

ECOLOGICAL STUDIES OF WOLVES ON ISLE ROYALE\*

Annual Report

(Covering the nineteenth year in the Isle Royale studies)

1976-77

by

Rolf O. Peterson, Assistant Professor of  
Biological Sciences  
Michigan Technological University  
Houghton, Michigan 49931

and

Joseph M. Scheidler, Graduate Research Assistant  
Biological Sciences  
Michigan Technological  
University  
Houghton, Michigan 49931

30 April 1977

\*Receiving financial support in the current year from the National Park Service, Boone and Crockett Club, National Rifle Association, Quaker Oats Foundation, and Mr. Kenneth Mason.

NOT FOR PUBLICATION

The past year has been a complex one, logistically and administratively. Peterson began work on a wolf-moose research project on the Kenai National Moose Range in Alaska in July 1976, and spent the entire year on this off-campus project, except for a brief period at Isle Royale in winter. Joseph M. Scheidler, graduate student in Michigan Tech's Department of Biological Sciences, carried the major responsibility for field work on Isle Royale. Scheidler had worked on Isle Royale as a summer assistant in 1974 and 1975.

Summer field personnel were the following: Joe and Lee Scheidler, May 26 - October 29; Robert A. Irmiger and Philip W. Stephens, June 1 - September 1. Peterson made field trips to Isle Royale in April and June, 1976, and Durward L. Allen made spring and fall trips to the island.

The 1977 winter study extended from February 2 to March 17. Peterson was present from February 2 to 26; Scheidler, February 2-14 and February 26 to March 6; James D. Woolington, a former summer assistant, was present from February 26 to March 17. Fortunately, pilot Donald E. Murray, Mt. Iron, Minnesota, was able to be present for the entire winter study; this was his 19th consecutive winter of flying on Isle Royale. Murray provided the necessary continuity and expertise during the changeovers in observers. Connection flights from Grand Marais, Minnesota, were provided by the U.S. Forest Service, operating out of Ely, Minnesota. National Park Service personnel from Grand Portage National Monument provided logistical support during personnel transfers. National Park Service staff from Isle Royale that assisted on the island were: Eugene F. Blakesley, Jan. 24 - Feb. 4; Warren L. Rigby, Feb. 4 - 14; Thomas J. Hodges, Feb. 14 - 26; Stuart L. Croll, Feb. 26 - Mar. 6; Noel R. Poe, Mar. 6 - 17.

Peterson delivered a paper entitled "The role of wolf predation in a moose population decline" at the First Conference on Research in the National Parks, New Orleans, Nov. 9 - 12, 1976. A National Park Service research monograph resulting from his Ph.D. research should finally be available in 1977. Durward Allen continued to put in as much time as possible on a book covering 18 years of research on Isle Royale.

## SUMMER FIELD WORK, 1976

During the first several weeks of field work we concentrated on examining and collecting remains of wolf-killed moose located during winter, 1976. Thereafter, primary emphasis was placed on locating and monitoring wolf pack movements using howling responses. A total of 1380 km was hiked, including 475 km off-trails. During random cross-country hiking skeletal remains of all moose encountered were examined.

The first half of the summer was relatively moist, stimulating moderate production of most fruits (e.g. blueberry, currant, and raspberry). Cone crops on cedar, white spruce, and balsam fir were heavy, moderate, and very light, respectively. In contrast, the latter part of the summer was very dry, creating optimum conditions for fire. Several man-caused fires (quickly extinguished by park personnel) and a 4-acre burn started by lightning (allowed to burn) were recorded. The adjacent mainland in Ontario and Minnesota experienced numerous fires, and winter precipitation was so low that even in February, 1977, several fires were burning on the mainland.

Moose observations - summer and fall, 1976

Moose herd composition and productivity were estimated by summer ground observations. In addition, an aerial survey conducted after leaf-fall in October allowed a more accurate determination of calf production and recruitment of 1975 calves into the yearling age class. These data are shown in Figure 1 and Tables 1 and 2. Ground observations are biased, especially against calves, but they do provide a relative index to calf abundance.

Table 1. Moose observations during ground surveys on Isle Royale, 1970-76.

	6/9- 9/4, <u>1970</u>	5/18- 9/7, <u>1971</u>	5/9- 9/25, <u>1972</u>	5/4- 9/30, <u>1973</u>	5/6- 8/13, <u>1974</u>	4/29- 10/21, <u>1975</u>	5/26- 10/29, <u>1976</u>
Total seen	192	142	231	244	118	240	134
Males	64	47	106	92	36	97	51
Females	91	64	92	102	57	101	64
Calves	35	19	23	38	21	34	14
Unknown	2	12	10	12	4	7	5
Calves per 100 adult females <sup>1/</sup> (after June 1)	39	26	28	49	37	34	22
No. sets twins	5	1	2	4	4	2	0

<sup>1/</sup> Includes yearling females, which at times cannot be distinguished from older cows.

Table 2. Fall aerial composition counts of Isle Royale moose.

	Oct. 17-19 1972	Oct. 23-25 1973	Oct. 22-25 1974	Oct. 21-22 1975	Oct. 18-20 1976
Total seen	114	192	117	157	120
"Adult" bulls	47	73	43	61	50
Yearling bulls <sup>1/</sup>	2	8	7	4	3
Cows	53	81	51	76	55
Calves	12	30	16	16	12
Bulls/100 cows	93	100	98	86	96
% yearlings <sup>2/</sup>	4	10	14	6	6
Calves/100 cows <sup>3/23</sup>		37	31	21	22

1/ Bulls with spikes or small forked antlers were considered yearlings.

2/ % yearlings = yearling bulls / ("adult" bulls + yearling bulls).

3/ Yearling females probably are unproductive but cannot be reliably separated from older cows; they are included in the total number of cows observed.

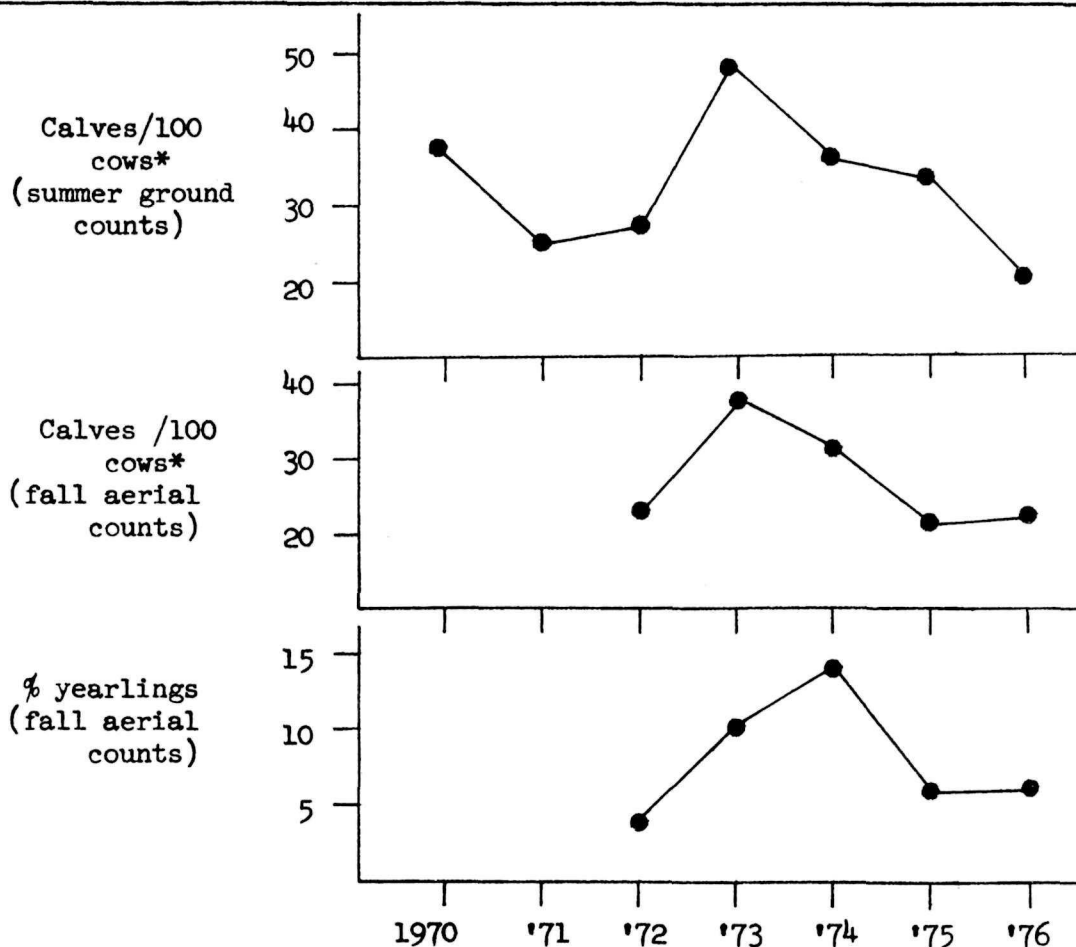


Figure 1. Productivity and survival data for Isle Royale moose, 1970-76.  
\*Includes yearling cows, most of which are unproductive.

The 1976 calf crop was among the lowest recorded since 1970. For the first time in 19 years there were no twins observed by researchers. The low twinning occurrence, and the low calf proportion in general, are likely the result of low initial calf production, high post-natal mortality, and predation by a record-high wolf population.

#### Moose Mortality, 1974-76

The remains of 93 moose were examined in summer, including 66 which died during winter, 1976 (58 located in winter, 8 in summer). Of the 59 wolf-kills from 1976, 31% were calves, approximating the long-term average for Isle Royale in winter. Six moose fatalities in winter, 1976, were attributed to malnutrition.

After returning to campus, Scheidler determined the age of all adult moose examined since May 1974. The age distribution for wolf-killed moose recorded over the past three years is shown in Table 3. It is apparent that wolves have resumed preying primarily on old adults. The average age of wolf-killed adults during winter, 1974-76, was 8.8 years, slightly older than the long-term average.

Table 3. Age distribution of wolf-killed moose in winter, 1974-76.

<u>Year</u>	<u>Calf</u>	<u>1+</u>	<u>2+</u>	<u>3+</u>	<u>4+</u>	<u>5+</u>	<u>6+</u>	<u>7+</u>	<u>8+</u>	<u>9+</u>	<u>10+</u>	<u>11+</u>	<u>12+</u>	<u>13+</u>	<u>14+</u>	<u>15+</u>	<u>16+</u>	<u>17+</u>	<u>Total</u> <sup>1/</sup>
1974	25	3	0	0	2	3	0	3	1	4	1	3	3	0	0	2	2	1	53
1975	12	5	2	2	0	1	4	4	3	3	3	1	2	4	1	1	1	0	51
1976	18	4	0	0	2	0	3	4	5	6	2	3	4	2	2	1	0	0	59
Total	55	12	2	2	4	4	7	11	9	13	6	7	9	6	3	4	3	1	163

<sup>1/</sup> Total includes 0, 2, and 3 adults of unknown age in 1974, 1975, and 1976, respectively.

Variations in age of wolf-killed adult moose since Isle Royale research began are shown in Figure 2. Heavy predation on young adult moose in the early 1970s was linked to pre-natal malnutrition. Wolves are presently relying on old moose, some of which may have accumulated during the early 1970s when wolves were able to prey on the younger age classes. Since yearling recruitment has been quite low since the early 1970s, we may find a dearth of old moose in the late 1970s, when moose born in the early 1970s will enter the age of high vulnerability to wolves. In this case we would expect that winter food supply for wolves would decline markedly.

Following summer carcass examinations food availability was calculated for the East Pack, the only group for which we obtained data on predation rate. Food availability remained at about 5 kg/wolf/day in 1976, which seems to be a base level for Isle Royale wolves (see Figure 3).

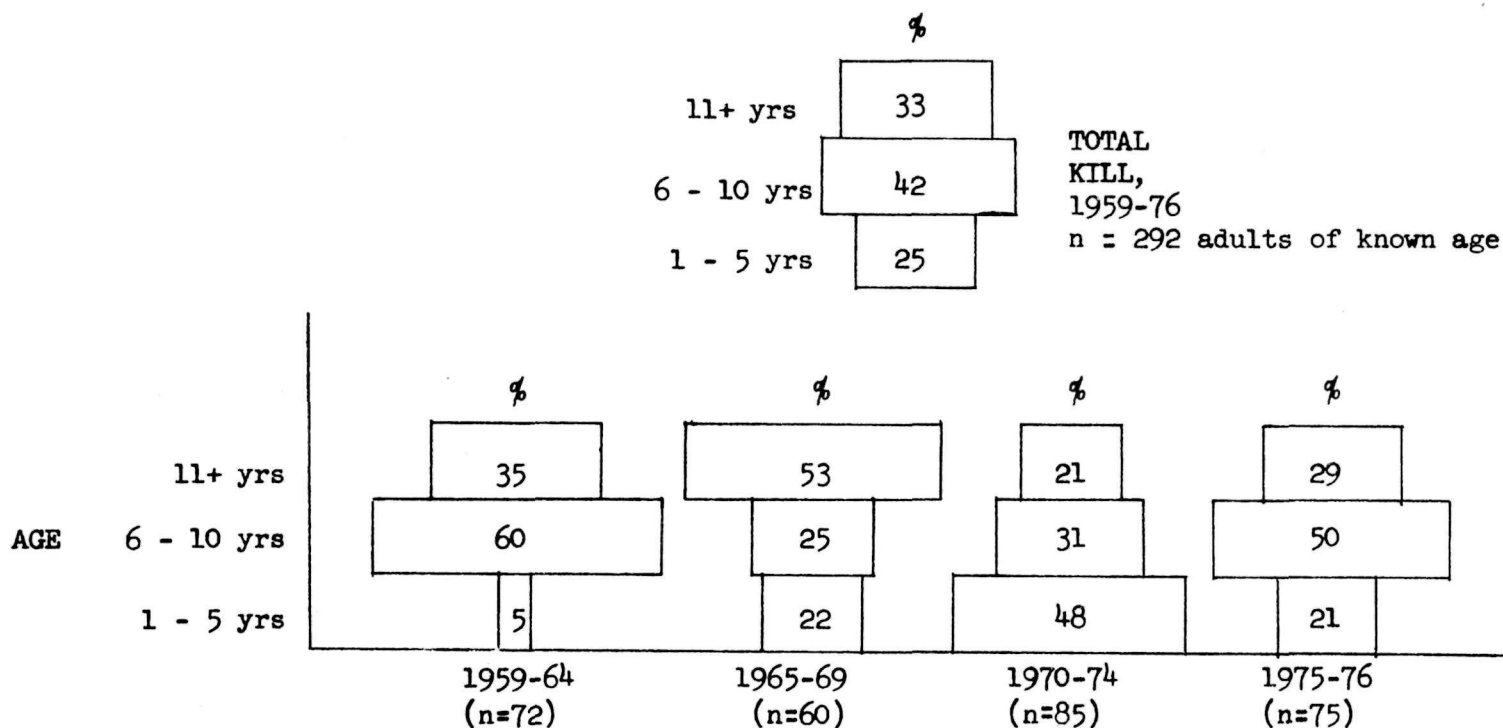


Figure 2. Age distribution of wolf-killed moose from Isle Royale, 1959-76. Only adult moose of known age are included in this breakdown.

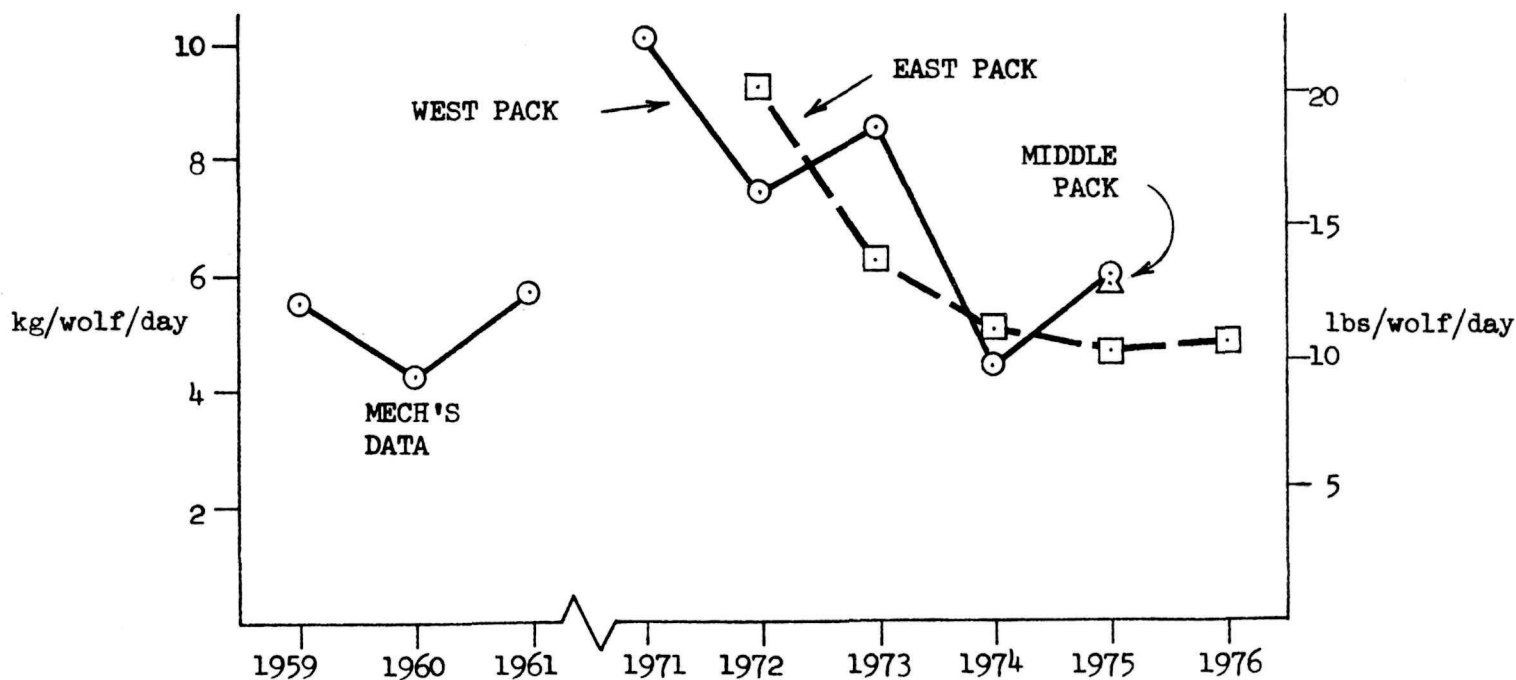


Figure 3. Calculated food availability (not necessarily actual consumption) for Isle Royale wolves in midwinter, based on known kill rates during the annual winter study.

Summer wolf activity, 1976

For three of the past four years the whelping den used by the East Pack has been located; in 1975 and 1976 the same den was used. In 1976 East Pack activity was centered at a series of traditional rendezvous sites through September. Based on howls there seemed to be at least four pups present in the East Pack in late summer. The 1975 West Pack den was not re-used in 1976, and no other dens were located. In late August, however, at least three pups were heard howling from a Middle Pack rendezvous site. One or two pups were heard in a group howl at the southwest end of the island in late October. From these data we conclude that a minimum of 8 pups were alive on Isle Royale in late summer.

In late August a wolf carcass was located within East Pack territory. The animal probably died in June, but cause of death could not be determined because of decomposition. The skull had been removed, but examination of other bones indicated that the animal was at least a year old when it died.

Examination of 641 wolf scats between spring and fall, 1976, revealed no changes in summer food habits; beaver and moose each comprised about half of the total prey occurrences.

### WINTER FIELD WORK, 1977

Weather played a dominant role in field work in 1977. Because of poor flying weather, only one of the transfer flights was made on schedule, and opening was delayed for 8 days by a severe storm. Intense cold in early winter created the best ice bridge to Canada ever observed in the course of this project; it was very smooth and extended the entire length of the island. The bridge probably formed in early January, and was still solid at the close of the study. The minimum temperature recorded at Windigo prior to opening of winter study was -39 degrees C., the lowest temperature ever recorded on Isle Royale. In contrast, average temperatures during the winter study were the warmest recorded since measurements began in 1963. Average daily minimum and maximum temperatures were -9.8 deg. C. and -0.1 deg. C. Extreme temperatures recorded during the 1977 study were -28 deg. C. (Feb. 16) and +13 deg. C. (Mar. 10).

Snow depths were below average, ranging in open areas from 33 to 66 cm, and averaging 52 cm. A total of 29 cm of snow (water equivalent 0.8 cm) and 0.4 cm of rain fell during the course of the study.

Flying conditions were about average for Isle Royale in winter. Flying was attempted on 25 of the 43 days, with flying time totaling 78 hours. Extensive ice created good landing conditions and reduced the amount of fog in February, but exceptionally warm conditions in the last two weeks severely limited areas suitable for landing.

### Wolf population, 1977

This was the first year since 1969 that the Isle Royale wolf population did not increase. Following last year's record-high of 44 wolves (Table 4), this year the total numbered only 34 (Table 5). Since a solid ice bridge existed prior to the start of the winter study, it is not known whether the decline was due to emigration or mortality. If the population rebuilds itself in future years we will probably conclude that emigration played an important role.

---

Table 4. Isle Royale wolf population levels in midwinter, 1959-77.

<u>Year</u>	<u>Best Estimate</u>	<u>Year</u>	<u>Best Estimate</u>	<u>Year</u>	<u>Best Estimate</u>
1959	20	1966	25	1972	23
1960	22	1967	22	1973	24
1961	22	1968	22	1974	31
1962	23	1969	17	1975	41
1963	20	1970	18	1976	44
1964	26	1971	20	1977	34
1965	28				

1959-77 Average: 25.4



Table 5. Composition of the Isle Royale wolf population, midwinter 1977.

East Pack	-	13
Middle Pack	-	7
West Pack	-	7
SW4	-	4
loners*	-	3

—  
34, minimum present and best estimate

\*individual loners present at SW end, NE end, and L. Richie.

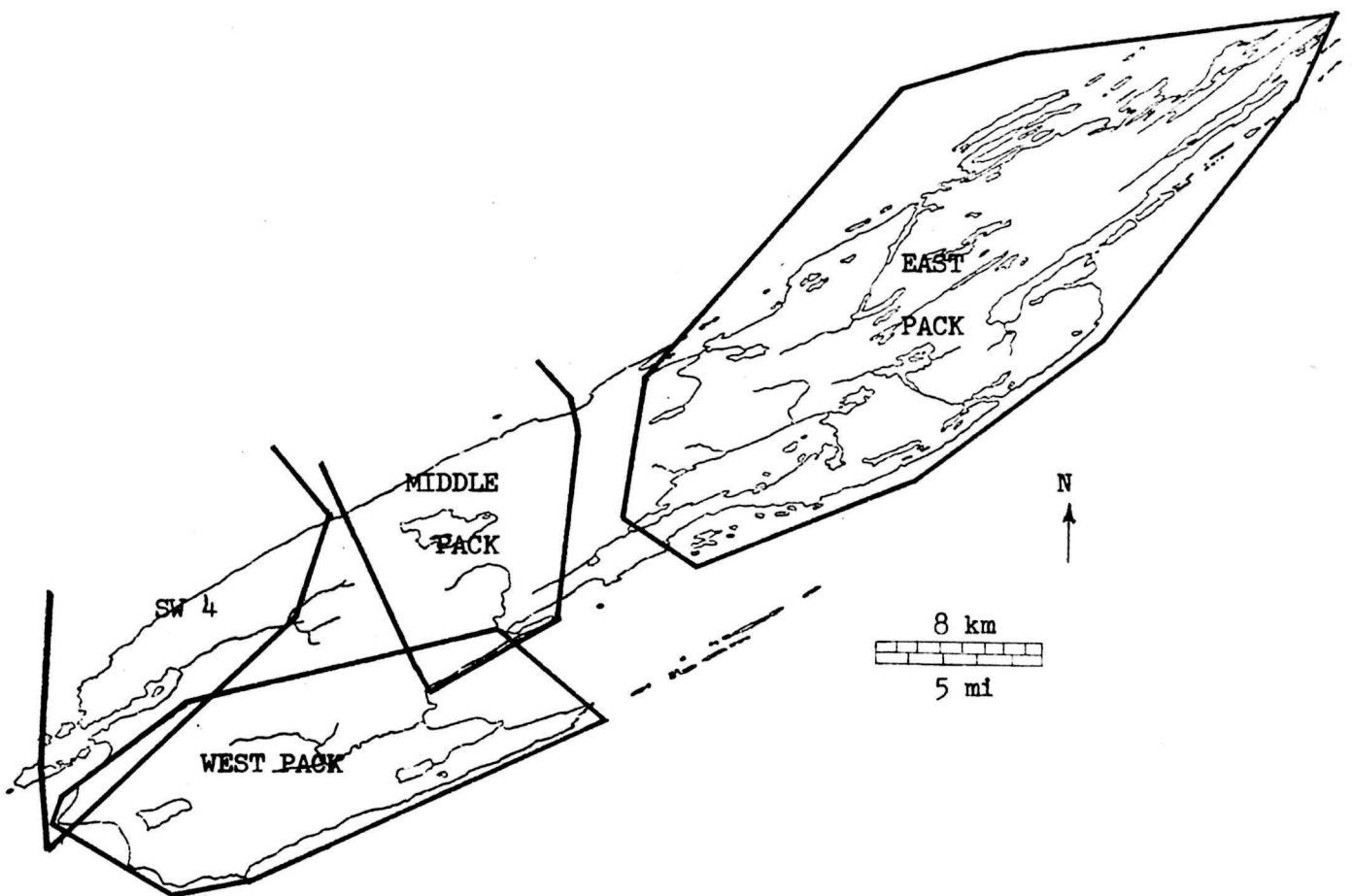


Figure 4. Spatial organization of Isle Royale wolf population in February & March, 1977.

The spatial organization of wolf packs on Isle Royale was slightly different from several preceding years (Figure 4). The East Pack and Middle Pack used approximately the same area as before, and a quartet of wolves called the SW 4 probably contained some of the same wolves seen in 1976 in a trio that used the same area. The only large pack present at the southwest end of the island was called the West Pack, although there were no identifiable individuals in this pack and the area used by this group in 1977 was somewhat different than in 1976.

The East and West packs both declined, and several small groups present in 1976 were missing. One instance was observed of an Isle Royale wolf traveling to Canada across the ice this winter, and individuals or small packs inclined to disperse from the island could have done so for at least a month prior to our arrival.

The East Pack again provided the best data on travel and predation patterns in 1977. This pack declined from 17 in 1976 to 13 in 1977. There were led by the same alpha male and female as in 1976; this was the sixth year that the East Pack alpha female has been recognized as the same individual (Table 6).

---

Table 6. Pack size and leadership of the East Pack, Isle Royale, 1972-77.

<u>Year</u>	<u>Pack size</u>	<u>Alpha female</u>	<u>Alpha male</u>
1972	10	F1	M1
1973	13	F1	M1
1974	16	F1	M2
1975	18	F1	M3
1976	17	F1	M3
1977	13	F1	M3

---

Except for a 10-day period, continuous track of the East Pack's travels and kills was obtained from January 30 through March 10. After intensively searching this pack's territory following the 10-day gap, we probably found all the kills made during this period also, providing a kill record covering 40 days and a travel record spanning 30 days (Table 7). During this period the East Pack killed 16 moose, and traveled an average of 11.8 km/day.

---

Table 7. Daily travel and kill rates for Isle Royale wolf packs.

	<u>Number of wolves</u>	<u>Length of coverage</u>	<u>Number of kills made</u>	<u>Average period between kills</u>	<u>Daily travel</u>
East Pack 1977	13	40 days	16	2.5 days	11.8 km (based on 30 days)
East Pack 1976	17	41 days	16	2.6 days	11.7 km
All packs, 1971-76	12, ave. size	439 days	144	3.0 days	11.2 km (based on 337 days)

Breeding was observed on Feb. 11 (West Pack), Feb. 16 (SW 4), and Feb. 20 (probably West Pack). Tracks indicating probable matings were also seen on Feb. 6 (Middle Pack) and Mar. 6 (East Pack). The alpha male and female in the East Pack were observed courting each other, and probably mated.

Four wolves were observed in the SW 4 on Feb. 7, 9, 11, and 16. When we began observations on Feb. 16 the alpha male was mating with a subordinate female at the mouth of Washington Harbor. The alpha male defended the subordinate female from the alpha female as long as they were in a copulatory tie, but as soon as it was broken the subordinate female broke away on a dead run to the north, crossing the peninsula north of Washington Harbor with the other three wolves in close pursuit. The subordinate female ran north from the end of the island across the ice bridge to Canada. We followed the female until she was 10 miles from Isle Royale and within 2 miles of the nearest island off the mainland, and she was still running at top speed when we left. The other wolves followed her for about 8 miles, then returned to Isle Royale. The next time we saw this pack, on Feb. 18, there were again four wolves present, and the alpha male was again courting a subordinate female. Although her identity was not definitely known, it was probably the same female that was chased to Canada on Feb. 16. The following day, Feb. 19, the pack still numbered four as they traveled north of Windigo. On Feb. 20, we found the subordinate female about 3.5 miles north of Isle Royale, bedded on the ice and bleeding slightly from the head region. We backtracked her running tracks to a kill on Washington Creek, where we found the other three pack members sleeping. This pack numbered 4 wolves on Feb. 27 and March 7, indicating that the female probably returned to the pack. We were not able to determine if the alpha male also mated with the alpha female, nor were we able to observe any interaction between the alpha and subordinate females after the mating on Feb. 16.

During the 1977 winter study we located 53 moose carcasses by aerial search (Figure 5):

- 39 fresh kills made by wolves
- 10 probable kills made before we arrived
- 3 old carcasses of moose dying of uncertain causes
- 1 moose dying of malnutrition during the study

The 39 kills were made during 40 days of coverage, compared to 51 kills in 48 days of coverage in 1976. Thus the kill rate did not decline markedly in spite of the drop in wolf numbers, probably because all of the major pack units are still operating. The decline may have resulted primarily from loss of peripheral individuals.

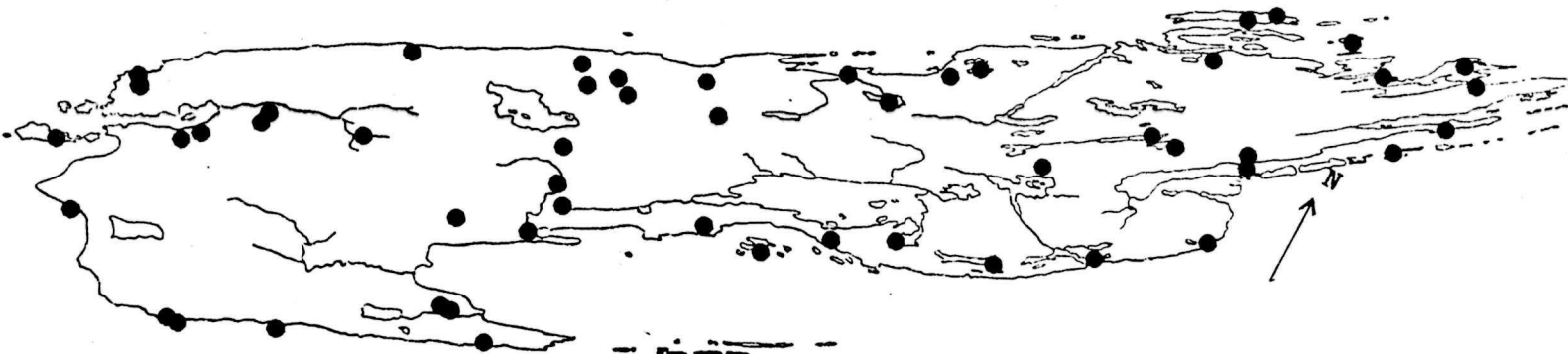


Figure 5. Distribution of kills located during 1977 winter study on Isle Royale.

Moose population, 1977

Since the last winter aerial moose census on Isle Royale in 1974 the population has probably been declining steadily. By 1976 the population was believed to have declined about 20% to 800-900 moose, based on yearling recruitment and estimated kill by wolves. Poor snow conditions precluded a reliable census in 1977, but we did note a substantial drop in the number of moose observed during routine flying by the same pilot and observer (Table 8). Snow conditions can cause tremendous variation in moose observability, and this may have been a factor in the reduced number of animals recorded in 1977.

Table 8. Number of moose observed on Isle Royale during routine flying in midwinter, 1973-77.

Year	Bedded moose		Standing moose		Total seen	Hours flown	Moose seen per hour
	No.	%	No.	%			
1973	218	50	221	50	439	85.2	5.15
1974 <sup>1/</sup>	169	30	392	70	561	94.3	5.95
1975	198	49	205	51	403	66.9	6.02
1976	165	45	200	55	365	75.7	4.82
1977	62	44	80	56	142	47.3	3.00

<sup>1/</sup> The higher percentage of standing moose in 1974 is attributed to the fact that during the 1974 midwinter census flying was often concentrated during periods when moose were active and easiest to see.

A cow with twins was seen several times on islands in Malone Bay. This was the first time Peterson has observed a set of twins on Isle Royale in winter since he began winter work in 1971. The East Pack, numbering 12 wolves, confronted this cow and twins while they were on Shiverette Island, but the wolves were unable to make a kill.

A middle-aged bull moose (#1312) was necropsied on Feb. 2, 1977. This moose possessed ample quantities of fat reserves and weighed 900 lbs. A calf (#1323), abandoned by its mother at Windigo, died of probable malnutrition on Feb. 28, 1977; this individual possessed no fat reserves in its body cavity or bone marrow, and weighed 310 lbs. when it died (100 lbs. less than a healthy calf weighed several years ago).

Snow conditions, 1977

During the first three weeks of February snow depth was about 50 cm in open areas. When we first arrived there were no crusts in the snow profile, and wolves experienced great difficulty in traveling overland. On Feb. 9 and 11 wet snow and rain fell, creating a strong surface crust which wolves were able to travel over with relative ease. Snow depths increased to 60-65 cm in late February and early March, but declined rapidly to 25-35 cm during a thaw that extended from March 5 until researchers left on March 17.

## OTHER WILDLIFE SPECIES

Foxes were heavily dependent on moose carcasses for food in February, 1977, especially early in the month when snow conditions made travel very difficult. As surface hardness of snow increased foxes seemed to be much less dependent on scavenging, and very few foxes were seen associated with carcasses after a strong surface crust formed. A summary of fox observations, 1972-77, appears in Table 9.

Table 9. Summary of fox observations in midwinter on Isle Royale.

	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>
Moose carcasses located	38	30	40	42	64	53
No. where foxes were seen	23(61%)	14(47%)	26(65%)	16(38%)	30(47%)	27(51%)
Foxes on utilized carcasses						
Ave. maximum number	2.4	1.3	1.9	1.3	1.2	1.7
Sum of max. numbers	55	18	48	21	37	45
Other fox observations						
per 100 hrs. flying	25	24	21	16	22	13

During 1976 summer field work, 114 species of birds (including migrants) were noted by the end of field work at the end of October. There were no nesting records of bald eagles, although 1 bird was seen by researchers in July. An active osprey nest was reported.

During the 1977 winter study almost the entire shoreline of Isle Royale was locked in ice, so we saw none of the usual herring gulls, goldeneyes, mergansers, and old squaws. Only a few evening grosbeaks were recorded in addition to the usual gray and blue jays, ravens, chickadees, woodpeckers and occasional great-horned owls.

Beaver were unusually active this winter, probably because of the warm weather. Beaver activity was noted at 28 different sites, and wolves killed beaver near Lake Whittlesey, Island Mine Trail, and the islands off Houghton Point. Beavers were observed cutting trees on March 8 and 10. Otter sign was frequently seen (18 locations) throughout the island.