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Ecological studies of the Beaver, Moose, and Wolf
in Isle Royale National Park

Second Annual Report

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ECOLOGICAL STUDIES OF THE BEAVER, MOOSE, AND WOLF

IN ISLE ROYALE NATIONAL PARK, 1961-62

by Philip C. Shelton

Isle Royale is a 210-square-mile National Park lying in northwest Lake Superior, 15 to 20 miles from the north shore. Physiographically, the island is a series of low parallel ridges, oriented northeast-southwest, with slow trellis drainage. These were formed by the differential erosion of basaltic and conglomerate strata which dip gently to the southeast into the Lake Superior basin. The plant cover is transitional between the northern spruce-fir and Lake States hardwood forest types.

Beavers, moose and timber wolves are the most significant mammalian inhabitants of Isle Royale and, together with the plant foods of beavers and moose, they make up a discrete food web, relatively little influenced by other members of the fauna.

Other mammals present are red foxes, snowshoe hares, minks, weasels, river otters, muskrats, red squirrels, bats, and two species of mice. Conspicuously absent are white-tailed deer, black bears, and porcupines.

This is a cooperative project of the National Park Service and Purdue University, under the direction of Durward L. Allen of the Department of Forestry and Conservation. Major support has been received from the National Science Foundation and the Wildlife Management Institute. We wish to thank George W. Fry and Henry G. Schmidt, successive Superintendents of Isle Royale National Park during the past year, for the critically important help, logistic and otherwise, which these studies have received in the Park. The unstinting efforts of Chief Naturalist Robert M. Linn, Chief Ranger Benjamin J. Zerbey and other staff members in support of this work have been an immeasurable asset.

The aim of this project is to examine critically the relationships between the three principle mammals and their food resources.

The first study in the series was made by L. David Mech from 1958 to 1961. It emphasized the numbers, hunting, and social behavior of the wolf and its relationships with the principle prey species-- moose. This, the second study, begun in 1960, is continuing the wolf-moose work and extending research to the secondary prey species of the wolves-- the beaver.

This summary report covers summer and fall work of 1961, concerned principally with beavers, and the winter study of 1962, concerned principally with wolves and moose.

Beaver Studies, Summer and Fall, 1961

Summer and fall field work extended from June 15 to November 8, with headquarters at Mott Island.

Studies of beavers consisted almost entirely of live-trapping and marking on roughly 15 percent of the island, extending from the southwest end of Sargent Lake to Passage Island. This appears to include a reasonable representation of the beaver habitats on Isle Royale. Sargent Lake appears to be excellent habitat, while some of the small islands off the northeast end of the main island may be marginal.

A major problem on Isle Royale is in sampling 210 square miles with a significant degree of intensity. It did not prove possible to catch all the members of a beaver colony in a few days of trapping. Some of the more accessible colonies were trapped up to 40 trap-nights without catching all the animals present. Therefore, an attempt was made to sample each colony sufficiently to find out which age groups were represented. This with an appraisal of the food supply available to individual colonies, comprises most of the data obtained thus far. Since all trapped animals were ear-tagged and released (with the exception of three which escaped without tags and four accidentally killed in the trapping operation), most of the information on growth, survival, and movements will be obtained during the summer and fall of 1962, when as many as possible of these animals will be retrapped.

Trapping and marking techniques

The live traps used were built by C. L. Hancock of Hot Springs, South Dakota. Several different baits were effective, the particular one used was determined by what beavers were currently eating at the site trapped. In summer this frequently was the leaves and green stems of thimbleberry or aspen twigs. During the fall, white birch, beaked hazel, and aspen twigs were the common baits. Beaver castor prepared by C. L. Hancock was used with the vegetable baits and proved definitely beneficial in attracting animals to the sets.

From July 6, when trapping began, until November 6, 91 different beavers were trapped in about 320 trap-nights. There were 63 recaptures for a total of 154 captures, or about 0.48 beavers per trap-night. Twenty different colony sites were trapped, with an average of 4.5 beavers per site.

Beavers were handled in a burlap bag. With practice, it became relatively easy for one person to transfer an animal from trap to bag holding it by the tail. In the bag, the following data were obtained on each animal: length and breadth of the scaled portion of the tail, total length, hind foot length, ear length, zygomatic breadth, weight, and sex. Both ears were tagged with numbered monel metal tags. Sizes used were 1 and 3, usually one of each per beaver. The animals were then released at or near the site of capture.

Age and sex ratios

Measurements of the tail, zygomatic breadth, and weights were used for age determination. These measurements were compared with those of known-age beavers from the Adirondacks as described by Patric and Webb (Jour. Wildl. Mgt., 24(1):37-44). In general the correlation was good between measurement of Isle Royale beavers and those from the Adirondacks. Another year of trapping marked beavers will refine the technique further.

Four age groups can ordinarily be recognized: kits, yearling, two-year-olds, and adults. There is some overlap between the latter three categories. The 91 trapped in 1961 were tentatively placed in the following groups: kits, 33; yearlings, 20; two-year-olds, 13; and adults, 25.

Assuming this allocation to be reasonably accurate, and that the different age groups are equally vulnerable to trapping, these figures indicate that there is at least a reasonably good crop of young born each year. Actually there may be a bias against kits in the trapping, since they probably are not as active as older animals. This would mean that more kits are present than the figures show. Evidently there is a mortality of about 30 percent through the first two years of life. Since the adult category includes animals from three years old to the maximum age of beavers, this is expected to be one of the largest groups.

Assuming the rate of annual mortality to be about a third, for all age groups, regression from the figures for each of the three lower age groups would give 25 as the expected number of adult animals in this series, the oldest being about 9 years old (33 kits, 20 yearlings, 13 two-year-olds, 9 four-year-olds, 6 five-year-olds, 4 six-year-olds, 3 seven-year-olds, 2 eight-year-olds, and 1 nine-year-old). Since the 13 two-year-olds and the 25 adults make up the total potential adult population for 1962 (total of 38), and the expected mortality is about 13, this should leave an adult population of 25 beavers again for 1962. This would indicate a stable population, with mortality balancing recruitment.

The sample size is small, and the assumed ratios may not be wholly valid, but these figures constitute a tentative calculation of mortality and turnover rate in the beaver population.

Of the 20 sites sampled, 17 had at least one adult and 15 at least one kit. Three "colonies", where presumable all animals were caught, consisted of two beavers each, a male and female. All were subadults (2-year-olds) but one, which was an adult. A single site had only one beaver, probably a yearling.

At least 8, and possibly 10, of the 20 sites had adults, yearlings, and kits. Theoretically, this is the normal composition of a mature beaver colony. Two-year-old beavers supposedly leave the parent colony in the spring when the new kits are born, leaving the colony composed of the two adults, the yearlings born the previous summer, and the current year's kits.

Exceptions to this general rule are to be expected and were found. One colony had all four age groups represented; one had adults, two-year-olds and yearlings; two had adults and kits only; and at least two (possibly four) had adults, two-year-olds, and kits.

All except kit beavers were sexed by palpating the cloaca for the os penis. This proved simple, fast, and accurate, except for small, early season yearlings, which may not have had sufficient development for the os penis to be detected. Most of these early yearlings were called females, possibly distorting the sex ratio for that group. The sex ratio for two-year-olds and adults was essentially even-19 males : 18 females.

Movements

The most commonly observed movements of beavers are their daily foraging activities. In addition to these feeding movements, whole colonies sometimes change locations. Six instances of this were noted during 1961.

In two cases, both on Tobin Creek, the movement was upstream from one pond to the next. Dams and houses for both ponds were maintained throughout the season, so the shift was from one house to another within the occupied territory. This occurred in early fall, about the time the food pile was begun.

Another example involved a movement of about 100 yards downstream in a series of very old ponds, about a mile up the Mt. Franklin Trail, by two sub-adult beavers. This was a change from an old, run-down house to one slightly more substantial.

A move by the Moskey Creek Colony was brought about by a midsummer drop in water level, after which the whole colony occupied temporary quarters in a slough at the mouth of another creek a quarter-mile away. In September, when the ponds at the original site refilled, the beavers returned.

The other two movements observed were shifts from summer to fall and winter quarters similar to those of the Tobin Creek colonies, except that these took place in harbors where movement was less restricted. The Lorelei Lane colony left the house it had occupied continuously through 1960 and until the first week in September, 1961, near the northeast end of Outer Hill Island. They moved into a previously abandoned lodge at the southwest end of the same island, half a mile away. The Cemetery-Caribou Island colony moved from its summer quarters on Cemetery Island nearly a mile northeast to an abandoned house in a small cove at the northeast end of East Caribou Island. For the past two summers this colony has occupied the same lodge, but the animals moved for the fall and winter. Last winter they stayed on Rabbit Island about a third of a mile from their summer location.

Food relationships

Beaver food habits vary with the seasons on Isle Royale. Since no field work has been done in spring, the diet at that time of year is not known.

During the summer, leaves and green stems of thimbleberry are the major food of the beaver. This plant grows in abundance over most of the island, although it may be somewhat depleted in the immediate vicinity of some colony sites. Aquatic vegetation also is eaten during the summer. Mountain ash is used at this time, but the supply is not large enough to be important. Most of the trees near water are sprout growth from beaver-cut stumps, indicating that the original trees were cut long ago. Recutting occurs as fast, or sometimes faster, than regrowth.

Deciduous tree and shrub species make up the beaver's diet during fall and winter. The most important of these are aspen, white birch, red-osier dogwood, and beaked hazel. In addition, several other species have been cut in small quantities. These include sweet gale, mountain ash, alder, and red maple. Alder and sweet gale may not be eaten, but this has not been determined with certainty.

One instance each of spruce, white cedar, and balsam fir cutting was recorded. The balsam fir, cut in winter, had been peeled and presumably the bark eaten. The significance of conifer cutting is not known.

Winter caches usually are started about mid-September and added to throughout the fall, probably as long as there is open water. These are usually built close to the house, often directly against it. Principle fall and winter foods of the individual colonies were determined by food pile composition and the cutting done by the colony.

Analysis of 19 food piles in October showed significant quantities of birch in 15, aspen in 8, hazel in 6, dogwood in 5, and black ash in one. Alder was also included in one, but it may not be eaten. Other species that occurred in small amounts were sweet gale, red maple, and white cedar.

One common food missing from this discussion is willow. This is a highly preferred food species in beaver populations throughout the continent, but I have no record of willow cutting by beavers on Isle Royale. The most obvious reason is the scarcity of willow. There probably never was a large supply on the island, and since it is highly preferred by both beavers and moose, the stands near lakes, streams, and harbors probably were eliminated long ago. The only willows seen in the present study were low, shrubby, upland forms, all heavily browsed by moose.

Distances traveled for food

The average maximum distance from water which beavers traveled to reach

food trees was 60 feet for birch and 130 feet for aspen. Frequently aspen was reached only after a swim of up to half a mile; in no case did beavers swim more than 200 yards to reach birch. Together with the data from food pile composition (15 food piles with substantial amounts of birch, 8 with significant amounts of aspen), these figures reflect, first of all, the relative scarcity of aspen. But since aspen is actually much less abundant than these ratios (15:8, 130:60) would indicate, and since in almost all cases, birch is by-passed to reach aspen, the preference for aspen over birch is likewise evident.

The distance traveled for the secondary shrub species is seldom more than a few yards, although these species may at times be important supplements to the food supply of Isle Royale beavers.

Remaining food supplies

It is difficult to determine what constitutes potential beaver food because of the complexity of factors involved. The most obvious factor is distance of the trees from water and the slope of the ground. The extent of shoreline available to a colony is important in determining total food resources. Stream beavers are at an apparent disadvantage in that they have to create their own shoreline by damming streams, while lake and harbor dwellers may have several hundred yards of natural shoreline within their cruising range. The psychological effects of the presence of predators may be involved in determining how far from water beavers will forage.

There may also be food preference factors which vary from colony to colony, depending upon what particular food the animals are accustomed to eating. A colony that has lived on aspen may move to a new location when the supply is exhausted, even though birch is still abundant. Other colonies may subsist solely on birch with no ill effects.

In a few locations 90 percent of the birch within 50 feet of water has been cut. However, in most colony locations much less, often only 10 to 25 percent has been used. Beyond 50 feet from shore, little birch has been cut at any site.

Most of the aspen within 50 to 100 feet of water near beaver colonies has been cut, although many trees are still growing within 200 feet of the shore at several locations.

A comparison of two abandoned sites on Sargent Lake with currently occupied sites on the same lake indicates no significant difference in the food supply. If, on further analysis of abandoned sites, this is found to be generally true, then food shortage probably is not the cause for abandonment.

Given the assumptions (1) that trees within 100 feet of water on gentle to moderate slopes are available to beavers, and (2) that birch or birch supplemented with hazel or dogwood is adequate food, there is no evidence for a

beaver food shortage on the area studied at the present time. Both assumptions seem reasonable in the light of present knowledge.

Further analysis, especially in comparing food resources of currently inhabited colonies with those of recently abandoned sites, will be continued in 1962.

Past and present status

The scarcity of beavers on Isle Royale that has been the focal point of discussions on this species for the past several years, including the report of last year, may be more apparent than real. The abundance and conspicuousness of abandoned sites, many of which may result from random movements of the occupants, may have given rise to the impression of scarcity. It probably is true that beavers are not so numerous as they were 10 years ago, but the decline has either been over-emphasized or there has been a partial recovery.

As shown in the discussion of food resources, it does not seem likely that there is any general beaver food shortage on Isle Royale at this time, although depletion is steadily occurring and may be reaching a critical point in local areas. Regeneration of aspen and birch, both seral stage trees, usually depends upon some kind of disturbance which will prevent development of the climax conifers. Fires and logging operations are commonly involved. On Isle Royale neither of these has occurred since the 1936 burn. This fire burned about a third of the island, and may now be producing beaver food in local areas, especially around Lake Harvey. The present status of Isle Royale as a National Park, and intensive fire control, makes future disturbance unlikely. Heavy moose browsing may prevent regeneration of aspen and birch stands also.

The effect of wolf predation on the beaver population is not known. Scat analysis shows that beavers are eaten by wolves throughout the season of open water, but the importance of this to either species has not been determined. If, as the preliminary figures show, beavers are being recruited at least as fast as they are lost, the wolves are removing only the surplus (assuming that the beaver habitat is saturated).

Another possible decimating factor is disease. There is evidence in the literature of an extensive beaver die-off during the early 1950s throughout the northwestern Great Lakes area, including northern parts of Minnesota, Wisconsin, and Michigan, and northwestern Ontario. Tularemia is generally thought to have been the cause. Since this occurred at approximately the same time as the supposed beaver decline on Isle Royale, it is reasonable to suspect that the same disease may have been involved.

The Moose Herd

Over the first three years of this series of studies, L. D. Mech has gathered vital statistics on the moose herd in various ways. The chief objectives have been to determine: (1) the total number of animals on the island, and possible trends in moose numbers; (2) the productivity of the herd, as shown by summer and fall adult:calf ratios; and (3) the overwinter loss of calves, as shown by late winter adult:calf ratios when compared with the summer ratios.

Briefly, the results of the three year's work are: (1) The late winter population is at least 600 moose, based on an aerial count of the whole island made in 1960. (2) Summer adult:calf ratios, based on observations by Mech, various park personnel, and commercial fishermen, were 100:25 in 1959, and 100:15 in 1960. In 1959, a fall aerial count indicated a ratio of 100:22. (3) Late winter adult:calf ratios, based on aerial surveys have shown that there is a decrease in the proportion of calves at this time of year, indicating that mortality is selective against calves.

This work is being continued as part of the long-term study of wolf-moose relationships. The summer adult:calf ratio, based on 382 observations was 100:25 in 1961, a return to the 1959 level, after an apparent low in productivity in 1960. In late October, another attempt was made to obtain a ratio by aerial count. Of 176 moose observed, 17.6 percent were calves. In the following March aerial determinations were made on 80 moose, of which 27.5 percent were thought to be calves. While this figure is statistically reasonable due to the small sample size, it probably is inflated due to difficulties in distinguishing calf moose from yearlings. This is a large potential error in late-winter work of this kind.

No attempt has been made to make a total count of the island since 1960. In none of the three other years was weather favorable enough to conduct such a count (it required 45 hours of flying), and it is not expected that such weather will occur often enough to be depended upon. During the winter of 1961, Mech counted moose on four sample areas, totaling about 10 percent of the island. These were counted again this year. The results show that variations probably are too great on this size sample for the technique to be useful. As a result of these inadequacies of the aerial census technique, future quantitative work on the moose herd will involve other methods, probably spring pellet-group counts.

Summer Wolf Studies

As usual, summer wolf observations consisted of a few sightings by park visitors and the National Park Service trail crew. Two fresh kills, both calves, were reported to us and were investigated.

Scat collection and analysis was continued as in past years. In 79 wolf scats of undetermined age, but probably dropped in late winter or early spring, 83 percent of food occurrences were moose, 11 percent beaver, and 6 percent snowshoe hare. In 55 spring wolf scats, moose comprized 79 percent of food occurrences; beaver, 18 percent; and snowshoe hare, 3 percent. Only 17 fall wolf scats were collected; in these 47 percent of occurrences were moose, and 53 percent were beaver.

Winter Study, 1962

Winter field work this year covered the period January 30 to March 20, approximately the same as in 1960 and 1961. The project had the services of Donald E. Murray, of Northeast Airways, Eveleth, Minnesota, who piloted the 90 hp. Aeronca Champ field plane for the fourth consecutive year. Murray and Shelton were on the island for the entire period, and Allen for the month of February. Staff members of Isle Royale National Park were on the island for periods of from 5 days to 2½ weeks. These were, in order, Communications Technician Richard Igo, Chief Naturalist Robert M. Linn, Superintendent Henry G. Schmidt, Chief Ranger Jack Raftery, and District Ranger Peter L. Parry.

As in previous years, the winter base camp was at the Windigo Ranger Station on Washington Harbor.

There was floating ice and open water between Isle Royale and the Canadian mainland when the field party arrived on January 30. During the first 10 days of February, when mininum temperatures were below zero all but three days, the lake froze completely across to the mainland along the entire length of Isle Royale. This ice still was intact and apparently quite solid when work terminated on March 20. Shelf ice extended out on to the lake along most of the southeast side of the island, permitting landings at many places that usually are inaccessible. Wolves were seen 2½ miles off the north shore, and could easily have crossed to Canada, but there was no evidence that this occurred.

Snow depth at Windigo was about 17 inches when the work began. By the first of March total accumulation had reached about 23 inches, and this had settled to approximately 20 inches when the party left.

Flying this winter totaled 121 hours-- less than in past years because of generally unfavorable weather. There were only 11 days on which no flying was done, but it was common to have only 1 to 3 hours in the air, due to poor visibility.

Wolf numbers and aggregations

The timber wolf directly affects the numbers of the major herbivores, moose and beaver, and subsequently influences their relationships to the vegetation on which they feed. Fortunately, counts of wolves have been reasonably accurate for the past four years.

On two different days in 1962 there was positive proof of at least 21 wolves on the island. Twenty-one different animals were seen on a flight on February 21. On March 15 a total of 19 wolves were counted, and tracks of two additional animals were found. Probably one more was unaccounted for, or possibly two. Thus, the total population for 1962 was 22 or 23.

The large pack, which constitutes the major portion of the Isle Royale wolf population, numbered 15 or 16 animals for the past three years. This year 17 wolves were seen several times, indicating an increase of one. One wolf in this pack appeared to be a pup to all who saw it, indicating that one young animal was reared in the summer of 1961. If this be true, it represents the first detected increase in the population since the winter of 1959, when these studies began.

During the past winter the large pack did nearly all its hunting in the southwest half of the island, making only two short forays as far northeast as Siskiwit Lake. On these occasions, the extreme points reached were Intermediate Lake and Chippewa Harbor.

This pack split once for a period of no more than 5 days. It was not possible to get certain counts but the two groups probably numbered 10 and 6.

The 17th wolf often was not with the others, and a lone wolf was seen several times in the range of this pack. However, when 17 wolves were present, there was no indication that any wolf was being kept to the rear of the group; often they were all quite closely bunched. Apparently this wolf was tolerated by the pack but frequently chose to travel alone.

In addition to the big pack, there were two groups of two wolves, and one loner, all of which inhabited the northeast half of the island. Groups of two wolves were seen only as far southwest as Todd Harbor and Siskiwit Lake. In previous years, there has been a pack of three in the northeast portion of the island, ranging down the north shore sometimes as far as Washington Harbor. No such aggregation was seen this year, but one of the couples may have been part of this pack of three.

Wolf behavior

Few observations could be made this year on hunting behavior because of an evident change in the wolves' reaction to the aircraft. A limited collecting permit had been granted by the Park. If opportunity permitted, the plan was to kill and autopsy any moose that had been pursued by the wolves and either outran or fought them off. It was expected that something could be learned by comparing the age, condition, and degree of parasitism of such

a moose with those which had been killed by the wolves. Unfortunately, there was no opportunity to do this.

In 1962 the pack was obviously more disturbed by the aircraft than in past years. This year, when the plane came over while the wolves were hunting, the usual behavior was to stop, mill around a bit, then retreat to the last stand of thick timber through which they had passed, and lie down there until the aircraft had been gone for an hour or more.

Observations indicated that at least one, and possibly 2 or 3, of the lead wolves were responsible for initiating the retreats; the others followed. Often several wolves would stay out in the open, apparently undisturbed, while others, presumably the shy leaders, were out of sight in the timber. The reason for this behavior is not known. It is conceivable that they have been frightened by a low-flying plane, possibly even during the summer, that came upon them unexpectedly. Or the presence of a young wolf in the pack might make the parents more wary. It is hoped that in years to come the pack can be reconditioned to the plane so that observations of hunting behavior can be continued, and so that "tested" moose can be found and collected. Only once during the winter period was it possible to follow the pack for most of a day, but no moose were attacked during this time.

The 3-day activity cycle of the pack was the same this winter as in years past. A moose was killed about every 3 days on the average, with variations from 1 to 6 days. The wolves usually stayed at a kill for 36 to 48 hours, then moved 15 to 30 miles in about a day to the site of the next kill. The favorite travel route was the shore ice around the southwest end of the island. About half the moose killed were within a quarter-mile of the shore.

Few data were obtained on the smaller groups of wolves, due to the difficulty of keeping up with them from day to day. Information available indicates that they travel less and perhaps use less regular routes than the big pack.

The activities of two wolves were followed for 8 days, Feb. 14 to 22, during which time they travelled from near Blake's Point westward as far as the southwest end of Amygdaloid Island then back to the narrows between Five-finger Bay and Duncan Bay. There they wounded a moose and watched it for at least 2 days, then left it and travelled at least 5 miles southwest up over the Greenstone Ridge. The moose died a few days after the wolves left. Two weeks later, two wolves, presumably the same ones, returned to the moose and fed on it.

In the meantime the moose was autopsied and found to be 10 to 15 years old. Its lungs were heavily infested with hydatid tapeworm cysts. The wolves evidently had injured the moose only on the rump, but the wounds were deep and probably resulted in large loss of blood.

Three other moose were found that were being fed upon by smaller groups of wolves and which may have been killed by them. At least one of these could have been wounded previously by the large pack.

One wolf was found gnawing the bones of an early winter kill which it had dug out of the snow. There was almost no meat left on the carcass at the time it was inspected. Tracks indicated that the wolf had been in the vicinity for at least 2 or 3 days.

Age and condition of moose killed

Jaws of 18 moose, all probably killed by wolves, were collected during the winter study. Two of these were calves. Of the others the youngest was probably $4\frac{1}{2}$ to 5 years old (Peterson wear class IV). Most of the others fell into wear classes VI to IX, estimated ages 7 to 15+ years.

The femur marrow of 9 of these moose showed signs of fat depletion. Two had "lump jaw."

Two moose, both killed by small groups of wolves, were autopsied before the viscera were eaten. The lungs of both were heavily infested with hydatid tapeworm cysts; one contained at least 50, the other 25 to 30. Both were in wear class VIII, indicating probable ages of 10 to 15 years.

Thus the findings of past years-- that wolves are killing predominantly calves and old, possibly debilitated moose-- are further born out by these data.

Miscellaneous winter observations

Otter tracks were found between Cemetery and West Caribou Islands on the 8th of February, and near the head of Moskey Basin on March 10. This is the first authentic record of this mammal on Isle Royale, although its presence has been suspected for some time. Several pictures were taken of the tracks.

Beavers from the colony on Outer Hill Island cut a hole through the ice and were feeding on shore throughout the winter study period. They were feeding on fall-cut birch logs, and also on small, freshly cut balsam firs. The food piles of this colony, built during September and October of last fall, washed out during a 2-day blow in early November. This probably is the reason for their having to feed on land during the winter.

No other beaver signs were seen this winter.

Snowshoe hares and foxes appear to be more abundant this year than formerly. This was noticed by those members of the party who have been on the island several winters, including the pilot and National Park Service personnel. Summer observations also indicate an increase in hares.