by overutilization.

The reports of high moose populations in D Division became more specific during the late 1950's. The first antlerless season was announced in 1956, accompanied by the remark (British Columbia Game Commission, 1956:32) that "The moose population in this area is heavy ..." (This was the last year of the specific reports from D Division as they were not included in subsequent annual reports of the newly formed Department of

Recreation and Conservation.) In 1958, it was reported (British Columbia Department of Recreation and Conservation, 1958:18), "Winter ranges in most sections of the province continue to show excessive utilization. In the Prince George area most ranges are severely overbrowsed and rapidly decreasing in productivity." It is of interest that the Prince George area was mentioned on a number of occasions as the centre of intensive wolf-control operations during the preceding nine years.

The fact that these recent reports show that moose ranges in northern British Columbia are heavily populated and, in some cases at least, severely overbrowsed and decreasing in productivity raises many questions about the actual need for the intensive wolf-control program of the previous decade. The sequence of events has given me much cause for thought: In the early days of the work there was the expression of purpose - "control where needed". Then, apparently, followed the acceptance of the principle that actions could not be guided by biological considerations when public opinion was pressing. Simultaneously, too, there followed a zealous campaign of wolf control in an area where, when judged against the background of Cowan's (1947) criteria, the need for a wide-scale control program seems open to question. Finally, there was expended in British Columbia a fixed annual sum of over $100,000, much more than had ever been spent on bounty payments.

Circumstances and experiences such as these in areas that have discarded the bounty system have led me to urge that Ontario should make haste slowly in its transition from the bounty system to a program of control-where-needed. It is apparent that there are pitfalls. I continue to hope that Ontario can avoid them.

Summation

The problem of how to undertake judicious wolf and coyote control is not a simple one to solve. Biologically, a great deal of understanding has been gained on predators and predation during the past quarter of a century. However, much more is involved than biological facts. In areas where predators live in close relationship to domestic stock, the problems which exist are frequently as emotional as they are real. On game ranges timber wolves live to a large extent on big-game animals. From time immemorial the gory sight of wolf-killed deer or moose has stirred men so deeply that few have stopped to ponder the relative merits of the rights of man and wolf. Fewer have delved into the meaning of predation - and those that have, have seldom managed to make their voices heard beyond the walls of the ivory

towers. It has been enough that the wolves had beaten us to another creature that we wanted for ourselves (Paraphrase of Nagel, et al., 1955). We took direct action, usually with the fervent conviction that, if we did not act, the death knell would sound for the animals we so cherished for ourselves. The direct action has been the bounty systems and, in recent years, the highly efficient predator control hunter with his strychnine kit, his aircraft, and his "1080" bait.

In most areas, and for most species, the years of the bounty systems were good years. The snares, the traps, even the casually planted poisoned bait, probably did little more than skim the cream and keep predator populations in good breeding fettle. Times have changed - the tough years are ahead for the big predators. We are staking our claim to a bigger and bigger share of the game crop - and control programs are becoming deadly efficient. We now have the knowledge and the potential to emulate our neighbour to the south who has virtually exterminated some of his predators - and we often talk as if this is a desirable goal. Is it? Under what circumstances is control of any degree desirable?

If we are to continue to refer to predator control as a phase of wildlife management, it is time we started making a real effort to answer these and other closely related questions. Surely, along with our growing maturity in the formulation of regulations for the harvest of game and fish, we can mature in our approach to the big predators. Surely we can deny, or at least fight against, the appeals for direct action in cases when we know that the appeals are unjustified.

Please do not misunderstand me, I do not suggest that we drop predator control. Rather, I suggest that the time has come to establish, and to stick to, the goal that predators will be controlled only where it is biologically and economically justified. For years we have been saying we espoused the cause of predator control when and where needed. However, the tendency has been to have the control first and to worry about the "where needed" later. Questions that most urgently require answers are: "What percentage of predator-control funds being spent on poison programs as well as on the bounty, is actually being wasted in Canada today? What are the harmful effects of our predator-control programs?" Let us muster the courage and gain the understanding necessary to answer these questions. In so doing we may have cause for reflection.

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