ECOLOGICAL STUDIES OF THE WOLF ON ISLE ROYALE*

Fourth Annual Report

(Covering the sixteenth year in the Isle Royale studies)

1973-74

by

Rolf O. Peterson, Graduate Research Assistant

Durward L. Allen, Professor of Wildlife Ecology

Department of Forestry and Conservation
Purdue University
West Lafayette, Indiana 47907

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This has been the sixteenth year in our Isle Royale research and the fourth year in the doctoral research of Rolf Peterson, who expects to submit his thesis during the coming summer. It will deal with his studies of wolf ecology, plus moose herd characteristics and dynamics as revealed by an extensive collection of skeletal remains.

Peterson and his wife, Carolyn, did field work on the island from May 4 until November 10, 1974, and were assisted by Philip W. Simpson (May 15 to July 25), Timothy C. Lawrence (May 15 to August 17), and Michael W. Wrighthouse (July 26 to August 17). Allen made field trips on the island in May, September and October. Robert R. Mohr, of Crane Lake, Minnesota, served as pilot for an aerial moose herd composition count in October.

The 1974 winter study extended from January 23 to March 17. Allen was present from January 23 to March 1, and Peterson stayed the entire period. We again benefited by the long experience of pilot Donald E. Murray, of Mountain Iron, Minnesota, in his sixteenth consecutive winter of service to the project. Several National Park Service personnel assisted directly in the winter study operation: William E. Dohrn, 23-31 Jan.; Carl M. Fleming, 31 Jan. - 9 Feb.; Ivan R. Tolley, 9 Feb. - 1 Mar.; Dale Peterson, 1 - 17 Mar.

Summer Field Work, 1973

Two hiking teams were used to cover as much of the island as possible, with hiking mileage totaling 1103 (including 563 miles of off-the-trail work). This provided a sample of wolf-killed moose from the winter of 1973, in addition to many older remains previously undiscovered. Summer ground observations provided records of moose herd composition, although the most reliable data on sex ratio and calf production came from aerial observations after leaf-fall in October. Wolf-related information was gathered primarily by indirect means such as examination of fresh sign and howling, plus a few direct observations. Intensive scat collecting provided valuable recent information on summer food habits of the Isle Royale wolves, which have changed significantly since initial scat collections were made over 10 years ago.

Moose observations

Ground and aerial composition counts made over the past four summer and fall seasons are summarized in Table I. It is evident that calf production in 1973 was considerably higher than in the previous three years, especially 1971 and 1972. The winter of 1972-73 was unusually mild (with respect to snow depth and temperatures), suggesting that the severe winters of 1971 and 1972 were the primary factors causing low calf production in the following spring seasons.

Table 1. Moose herd composition and productivity, 1970-73

	June 9 - Sept. 4, 1970 (ground)	May 18 - Sept. 7, 1971 (ground)	May 9 - Sept. 25, 1972 (ground)	October, 1972 (aerial)	May 4 - Sept.30, 1973 (ground)	October, 1973 (aerial)	May 6 - Aug 13 1974 (ground)
Total seen	192	142	231	114	244	192	118
Males	64	47	106	49	92	81	36
Females	91	64	92	53	102	81	57
Calves	35	19	23	12	38	30	21
Unknown	2	12	10	--	12	--	4
Sex ratio	70mm/ 100ff	73mm/ 100ff	115mm/ 100ff	93mm/ 100ff	90mm/ 100ff	100mm/ 100ff	63 m/ 100 ff
Percentage of females w/ young (after June 1)	33.0	24.6	25.6	20.8	43.4	37.0	17/57 29.8%
Calves per 100 adult females* (after June 1)	38.5	26.2	28.0	22.6	48.7	37.0	36.8
No. sets twins	5	1	2	1	4	0	4

*Includes yearling females, which at times can not be distinguished from older moose.

21/57 = 36.8/100

October aerial counts seem to provide the least biased data on the adult sex ratio. Surveys conducted in 1972 and 1973 indicate that the current sex ratio of the Isle Royale moose herd is approximately even.

Moose mortality

For the past three summers a special effort has been made to gather a "random" sample of moose remains. This increases our knowledge of moose mortality patterns and enlarges our sampling beyond that which is done routinely during winter study. Data gathered in this fashion should give a reliable picture of year-round moose mortality and incidence of abnormalities such as arthritis and jaw necrosis.

Remains of 112 moose were examined during the 1973 summer field season, including most of the kills spotted from the air during winter study, 1973. We now have a sample of 42 wolf-killed moose from the winter of 1972-73. The age distribution of these moose is given in Table 2. Only 29 percent were calves, a significant drop from 1970-71 and 1971-72, when unusually deep snow made calves more vulnerable to wolf predation (over 50% of the wolf-killed sample).

Table 2. Age distribution of wolf-killed moose, winter 1972-73.

Age (years)	Calves	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+	11+	12+	13+	Unk. Ad.	Total
No.	12	6	5	3	2	0	1	1	1	1	1	3	2	2	2	42
Percent	29	14	12	7	5	0	2	2	2	2	2	7	5	5	5	99

Also noteworthy is the high incidence of young animals in the adult sample. Moose in the 1+ to 4+-year-old group comprised 53% of the total adult kill, compared to 18% in this age group for the years 1959 through 1972. All the moose in this age group that were killed in winter, 1972-73, were either carried as a fetus through a hard winter (1969, 1971, or 1972) or experienced such a winter as a calf. This suggests that severe winter conditions may have long lasting effects on the viability of the youngest age groups, possibly through effects on growth and development. We have collected a metatarsus from as many moose as possible since 1971 in the hope of documenting such an effect, although we lack comparable data from earlier years. This collection also furnishes information on epiphyseal closure, which is thought to coincide with puberty. None of the nine yearlings examined since 1971 and only two out of eight 2½-year-old moose have shown epiphyseal closure in the metatarsus. Although precise data on the timing of epiphyseal closure in moose are lacking, it appears that body development in recent cohorts has been delayed.

In contrast to 1971 and 1972, no moose were found in 1973 that appeared to have died of malnutrition. In general, malnutrition is an infrequent direct cause of mortality for Isle Royale moose, and it appears during those winters characterized by exceptionally deep snow or unusually long duration.

Summer wolf activity

In the course of these studies we have commented on the effect of human visitation on wolf travel routes, indicating a decrease in wolf sign on trails in recent years with the build-up of visitation. In 1973 wolves were noticeably restricted in their use of park trails from late May through late September.

In order to quantify these observations, a record of scats observed and miles hiked was kept during summer, 1973. Trails were routinely cleared of scats when hiked by Purdue personnel. The records are summarized in Table 3.

Table 3. Incidence of wolf scats on trails, 1973.

	Miles of trail	No. of scats	Scats per mile	Length of scat deposition period
Spring (to mid-May)	71.3	397	5.6	4 months
Summer (to mid-Sept.)	55.5	20	0.4	3-4 months

In 1973 there was more than a 90% decrease in scat incidence on trails after visitation began. Wolves seem to have a low threshold of tolerance to human disturbance, since they greatly curtailed their use of trails within two weeks after visitors first began hiking the trails in early May. It does not appear that visitation at current levels affects the wolves in any way other than restricting their use of trails. This situation may change if visitor impact (total numbers, distribution or season of use) is increased.

From the winter study of 1973 we knew that the island had two main wolf packs, West and East, numbering as many as 8 and 13 wolves, respectively. During field work the following summer we found activity areas, or rendezvous sites, of both packs. These serve as temporary homesites for the pups and are centers of activity for the adults, who return frequently with food for the pups. All five of the rendezvous sites examined were close to water, and a moose carcass was found at two of the areas, suggesting that the pups may have been moved to a fresh kill. Observations at an East Pack mid-summer rendezvous site indicated the presence of seven pups in this pack. An undetermined number of pups were present in the West Pack.

A total of 540 scats were collected from wolf activity areas and game trails to determine summer food habits. No intensive scat collection had been made since the early 1960's, so this provided a valuable opportunity to make long-term comparisons. It is now evident that beaver are an important summer food item, their remains amounting to 51% of the prey remains in scats (n=831). Summer wolf predation on beaver appears to have tripled during the last ten years, a period when the beaver population has steadily increased. Both the West and East packs showed similar frequency of occurrence for beaver remains, and beaver utilization remained constant from spring to fall. The only other important food item on Isle Royale is moose, with calves comprising 79% of total moose occurrences in the scats (using only scats deposited before calves lose their juvenile coat in August).

Other summer observations

The great aspen leaf roller (Archips conflictana), which had defoliated a large portion of the aspen on the island during the 1970, 1971 and 1972 growing seasons, was present at only low levels in 1973.

A total of 112 species of birds were recorded on the island from early May through October, including migrants. No peregrine falcons were observed at any time, and project personnel obtained no nesting records of bald eagles or pigeon hawks, although three eagles were seen.

Fruit crops in 1973 were generally good, with some species (blueberries, raspberries, chokecherries, and mountain ash) producing abundant fruit. Spruce, balsam fir, and white pine cones were numerous.

Winter Field Work, 1974

Temperatures during the 1974 winter study were slightly above normal, primarily due to unseasonably warm weather in late February and early March. The mean daily maximum and minimum temperatures were 27.1 degrees F. and 5.7 degrees F., compared to the 1967-73 average of 23.8 and 1.6 degrees F. Extreme temperatures were -18 degrees F. (Feb. 2 and 14) and 45 degrees F. (Mar. 3 and 6).

On our arrival snow depth in open areas at Windigo was about 23 inches. Frequent light snow gradually increased snow depth to a maximum of 30 inches on Feb. 18, after which little new snow fell. After a thaw early in March the snowpack was reduced to about 23 inches and had a strong surface crust. Three inches of new snow just before our departure brought snow depths in open areas at Windigo up to 26 inches by March 17. During the winter study total snowfall amounted to 41.3 inches, with a water content of 2.42 inches.

Low temperatures in early February created good ice conditions around most of the island and an ice bridge to Canada that lasted beyond our departure date.

Flying conditions were generally good, with flights attempted on 30 of 49 days. Flying time totaled about 98 hours.

Winter birds

Small flocks of redpolls that included a few pine siskins were seen this winter, apparently in response to a "fair" crop of birch and a "good" crop of alder seed. Occasional pine grosbeaks were also recorded, in addition to the regular winter residents. In early February small flocks of goldeneyes and old squaws were seen in open water along the south shore.

An eagle, probably an immature bald, was seen feeding on a wolf-killed moose on February 19 and 20. This is the first recorded observation of an eagle utilizing a moose carcass on Isle Royale. Another unique record was obtained on Feb. 16, when a wolf was seen to catch a raven at a kill on Francis Point.

Secondary species of mammals

Otter tracks were commonly seen this winter, indicating a flourishing population. Beaver sign was seen infrequently. On March 10, however, aerial observation indicated that wolves had killed one or more beavers on the shore of the Big Siskiwit River.

Only four snowshoe hare observations were made in over 1000 miles of hiking during summer, 1973, indicating a low population. During winter, 1974, hare tracks were plentiful only in scattered areas.

For the past three winters we have kept a record of foxes observed both on and off moose carcasses, hoping to arrive at a useful index of fox numbers. This should quantify observations on fox utilization of moose carcasses and may help us follow general trends in the fox population. As long as basic data are available, the index can be changed, and hopefully improved, with time. Currently, an index is derived by adding the sum of the maximum number of foxes seen on each moose carcass to the total number seen unassociated with a carcass (more than half a mile away) in 100 hours of flying. This should minimize tallying the same fox as we repeatedly check old kills. Information on fox observations is summarized in Table 4. The calculated index was similar in 1972 and 1974, with the drop in 1973 tied to a decrease in fox utilization of moose carcasses. In 1974 foxes made extensive use of mountain ash fruit in certain areas (Blake Point, Malone Bay - Spruce Point, and Washington and Grace Islands). Nine of the 21 foxes seen away from moose carcasses were in these areas of mountain ash fruit abundance, and 5 were eating fruit that had fallen off the trees. The records and indices calculated in Table 4 substantiate our subjective judgment that the fox population of the island has been relatively unchanged at a fairly high level over the past three years. The availability of moose carrion may well buffer the effects of a hare decline.

A single black fox was seen on Amygdaloid Island this winter, possibly the same one reported on nearby Belle Isle during the summer of 1973.

Table 4. Summary and index of fox numbers in winter.

	1972	1973	1974
Moose carcasses located	38	30	40
Utilized by foxes	23 (61%)	14 (47%)	26 (65%)
Foxes on utilized carcasses			
Average maximum number	2.4 ~~2.42~~	1.3	1.9
Sum of max. numbers (a)	55 ~~57~~	18	48
Other fox observations*			
Per 100 hours flying (b)	25	24	21
Index of fox numbers			
(a) + (b)	72	42	69

* Foxes seen from the air more than half a mile from a known carcass.

Wolf population, 1974

Several interesting developments in the wolf population occupied most of our attention and flying time during the past winter. The situation was complicated by the breakup of the West Pack, which took place before a reliable estimate of the total population could be made. After the fragments of the West Pack were tracked down, we were able to arrive at a figure of 31, summarized as follows:

West Pack	12
East Pack	16
One duo	2
One loner	1
	31 - minimum population (also best estimate)

This is the highest population recorded for Isle Royale since the studies began in 1959. The former high was reached in 1965, with 28 as the best estimate and 29 as a possible maximum. In the West Pack at least four pups survived to the 1974 winter period, as judged simply by the increase in numbers from 8 in 1973. It is probable also that a minimum of four pups were present in the East Pack. It had increased from 12 in 1973 to 16 in 1974, and the recognizable dominant male from last year was not present.

It appears that this excellent pup survival was associated with the availability of moose calves and beavers during the 1973 rearing season. It is notable that pups in 1974 were well developed and difficult or impossible to distinguish from the adults.

The West Pack numbered 11 or 12 in all initial sightings in late January. Subsequently the pack broke into several smaller groups. The lead male, recognizable from 1973, was present in one group of four as the dominant wolf. A single wolf was tolerated by this group near a kill and probably was one of the original pack members. Several days later another group of four was found after they left a kill in the interior of the island. In addition, two wolves were found at the west end of the island, and these were soon joined by another single. This group of three then stayed together for the remainder of the study period. No other wolves were found in the West Pack range, so it appeared that the West Pack broke into units of 4, 4, 3 and 1.

The cause of the splitting is unknown, but observations immediately prior to the split suggested a possible change in male leadership, which could have been an important factor. In 1973 the alpha male had been clearly dominant in all observed interactions with other wolves. In 1974

initial observations of this pack were either quite brief or in forested areas, and his status was not clearly evident. On Feb. 4, however, we found two formerly subordinate wolves in a copulatory tie. During and immediately following the mating of this pair, the alpha male behaved in a very subdued manner, walking at the rear of the pack with his tail down. This was the last time we saw the entire pack together.

The alpha male was clearly the dominant individual in the group of four in which he later appeared and also in the group of 8 formed by the re-uniting of two groups in early March. The pair of wolves that had mated just before the break-up were not distinctive in appearance and could not be subsequently identified. We cannot rule out the possibility that they were present in the re-united pack, which numbered 7 on March 12, the last day of field work.

We were not able to follow continuously the movements of the several small groups of wolves after the splitting of the West Pack, although all known movements were within the West Pack territory. During the period January 21 through March 12 (51 days) these 12 wolves killed a minimum of 12 moose. Three moose that died from other natural causes also were utilized.

In the previous two years the East Pack was never observed west of Siskiwit Lake. On February 12, however, tracks indicated that they had traveled to Mud Lake, a mile west of Siskiwit Lake. Three days later we watched the pack as they crossed their former territorial boundary and entered Siskiwit Bay. An unusual amount of scent-marking took place as they crossed the ice to Houghton Point. There the pack killed a moose and remained in the area for 5 days. During this time, while traveling southwest along the shore of Houghton Peninsula, the pack encountered and killed a wolf that probably was a member of the West Pack. We were able to recover the intact carcass of this wolf (a 64-lb. female). The animal had deep wounds about the neck and throat area, and the thoracic cavity had been punctured, collapsing one lung. None of the carcass had been consumed by the East Pack, though they had marked it heavily with urine.

The East Pack continued southwest along the shore until they reached a major scent post of the West Pack. After much examination and scent-marking of their own, they turned around and headed back toward the east end of the island. On March 1 the East Pack again traveled to Houghton Point and made another kill, then returned to their former range after crossing to the north side of the island. We have a travel record covering all the major movements of this pack for the period January 24 to March 12. Mileage and kill information are summarized in Table 5, along with records on this pack from the previous two winters.

Table 5. Travel and kills of the East Pack, 1972 - 74.

Year	Period	No. wolves	No. kills	Average daily mileage*
1972	Jan. 27 - Mar. 9 (42 days)	8-10	16	5.7
1973	Jan. 25 - Mar. 4 (39 days)	13	11	8.9
1974	Jan. 24 - Mar. 12 (48 days)	16	13**	5.9

* Includes only major movements of the pack.
**Kill figure includes one moose killed by other wolves and consumed almost entirely by the East Pack.

Although more kills of the East Pack were located in 1974 than 1973, calculations show that actual prey available to each wolf declined, due to the increase in pack size and the longer period involved. Also, the percentage of calves in the kill was higher in 1974, lowering the average weight of the animals killed.

The apparent increase in the size of the territory of the East Pack could be ascribed to a need for the food resources of a larger area, since the pack has grown from 10 to 16 in three years. Another possibility is that the change in male leadership in the pack had some effect on the choice of travel routes and areas of the island utilized, since the alpha male from 1972 and 1973 was not present in 1974. However, the dominant female from the past two winters was still present, and she had some part in initiating pack activities and determining direction of travel.

In addition to the island's two main wolf packs, a duo and at least one "loner" were present. The pair of wolves, quite possibly the same pair as last year, occupied an area along the shore and inland between McCargo Cove and Little Todd Harbor. During the period Feb. 12 through 27 this pair killed two moose and fed on two old kills. We saw only one loner while both packs were still at full complement, though others could have been present. A single wolf with a lame front leg was seen in Duncan Bay on March 12, though this could have been a member of the East Pack. All other observations of single wolves were in the range of the West Pack after it had fragmented, and could have originally been members of the West Pack.

Changes observed in the two packs, including the breeding productivity of the past three years, as well as the small number of unattached wolves on the island, suggest that we now have a relatively "young" population. This has the potential for high survival at a time when a peak of numbers also has been reached. The record of the years immediately ahead will be of great interest, particularly with reference to the population control mechanisms of the wolf.

Winter moose mortality, 1974

A total of 40 moose carcasses were located from the air during the winter study period. Known wolf kills during this time numbered 26, and 9 old kills were revisited. Four moose died from falls over cliffs or on rocky shores. Although all of these were fed upon by the wolves, they were accidental deaths. Of the three examined, two were calves and the other a 19½-year-old female (#978). The latter was only the second animal of this age recorded in our autopsy series that now numbers near a thousand. In addition to the above, a 13½-year-old bull with fat-depleted bone marrow evidently was dead when the wolves found it (#970). The situation was similar to some of the presumed malnutrition mortality during the severe winters of 1971 and 1972, but in this case there was no evidence of the localized heavy browsing or confinement by deep snow.

Excellent landing conditions around the island allowed us to examine 24 moose carcasses. Included in the 20 wolf kills were 10 calves, an unexpectedly high number. Snow depths never exceeded 30 inches, the depth at which calf mobility is seriously affected, and thus snow conditions do not seem to account for the high calf kill (see "Snow studies"). Compared to the previous three winters, calves were more plentiful, and this may be a partial explanation. Bone marrow of the calves was generally good, with only 2 out of 12 showing obviously low fat content. With the exception of above-mentioned #970, none of the adults had severely fat-depleted bone marrow. Ten adult moose that had been killed by wolves were examined. Included in this group were two with severe arthritis in a pelvic socket (#986 and #979), and three with some degree of jaw necrosis (#962, #972, and #978). An 8-year-old bull (#969) had suffered a fracture of a metatarsus, partially healed at the time of death. The leg was crooked and about 4 inches shorter than the other hind leg. Only two of the ten adults examined thus far were less than five years old. This is in marked contrast to other recent winters, when young adults constituted a large proportion of the kill. It supports the hypothesis that the vulnerability of young adults is tied closely to winter severity early in life.

Snow studies

Snow studies were centered in representative habitats in the Windigo area in order to monitor depth and condition. Non-systematic aerial observations of moose provided data on snow depth (relative to anatomical features) in other areas of the island, as well as the effects of snow on moose distribution and mobility.

A Swiss Rammsonde penetrometer was the primary instrument used in snow studies in 1974, in contrast to the modified compaction gauge used in 1972 and 1973. The Rammsonde consists of a calibrated stainless steel rod with a 10 cm-diameter cone on the lower end. A 1 kg drop hammer is used to force the rod through the snow profile, and the penetration with each successive blow is recorded. In this way basic information on snow density and crusts is standardized. This instrument is faster and easier to use than the compaction gauge, and it is also more widely employed in other areas of North America.

Snow depths ranged from 23 to 30 inches during the 1974 winter study in open habitats at Windigo. From opening until the middle of February snow density was low (0.08-0.22 g/cm^3) and no significant crusts were present in the profile. During this period moose distribution was stratified in a typical manner, with high moose densities in areas with conifer cover close to shorelines. Wolves had great difficulty traveling through this light, fluffy snow, and we observed several instances of moose easily outdistancing wolves during a chase. Calf mobility did not appear to be seriously affected (at least when compared to wolves), probably due to the low density and depth of the snow.

The snow profile compacted during the last half of February, when temperatures moderated and little new snow fell. During the first week of March a thaw produced a hard surface crust that was still evident at the close of the study. Measurements of this crust in the Windigo area indicated a maximum vertical hardness of about 7000 g/cm^2, although this was uncommon. More typical crusts had a vertical hardness of around 600 g/cm^2 and would barely support a man on snowshoes. The strength of the surface crust varied greatly with changes in ambient temperature and exposure to wind and sun. Wolves were generally able to travel freely throughout the interior of the island after this crust formed, often leaving barely a track. Moose received little or no support from this surface crust, and thereafter aerial moose observations were relatively infrequent, probably indicating reduced activity in areas with open or deciduous overhead canopies.

Moose population estimates

The last aerial census of moose on Isle Royale was conducted in 1972, using a stratified sampling procedure developed by previous Purdue investigators. An intensive circling pattern was flown over small plots, which average less than half a square mile in area. Current moose sign (primarily tracks), vegetation type, and data on relative moose densities from previous years were used to assign strata. Results of the 1972 census are given in Table 6, which incorporates several corrections made after plot areas were redetermined with a transparent dot grid (256 dots/in^2). This estimate is about 6% lower than that reported in the 1971-72 annual report.

Table 6. 1972 aerial moose census.

Stratum	Area (sq. mi.)	No. of plots	Percent of stratum counted	Moose counted	Moose per sq. mi.	Estimated total
1	120.29	17	6.4	5	0.7	78
2	57.39	8	6.8	19	4.9	279
3	35.07	18	20.2	93	13.1	461
Isle Royale	212.75	43	--	117	3.8	818

Estimate ± 95% conf. interval: 818 ± 234

The same basic census technique was used in 1974 (Table 7). Counting was done during the last two weeks of February, with about 28 inches (70 cm) of snow on the ground in open areas. Almost all of the plots were counted under optimum conditions, i.e. high cloud cover (no shadows) and little or no wind. In the censuses of 1972 and 1974 four strata were used in the field counts, but the two low-density strata were combined (stratus 1 in the tables) in final calculations. In 1974 the strata were redesigned with reference to current moose sign, vegetation types, and elevation. No counting was done after March 1, when a heavy crust developed on top of the snow pack. There are 70 plots in the basic system, and those counted were distributed among the strata with a view to maximum accuracy at whatever point the work had to be terminated.

Table 7. 1974 aerial moose census.

Stratum	Area (sq. mi.)	No. of plots	Percent of stratum counted	Moose counted	Moose per sq. mi.	Estimated total
1	103.44	12	5.2	7	1.3	135
2	80.50	8	4.6	11	3.0	239
3	29.54	16	19.0	95	17.0	501
Isle Royale	213.48	36	--	113	4.1	875

Estimate ± 95% conf. interval: 875 ± 260

Studies in Alaska indicate that aerial counts of this kind are generally at least 20% low. Adding this amount to the estimates obtained in 1972 and 1974 yields a figure of approximately 1000 for both counts. In 1974 the low density strata included all of the 1936 burn and much of the predominantly deciduous forests in the interior of the island, especially at high elevations. The high density stratum was limited to shoreline areas and small islands, primarily areas with available conifer cover at either end of the main island. Stratum 2 included the rest of the shoreline and some mixed forests further inland.

Proposed Research, 1974-75

In summer and fall 1974 field work will follow the usual pattern, although in June Peterson will return to the campus to finish his doctoral thesis-- hopefully by late summer. Thereafter he will be retained in a post-doctoral position.

The bulk of the summer field work will be carried out by two undergraduate field assistants, who will concentrate on collecting the remains of wolf-killed moose from the past winter. Of special interest is the mortality pattern of recent year-classes of young adults-- evidently increased vulnerability of these generations is reflecting the physical effects of three severe winters since 1969. As in past years, the finding of old remains will contribute to our random sampling of age distribution in the total turnover of the herd. In October another aerial count will be taken to obtain information on sex ratio and 1974 calf production.

The winter of 1975 will be particulary significant in the opportunity it affords to appraise wolf survival and recruitment at a time of peak population. The potential effects of increased wolf numbers on the moose herd are of obvious interest, as are the further possibilities in studying the territorial relationships of two breeding packs.

We continue to be impressed with the widely variable complexity of relationships in this life community and the extent to which each additional year helps to interpret old findings and expand our understanding of it.

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