

ECOLOGICAL STUDIES OF WOLVES ON ISLE ROYALE*

Annual Report

(Covering the twentieth year in the Isle Royale studies)

by

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NOT FOR PUBLICATION

Wolf-moose research in Isle Royale National Park has now continued for 20 consecutive years, yet the dynamics of this island ecosystem and wolf-moose interaction, in particular, continues to generate much interest among researchers and the general public. Summer field work in 1978 was headed up by graduate student Joseph M. Scheidler, who will shortly begin work on his master's thesis. Rolf O. Peterson spent most of the past year on a wolf-moose research project at Kenai, Alaska, but was present for the entire winter study on Isle Royale in 1978.

Summer research personnel in 1977 were the same as the previous year: Joe and Lee Scheidler and Philip W. Stephens, May 31 - Aug. 17, and Robert A. Irmiger, June 14 - Aug. 17. Scheidlers were again present Oct. 15 - 21 for a fall aerial survey of the moose population, with pilot Mark Kortkamp, Ely, Minnesota.

The 1978 winter study extended from January 29 to March 11. The field team consisted of Peterson, pilot Donald E. Murray of Mt. Iron, Minnesota, and National Park Service personnel from Isle Royale and Grand Portage National Monument. NPS personnel were the following: Thomas J. Hodges, Jan. 29 - Feb. 3; Warren L. Rigby and Bernie J. Gestel, Feb. 3 - 14; Stuart L. Croll and John H. King, Feb. 14 - 25; John M. Morehead and Robert A. Huggins, Feb. 25 - Mar. 3; Noel R. Poe and Ivan D. Miller, Mar. 3 - 11.

Deserving special recognition is Don Murray, who has flown the study aircraft each winter for the past 20 years. For the past several years, with the wolf population at an all-time high, Don's aerial tracking abilities have been invaluable, and his contribution over the years has been most significant. Another individual who assisted greatly during the past year is Robert M. Linn, NPS Senior Scientist at Michigan Tech. Without Bob's help in administrative and financial matters, the study could not have continued.

We expect Peterson's monograph, "Wolf ecology and prey relationships on Isle Royale" to be published by the U. S. Government Printing Office within three months. Please direct requests for this publication to: R. O. Peterson, Kenai National Moose Range, Box 500, Kenai, Alaska 99611. Durward Allen sent his book on the Isle Royale study to the publishers in January, but we cannot, at this time, predict a publication date.

SUMMER FIELD WORK, 1977

Emphasis was placed on ground examination of a large number of moose carcasses located the previous winter, determining primary wolf activity sites and the status of pups produced in the wolf population. Hiking mileage totaled 906 km (563 mi), including 288 km (179 mi) off-trail.

Weather during summer was cooler with more rain than the previous year. Cone production on spruce and cedar was rated moderate on most trees, abundant on a few, while balsam fir produced no cones. No natural or man-caused fires were recorded.

Moose observations - summer and fall, 1977

Moose population composition and productivity were estimated by summer ground surveys and an aerial survey after leaf-fall in October. The ground counts (Table 1) provide relative indications of density and calf production, while the aerial survey (Table 2) provides data on calf abundance, adult sex ratio and overwinter survival of calves born the previous year (Fig. 1).

Table 1. Moose observations during ground surveys on Isle Royale, 1970-77.

	<u>6/9- 9/4, 1970</u>	<u>5/18- 9/7, 1971</u>	<u>5/9- 9/25, 1972</u>	<u>5/4- 9/30, 1973</u>	<u>5/6- 8/13, 1974</u>	<u>4/29- 10/21, 1975</u>	<u>5/26- 10/29, 1976</u>	<u>5/31 8/17, 1977</u>
Total seen	192	142	231	244	118	240	134	44
Males	64	47	106	92	36	97	51	14
Females	91	64	92	102	57	101	64	25
Calves	35	19	23	38	21	34	14	4
Unknown	2	12	10	12	4	7	5	1
Calves per 100 adult females ^{1/} (after June 1)	39	26	28	49	37	34	22	16
No. sets twins	5	1	2	4	4	2	0	0

^{1/} Includes yearling females, which are probably unproductive but cannot be reliably distinguished from older cows.

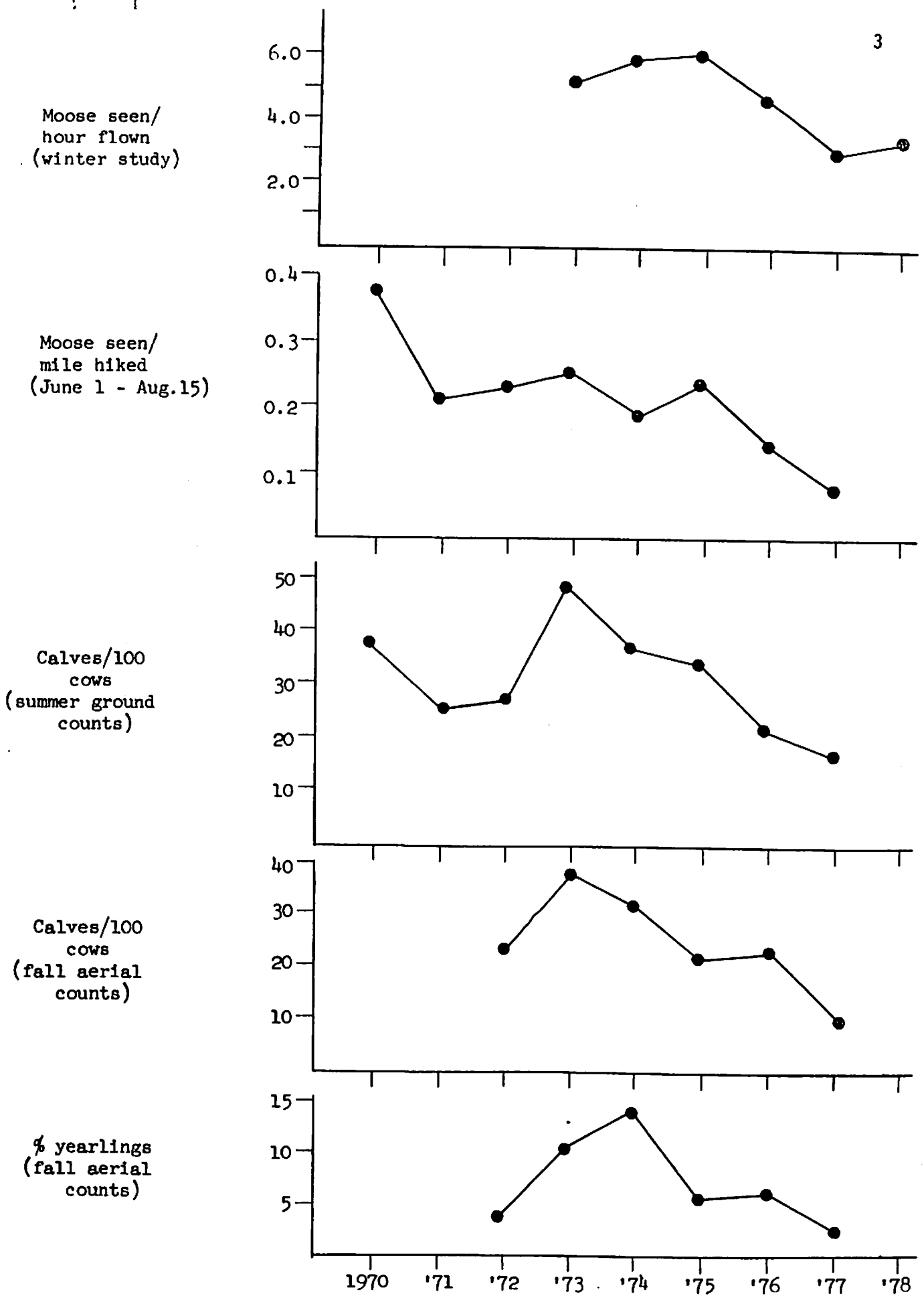


Figure 1. Density indices, productivity and survival data for Isle Royale moose, 1970-78.

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

	Oct. 17-19 <u>1972</u>	Oct. 23-25 <u>1973</u>	Oct. 22-25 <u>1974</u>	Oct. 21-22 <u>1975</u>	Oct. 18-20 <u>1976</u>	Oct. 18-20 <u>1977</u>
Total seen	114	192	117	157	120	75
"Adult" bulls	47	73	43	61	50	29
Yearling bulls ^{1/}	2	8	7	4	3	1
Cows	53	81	51	76	55	41
Calves	12	30	16	16	12	4
Bulls/100 cows	93	100	98	86	96	73
% yearlings ^{2/}	4	10	14	6	6	3
Calves/100 cows ^{3/}	23	37	31	21	22	10

^{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.

The number of moose observed during summer was exceptionally low, as was the total observed during the fall aerial survey. All indicators point to a substantial moose population decline in the last few years, to be discussed in a later section. Calf abundance was lower than in any previous year, and no twins were observed by researchers.

Moose mortality, 1974-77

Remains of 70 moose were examined in 1977, including 63 which died during the previous winter and spring. Calves comprised 21% of 42 wolf-kills from the winter of 1976-77, considerably less than the long-term average. A dozen moose dying of malnutrition in late winter were examined in 1977, predominantly calves.

The age distribution of wolf-killed moose examined in the past four years appears in Table 3. The average age of adults killed since 1974 is 8.1 years. During this period the wolf population has been at a peak level, with their primary prey in winter being moose born during the last half of the 1960s. Since calf production and survival in the early 1970s declined considerably, there are relatively few moose now entering the vulnerable 8+-year-old age group. For this reason we anticipate a decline in winter food supply for wolves within the next few years.

Table 3. Age distribution of wolf-killed moose in winter, 1974-77.

Year	Calf	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+	11+	12+	13+	14+	15+	16+	17+	Unk. age Adults	Total
1974	25	3	0	0	2	3	0	3	1	4	1	3	3	0	0	2	2	1	0	53
1975	12	5	2	2	0	1	4	4	3	3	3	1	2	4	1	1	1	0	2	51
1976	18	4	0	0	2	0	3	4	5	6	2	3	4	2	2	1	0	0	3	59
1977	9	3	0	1	0	3	1	0	2	7	3	2	3	1	1	3	1	0	2	42
Total	64	15	2	3	4	7	8	11	11	20	9	9	12	7	4	7	4	1	7	205

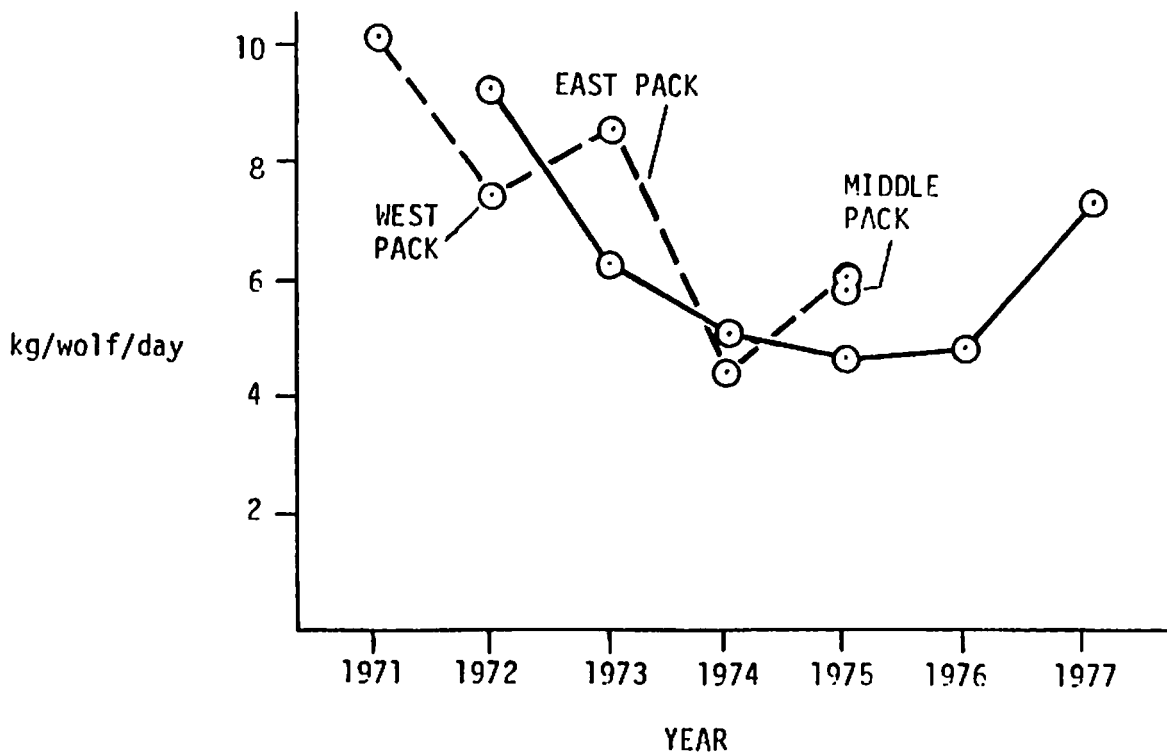


Figure 2. Calculated food availability (not necessarily actual consumption) for Isle Royale wolves in midwinter, based on known kill rates during the annual winter study.

Age and sex information gathered during the summer provided an estimate of winter food availability for the East Pack during winter study, 1977 (Fig. 2). Accompanying a decline in pack size was a proportional increase in food availability. It appears that the total weight of food available to this pack has not varied significantly in spite of annual differences in pack size, implying that the extra members are "peripheral" wolves or pups that do not contribute directly to increased kill rates.

There is a significant correlation between winter severity and size of Isle Royale moose calves born the subsequent spring. Total snowfall is not recorded on Isle Royale, but data from Grand Marais, Minnesota, provides an approximation of island weather patterns. Calves born in 1976 were the smallest of any cohort since 1970, and total snowfall higher than in previous years (Fig. 3).

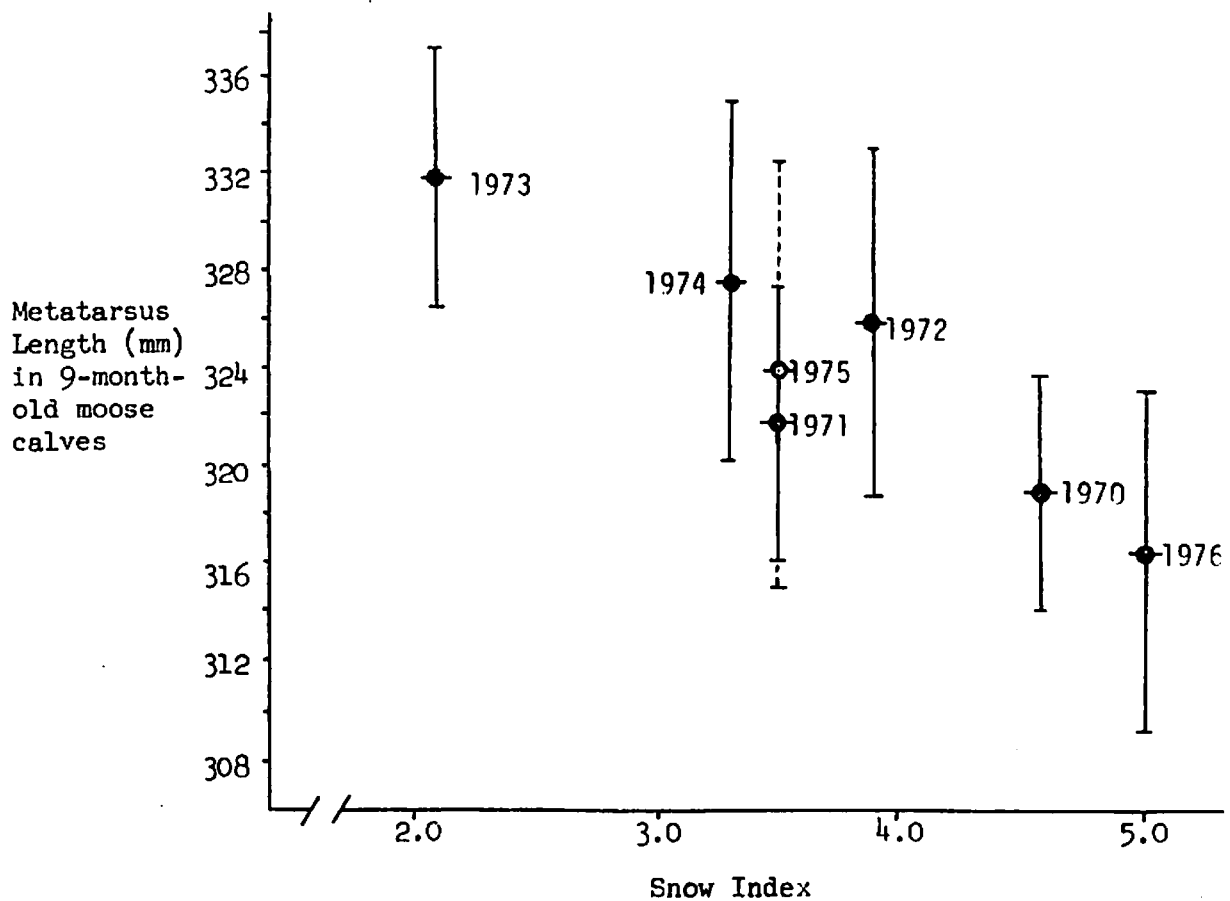


Figure 3. Size of Isle Royale moose calves compared to severity of winter prior to birth.

Summer wolf activity, 1977

Based on observations this past winter, a minimum of four litters of wolf pups were born on Isle Royale in 1977, although we had reliable information only on two litters during the summer. No dens were located, and both East and Middle packs had rendezvous sites in non-traditional areas. Both packs had a minimum of 3 pups present in August.

Beaver occurred more frequently in summer wolf scats than any other food item, based on examination of 191 scats (Table 4). Beaver density continues to be high, and this is an important factor in pup survival through the summer.

Table 4. Contents of wolf scats examined on Isle Royale, 1977.

<u>Period</u>	<u>No. of scats examined</u>	<u>No. of food occurrences</u>	<u>Percent occurrence</u>				
			<u>moose</u>	<u>beaver</u>	<u>fruit</u>	<u>other</u>	<u>unknown</u>
Spring to mid-Aug.	191	204	39	50	4	6	1

WINTER FIELD WORK, 1978

Weather during the 1978 winter study was exceptionally good, allowing us to fly on 29 out of 40 days for a total of 105 hours. We experienced no thaws until the very end of the study, so snow depths remained constant throughout. A solid ice bridge to Ontario did not form this winter, although frequently only a few open leads were evident. Landing conditions throughout the island were good. Average daily minimum and maximum temperatures were -16.7 deg.C (1.9 deg.F) and -4.9 deg.C (23.1 deg.F), respectively.

Wolf population, 1978

After last year's decline to 34 wolves, we were surprised to find that the wolf population had increased to 40 in 1978. This lends support to the idea that emigration over the ice to Ontario may have been responsible for last winter's decline (see Fig. 4).

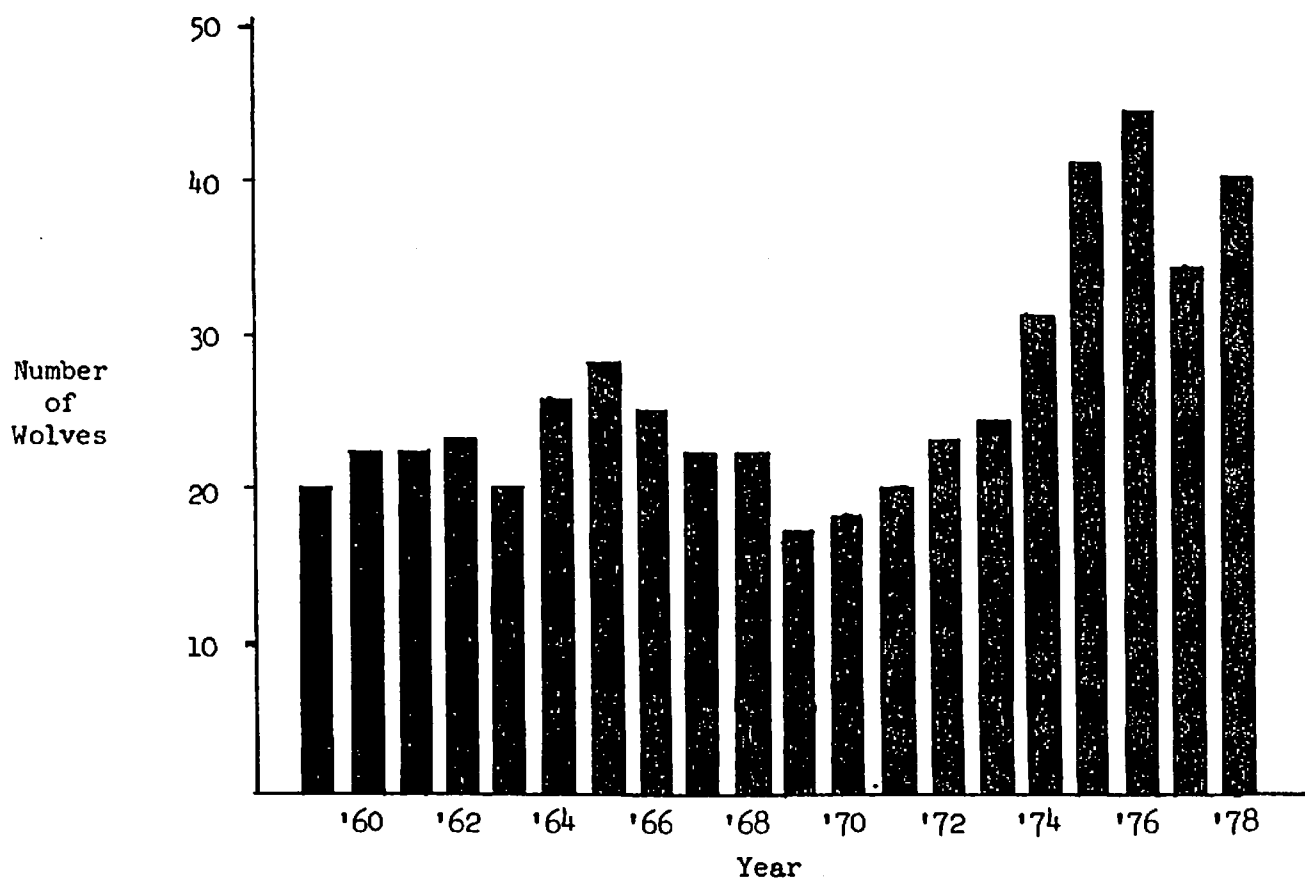


Figure 4. Wolf population levels in midwinter, Isle Royale National Park, 1959-78.

A total of four distinct packs were present in 1978. The Southwest Pack of seven emerged at the southwest end where in 1976 there had been three wolves and in 1977 four wolves. The West Pack and Middle Pack occupied the rest of the western half of the island, and the East Pack continued to dominate the entire eastern half of Isle Royale (Fig. 5). The East Pack has continued to slowly decline from a high of 18 in 1976; it began the winter study at 12 wolves but numbered only 11 for most of the study. The Middle and Southwest packs increased substantially over last year, and the West Pack remained about the same (Table 5). At least one litter of pups must have been born in each pack last summer to account for the wolves observed in 1978.

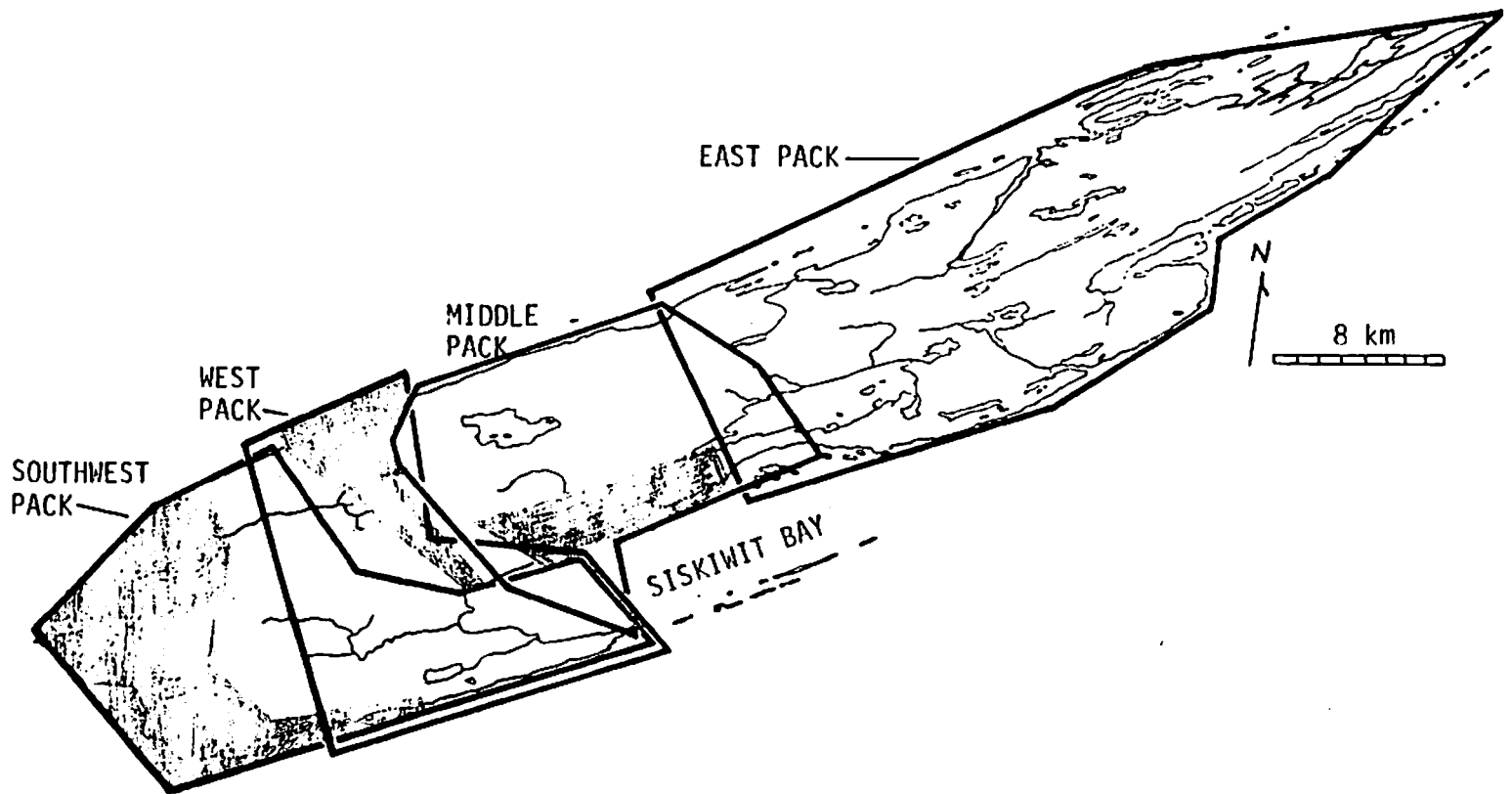


Figure 5. Wolf pack territories (including all locations for each pack) on Isle Royale in 1978. Areas of intensive use for the Southwest, Middle and West packs are lightly shaded. The East Pack used its entire territory with equal intensity.

Table 5. Composition of the Isle Royale wolf population, midwinter 1978.

East Pack	12
Middle Pack	11
West Pack	8
Southwest Pack	7
loners	<u>2</u>

40, minimum number present and best estimate

The territories of the three packs on the western half of the island overlapped considerably, primarily because all three packs at one time or another crossed frozen Siskiwit Bay and traveled along its perimeter. The areas intensively used by each pack were exclusive and non-overlapping, however, and we recorded no instances of direct contact between packs.

The only recognizable wolves were the alpha male and female of the East Pack, unchanged from last year. This is the fourth year with the same alpha male and the seventh year with the same alpha female; she has held that position throughout the history of the pack.

One mating was observed in the Middle Pack on Feb. 24. At least one female in heat was observed in the Southwest, West and Middle packs. In addition to the alpha female in the East Pack, a subordinate female came into heat and was actively courted by a subordinate male. The subordinate pair was repeatedly punished by the alpha pair following courtship behavior, and we do not know if they mated. The East Pack alpha male courted the alpha female, and they probably mated. It is likely that four litters of wolf pups will be born in 1978.

Wolf Predation, 1978

Kill rates were obtained for all four packs for a 42-day period, as well as for the island as a whole, and travel records were complete enough to provide an estimate of the average distance traveled daily by the various packs (Tables 6 and 7). Average daily travel for all four packs, combined, was about the same as in previous years, although the total amount of travel by the West Pack was strikingly low.

This year, for the first time, it was evident that the moose population decline was beginning to affect the wolves in winter. The island-wide kill rate was only about 60% of the level of the last two years (Table 6), and individual wolf packs in 1978 killed moose less than half as often as during the previous six years, although pack size was smaller (Table 7). In almost all cases, kills were completely utilized by the time the wolves abandoned them.

Table 6. Island-wide predation rate in midwinter, 1976-78.

<u>Year</u>	<u>No. kills</u>	<u>No. days coverage</u>	<u>No. kills per day</u>
1976	51	48	1.1
1977	39	40	1.0
1978	26	42	0.6

Table 7. Kill rates and travel records for Isle Royale wolf packs.

Pack	No. wolves	Length of coverage	No. kills made	Ave. period between kills	Ave. daily travel (# days coverage) ^{1/}
Southwest '78	7	42 days	6	7.0 days	14.6 km (24 days)
West '78	8	42 days	4	10.2 days	6.7 km (33 days)
Middle '78	11	42 days	5	8.4 days	11.0 km (25 days)
East '78	12 ^{2/}	42 days	11	3.8 days	13.8 km (42 days)
All packs, '78 (ave.)	9.5	168 days	26	6.5 days	11.5 km (124 days)
All packs, 1971-77 (ave.)	12	479 days	160	3.0 days	11.2 km (367 days)

^{1/} # days coverage used to calculate mileage is sometimes less than coverage used to determine predation rate.

^{2/} East Pack dropped from 12 to 11 wolves after Feb. 8, 1978.

Another indication that wolves had more difficulty killing moose in 1978 was the interest they showed in moose that they previously wounded. The West Pack wounded a cow moose (78-9) on Feb. 1, and remained in the area almost constantly until the moose died 7-8 days later. The Middle Pack returned on Feb. 9 to a moose (78-10) they had wounded before Jan. 26 and completely consumed everything but a few bones, even though the entire carcass had frozen solid before they returned. We observed the East Pack attack and wound an adult moose on Feb. 12, and were surprised to see the pack abandon it immediately; however, they returned to the area briefly on Feb. 17 and 26, but either could not kill the moose or were unable to find it. Finally, on March 7, the pack returned again and found the moose (78-30) dead in thick cover. There were two additional cases (78-7 and 78-20) in which wolves probably wounded a moose and returned several days later and either found it dead or were able to kill it. We speculate that this may indicate that the wolves were attempting to kill moose that were not highly vulnerable to attack, and were only able to wound the moose initially.

During the 1978 winter study we located 31 moose carcasses by aerial search (Figure 6):

- 26 fresh kills made by wolves (including 78-10)
- 2 probable kills made before our arrival
- 3 old carcasses of moose that died of uncertain causes

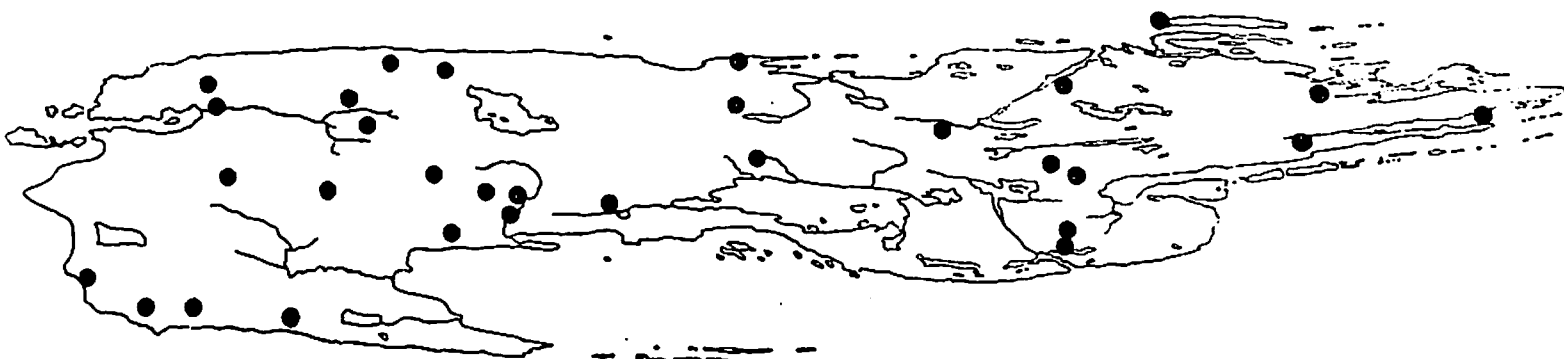


Figure 6. Distribution of moose carcasses located by aerial search in 1978.

Moose Population, 1978

The last aerial census of Isle Royale moose, in 1974, produced an estimate of about 1000 moose ($\pm 30\%$). Since then we have relied on indirect indices of moose abundance to estimate population size. Over the past five years two independent indices, the number of moose seen per mile hiked in the summer and the number of moose seen per hour flown during winter, show a significant correlation, both indicating considerable decline in moose numbers (see Figure 1). Between 1973 and 1977, summer moose observations declined 60%, and winter moose observations declined 40-50%. Since the aerial observations in winter are probably subject to fewer biases, we will put more emphasis on those figures and estimate the current winter population at 500-600 moose.

The aerial moose observations in winter are summarized in Table 8. The observations were made by the same pilot and observer in the same aircraft under similar weather conditions, primarily at altitudes of 400-800 feet while tracking wolves. Moose were recorded both during level flight and intensive circling. The proportion of moose standing vs. bedded is similar each year except 1974, when a moose census was flown and special efforts made to count during periods when moose were most active. Overall moose distribution patterns have been similar during these years, with the most unusual pattern observed in 1978 (see below). For the reasons outlined above, the variation in number of moose seen each year probably reflects actual moose density more than any other variable.

In 1978 moose distribution was greatly affected by the presence of thousands of windfalls resulting from high winds last fall and in January, just before our arrival. This provided a locally abundant source of food for moose in some areas where they normally are not found in great numbers, resulting in unusual distribution which may have increased sightability for aerial observers. Traditional high-use areas that were vacant this winter included the Windigo area and the peninsula north of Washington Harbor. Northeast of these areas the Greenstone Ridge and Red Oak Ridge supported unusually high numbers of moose which fed primarily on tops from windfalls. An unusual concentration of moose occurred

Table 8. Aerial moose observations on Isle Royale in midwinter, 1973-78.

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	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
1978	162	47	182	53	344	102.6	3.45

in the area bounded by lakes Richie, LeSage, Anglemorm and Moskey Basin. As usual, the Tobin Harbor area and the south shore from Cumberland Point to Houghton Point contained many moose. The 1936 and 1948 burns, comprising about 20% of the island, were almost entirely vacant all winter.

At Windigo, our winter headquarters, we saw no moose at all on the ground in six weeks, and only one set of tracks crossed the area during this period. No moose were observed on Beaver Island, a short distance from Windigo. Due to the local scarcity of moose, none were necropsied this winter.

Snow Conditions, 1978

In December, 1977, a major thaw and rain occurred in the Lake Superior area, resulting in a layer of very hard snow 10-15 cm thick. When we arrived in late January new dry snow had increased total snow depth to 40-70 cm, depending on overhead canopy. For most of the winter study, snow depths ranged between 30 and 60 cm and showed little variation in any one site throughout the period. Snow depth in an open area at Windigo averaged 56 cm during the winter study. Total snowfall during the study was 29.0 cm at Windigo, with a water equivalent of 1.1 cm.

No surface crusts were present at any time during the study, and wolves had some difficulty moving through the soft snow. However, wolves continued to travel extensively through the interior of the island by traveling over their old trails repeatedly. The icy layer at ground level was hard enough to support moose, and the soft snow above did not appear to be a hindrance to them.

OTHER WILDLIFE SPECIES

Snowshoe hares appeared to be more abundant in 1978 than in any previous year since 1970. Judging from fox observations (Table 9), there were no obvious shifts in their abundance or activities. A single black fox was seen southwest of Chickenbone Lake, feeding on a wolf-killed moose. Carcasses of two foxes killed by wolves were recovered; both were killed on frozen lakes or bays where wolves have a distinct advantage.

Table 9. Summary of fox observations in midwinter on Isle Royale, 1972-78.

	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>
Moose carcasses located	38	30	40	42	64	53	31
No. where foxes were seen	23(61%)	14(47%)	26(65%)	16(38%)	30(47%)	27(51%)	20(65%)
Foxes on utilized carcasses							
Ave. maximum number	2.4	1.3	1.9	1.3	1.2	1.7	2.0
Sum of max. numbers	55	18	48	21	37	45	39
Other fox observations per 100 hours flying	25	24	21	16	22	13	27

Otter sign was observed at 12 sites on Isle Royale during the 1978 winter study, primarily in the Washington Creek and Grace Creek drainages and the north side of the Greenstone Ridge from Chickenbone Lake to Little Todd Harbor. Beaver sign was observed only three times, since the cold temperatures afforded them little open water.

Herring gulls, goldeneyes and mergansers were occasionally observed along the open south shore of the island during the 1978 winter study. One immature bald eagle was observed several times in the Windigo area during the first week of February, 1978; no active eagle or osprey nests were noted during summer field work in 1977.