

FILE- WOLVES

Provide Assistance to Isle Royale National Park
in the Monitoring of Wolf and Moose Populations
During the Winter of 1987

Final Report

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by

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Abstract

Wolves declined while moose and beaver increased during 1986-87, the 29th consecutive year of research into wolf-moose dynamics at Isle Royale. We have hypothesized that this predator-prey system is slowly cycling on a very long time scale, with population peaks approximately every three decades (Fig. 1). According to this hypothesis, wolves are expected to remain stable at a relatively low level through the 1980's, while moose steadily increase.

Wolf numbers stood at only 16 in 1987, the second lowest total documented for this population. Mortality rate for the wolves present last year was 40-45%, very high for a protected wolf population. The nature of this mortality is unknown, but low kill rate, extensive trespassing and continued interpack conflict all point to a chronically low food supply. We expect that the current food shortage will continue until the end of the 1980's, when abundant cohorts of moose born since 1981 will attain middle age and hence be more vulnerable to wolves. Only two wolf packs persisted through the 1987 study. The East Pack II (EPII) enlarged its territory considerably to about half of the land area of Isle Royale. Researchers witnessed an attack by the EPII on a group of three wolves, apparently a remnant of the Harvey Lake Pack (HLP). The alpha male in the latter group was killed and the two surviving wolves were dispersed.

The moose population was estimated at 1380 $\pm$ 204 (95% confidence interval), suggesting a substantial increase over last year. Calf recruitment in 1986 was strong, especially in the eastern half of the island where wolf density has plummeted within the last two years. Overall, moose mortality remains low, and malnutrition remains a significant source of mortality for very old moose. Radio-collared moose were used in 1987 to continue an assessment of moose "sightability" on census plots, or the proportion of moose seen and counted on plots. After moose have moved into conifer cover and midwinter distribution has stabilized, 75% of the moose on plots can be detected from circling fixed-wing aircraft.

INTRODUCTION

The results reported here are derived from the 29th annual winter study of the wolves and moose of Isle Royale National Park. The objective of this long-term research and monitoring program is to clarify the predator-prey relationship in this simplified, large mammal system, and to understand mechanisms of population regulation for both species. The current working hypothesis is that wolves and moose on Isle Royale are fluctuating in a long-term cycle, with a period length of about

three decades. This hypothesis predicts that moose should increase steadily throughout the 1980's, while wolves remain stable at a low level.

MATERIALS AND METHODS

Most of the findings reported here resulted from a winter study which extended from 22 January through 11 March 1987, when light aircraft were used to census and observe the island's wolves and moose. Donald E. Glaser again piloted his Supercub throughout the winter study period. Rolf O. Peterson (principal investigator) and Kim A. Trostel (field assistant) were responsible for conducting the field work.

Most of the field work was based on aerial surveys of the wolf and moose population, as described in Wolf Ecology and Prey Relationships on Isle Royale (R. O. Peterson, 1977. U.S. National Park Service Scient. Monogr. 11: 210pp).

The following National Park Service personnel assisted on the island during the winter study: Andy Anderson, Stu Croll, Bob Krumenaker, Bob Nobles, Bruce Reed, and Gregg Yarrow. NPS staff at Isle Royale National Park in Houghton and Grand Portage National Monument in Grand Marais, Minnesota, provided logistic support. Supply flights to the island were flown by the Ely Aviation Unit, Superior National Forest, U.S. Forest Service. Thanks and appreciation are extended to all of the above for these many and varied contributions.

RESULTS AND DISCUSSION

The Wolf Population, 1987

The size of the Isle Royale wolf population has generally followed trends in food supply, or moose vulnerability. Presently the moose population consists primarily of young, vigorous individuals born since 1980. Because they are not readily killed, these moose currently provide little food for wolves in winter. We predict that the wolf population will remain stable at a low level through the 1980's, after which they should be able to increase on the strength of abundant moose cohorts reaching middle age and senescence.

In 1987 the wolf population declined to 16, including one recovered dead during the winter study. The 20% decline from last year arose from relatively low reproduction coupled with high mortality. The West Pack II (WP II) declined from eleven to eight wolves, even with four surviving pups, while the East Pack II (EP II) had no pups and declined from five to four

(Table 1). An additional group of three wolves, consisting of an alpha pair and possibly one pup, was located early in the winter study in the middle of the island. This group appears to have been a remnant of the Harvey Lake Pack (HLP), persecuted by both neighboring packs for many years. The HLP lost its territory in 1986 after one wolf was killed and the pack routed by the EPII. However, two survivors did band together in the middle of the island in 1986, and may have persisted and even reproduced.

From changes in total population size and the number of pups present, survival rate can be determined for the wolves counted each winter. Included among the 16 wolves present in 1987 were four pups in the WPII and no more than one pup in the HLP pack. Pup identification is usually based on small size or behavioral cues, such as lack of sexual behavior, lack of incorporation into the pack dominance hierarchy, and/or exuberant play. In 1987 WPII pups were small and showed typical pup behavior. The third wolf in the HLP could have been a pup but observations were infrequent and not conclusive. Thus 11-12 of the 20 wolves present in 1986 were still alive in 1987, implying a mortality rate of 40-45%. Although we have evidence of chronic food shortage for this wolf population, we have little knowledge of the causes of this high mortality rate.

The wolf recovered dead in 1987 was the alpha male in the HLP pack, killed by three wolves from the EPII on 25 January. The fatal attack was witnessed in its entirety from the research aircraft by Glaser and Peterson:

"The three wolves in the EPII were led by the alpha male as they followed a wolf trail toward the kill where the HLP rested. The EPII alpha male frequently stopped to wait for the alpha female, who greeted and excitedly rubbed sides with the alpha male. From the number of dead end trails explored, we judged that the EPII had never been to the kill before. The HLP alpha pair rested near the kill while the subordinate adult fed. The EPII halted briefly when 100m from the kill, then plunged through untracked snow directly for the HLP alpha pair. The HLP alpha male was last on his feet, and received all the attention of the attackers. The EPII gained quickly on the alpha male and within 200m they pulled the hapless wolf down onto his back. The HLP alpha male snapped defensively and shoved vigorously with all four feet while the three wolves bit and tore at him. The EPII alpha pair attacked only his neck and chest, while the subordinate wolf worked on the posterior end. The attackers frequently shook their heads violently after tightly clamping their teeth onto their victim. About five minutes after initial contact blood appeared in the snow beneath his head, yet 12 minutes into the battle the victim

managed to leap to his feet briefly before being slammed back down. The attack resumed as before and the white teeth of the HLP alpha male continued to flash in vigorous defense. The wolf made two more efforts to arise but after 20 minutes he was unable to raise his head. His legs continued kicking but these movements slowed rapidly and finally were stilled. After moving away and lying down for a few moments the EPII renewed the attack, biting, shaking, and dragging the downed wolf. At the 30 minute mark the three wolves walked away together from the motionless carcass."

We found that the wolf had died of internal injuries, chiefly those inflicted by the alpha pair in the chest and neck regions. The dead wolf weighed 94 pounds -- were it not for the 12 pounds of moose packed into his stomach perhaps he would have escaped! The surviving alpha female was seen alone the day after the attack, scent-marking and apparently trying to find her associates. Days later she was seen with the other survivor, and for the remainder of the winter study they usually remained, often together, in the territory of the West Pack II. For almost two weeks following the attack the East Pack II traveled back and forth across the island in trails left by the two HLP survivors. During this time the EPII made 2 overnight "raids" into WPII territory, each time killing a moose, feeding, and returning to the middle of the island by early the next day.

The expansionist tendencies of the EPII were matched by a reciprocal reduction in the territory claimed by the WPII, which in 1987 greatly reduced the range of its travels (Fig. 2). Lake Desor, heavily scent-marked by both packs, appeared to be the dividing line between the two groups. At different times on 28 January wolves from all three social groups (EPII, WPII, and the fugitives from the HLP) were found on Lake Desor, yet no further direct contact between packs was detected during the winter study. Travel and kill rates of EPII and WPII in 1987 were comparable to those observed in recent years (Table 1). Daily travel for the EPII, actively patrolling and expanding its territory, was twice that of the WPII. It is evident that wolf food supply has been stable at a low level throughout the 1980's (Fig. 3), a period marked by frequent interpack conflict and occasional killing. While the aggressive behavior of the EPII in 1987 was unusual, it was not a response to an abrupt decline in food availability. Perhaps it is a unique manifestation of chronic food stress for the EPII, finally culminating in an intense drive to eliminate the adjacent HLP. Obviously, we know little about the time scale for wolf behavioral responses to chronic food shortage.

Lack of shoreline ice caused a preponderance of wolf-killed moose in the island's interior, primarily in the

southwestern half where both packs concentrated their activities (Fig. 4). With the virtual disappearance of the HLP and the expansion of the EPII toward the southwest, wolf density on the eastern end of the island has been reduced considerably in the last two years. Three mature females existed within the 1987 population, but we expect that only two are likely to reproduce this year. The EPII alpha female exhibited vaginal bleeding during 10-17 February and tracks suggested that she mated on 12 February. In 1987 the WPII had a new alpha female, but the alpha male in this pack has remained the same at least since 1982. The WPII alpha female showed estrous bleeding in early March, but when last seen on 3 March she was still strongly rejecting the courting alpha male.

A third mature female existed in the HLP when it was attacked by the EPII in late January. She and the alpha male showed mutual courtship behavior on the day he was killed. Thereafter, we saw no evidence that she attracted or even actively sought a new mate. We saw her once in the company of a another loner, but they soon separated.

The Moose Population, 1986-87

The moose population has been growing steadily since 1981, when calf survival abruptly increased as the wolf population crashed. In 1987 we accomplished all surveys of population size and recruitment during the annual winter study.

Moose Population Size. The moose population was censused twice during January and February 1987. The first survey was confounded by the coincident movement of moose into conifer cover, with a resulting rapid change in moose sightability (Fig. 5). After the shift to conifers had occurred another census was flown, with reduced but constant sightability.

As in previous years, before each census the island was first stratified into four zones of relative moose density (Fig. 6). We counted moose on 100 plots during the second attempt, plots averaging about one km² in area. Almost one-quarter of the entire island was covered by intensive circling from aircraft. Total moose seen during the second count was 281.

The resulting estimate and 95% confidence interval was 1380 +/- 204 moose, compared to last year's estimate of 1025 +/- 108. The 1987 estimate incorporates a correction for moose missed on plots. Recent testing indicates that we detect 75-95% of the moose on census plots, depending on the extent to which moose have shifted toward conifer cover. In 18 test plots over radio-collared moose in 1987, we counted 78% of the moose. In

1986 we detected 75% of the moose on a larger sample of test plots after the conifer shift, so this correction was used in 1987. If 95% of the moose were observed during the first census (as suggested by sightability trials early in the 1985 study), the resulting estimate is identical to that of the second census. Moose estimates shown in Fig. 1 for 1969, 1986, and 1987 have been corrected to reflect an estimated 75% sightability; data from intervening years are still being analyzed.

Calf Recruitment. Our best estimate of calf abundance during the past year came from the sample of 477 moose counted on the 156 census plots counted in mid-winter. Calf percentage was 18%, similar to the average for recent years (Fig. 7). Twelve different sets of twin moose calves were observed during the 1987 winter study, an all-time high. Eight of these twin pairs were found on the eastern half of the island, where wolf activity has declined abruptly, suggesting a substantial release from predation pressure.

Moose mortality. Snow cover on Isle Royale (required for locating dead moose) was complete for barely the length of the winter study, but we succeeded in determining total mortality for 45 days beginning on 20 January. Sixteen moose died during this time, about one every three days (Fig. 8). Thirteen moose were killed by wolves, two died directly from malnutrition, and one died after falling off a cliff. Two moose died some time after being wounded by wolves. One was finally killed by the WP11 15 days after their initial attack, and the other died on its own eight days after being wounded by the EP11. We examined remains of 18 moose on the ground during the winter study, and found that most mortality involved very old moose. Wolves have not yet been able to exploit the vigorous young moose that comprise most of the current population. Five calves, one yearling, and one young adult were killed, but all other moose that died were middle-aged or older, similar to the 1986 pattern (Fig. 9). In 1987 all but one of these older moose exhibited arthritis or periodontitis. One had a broken leg that was in slow repair.

Radio-collared moose. Thirteen moose with radio-collars continued to transmit at the end of the 1987 winter study. Most were instrumented in 1984 and served as the focus of intensive studies of moose foraging behavior during 1984-86. Intensive field studies of radio-collared moose in summer and winter have now been concluded, and data analysis and writing will continue for some time.

Seven radio-collared moose have died during the past three seasons. Surprisingly, only one was killed by wolves. Two bulls died during the fall rutting period, and the remainder

appeared to have died of malnutrition between December and April. The radio-collared moose included a high proportion of very old moose, and this age group is most susceptible to malnutrition mortality.

Test plots were flown 27 times around previous locations of radio-collared moose to estimate sightability during the moose census. In 18 such trials the moose was present on the plot, and in 76% of these cases observers were able to detect the moose during a test count. These results, together with a larger sample from 1986, indicate that 75% of the moose on plots can be seen after the shift to conifer habitats.

Radio-collared cow moose have shown a very clear pattern of every-other-year reproduction, at least for surviving offspring. Two of the eight cows produced no surviving offspring at all in a three-year period, and the remaining six successfully raised one or two calves into winter only every other year. In early June 1986 we made an effort to locate each cow to see if calves were produced at all in the "off" years. From this small sample of cows it appears that there may be a strong tendency to give birth to calves only every other year. Most cows have allowed their offspring to remain with them for two years.

WEATHER AND SNOW AND ICE CONDITIONS

Maximum snow depth was only 30-40 cm for most of the winter study period on Isle Royale, a record-low level matched only by the winter of 1968. During the winter study period itself temperatures were warmer than usual, and this was the first winter at Isle Royale when recorded daily maximum temperature has been above freezing (Fig. 10). Snowfall prior to our arrival was relatively low (Fig. 10), and the combination of warm temperatures and low precipitation was most unusual.

There was an unprecedented lack of ice around Isle Royale in 1987. Thin ice caused a one-week delay in the initiation of winter study in January, and at our Windigo base camp there was open water within 1 km of our ice landing field on Lake Superior in early March, when the study was complete.

OTHER WILDLIFE SPECIES

Foxes were observed on Isle Royale only infrequently in winter 1987, consistent with a general decline over the past 15 years (Fig. 11). Under conditions of chronic low snowshoe hare numbers at Isle Royale, it is possible that the gradual

reduction in availability of moose carcasses has led to a fox decline.

CONCLUSIONS

General trends in wolf and moose numbers in 1987 were consistent with expectations, with the exception of the 20% wolf decline. During the past year mortality was very high among wolves older than eight months of age, and the cause unknown. It may reflect lower food supply attributable to natural changes in moose age structure, or it may be random change in a very small population. Even with continued growth in the moose population, it is not expected that food supply for wolves will improve until abundant moose cohorts born in 1981 and after begin to reach the age of seven or eight years, late in the present decade. The moose population is nearing the level attained in the late 1960's, when the combination of heavy forage utilization and a series of severe winters led to a rapid decline in moose density. It remains to be seen if this system will follow the predicted course; that is, the next substantial moose reduction should occur at approximately the end of the century.

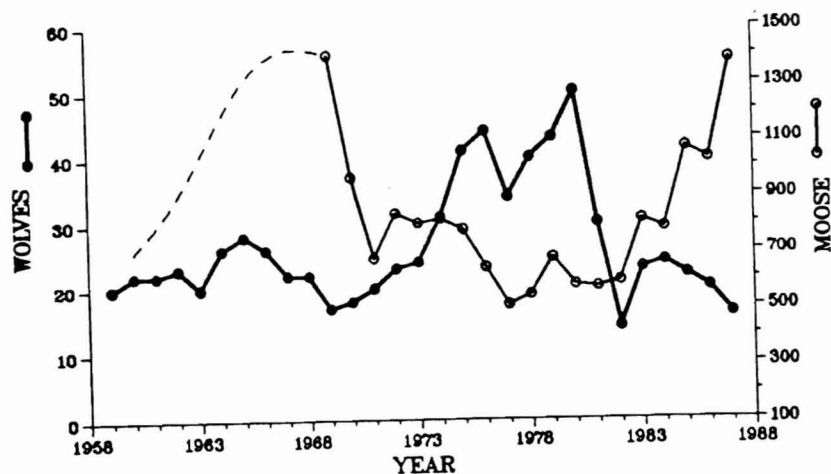


Figure 1. Wolf and moose population fluctuations, Isle Royale National Park, 1959-1987.

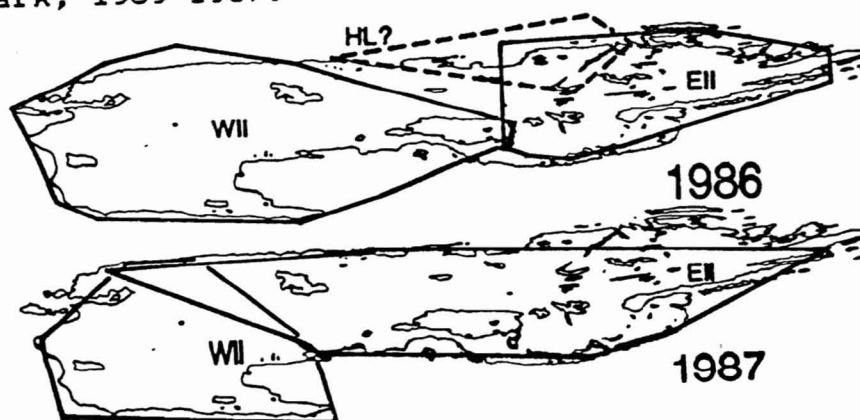


Figure 2. Isle Royale wolf pack territories indicated by movements, 1986-1987.

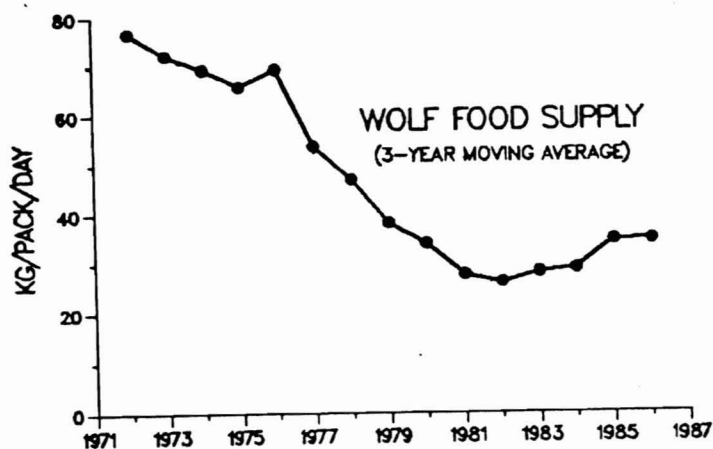


Figure 3. Wolf food supply on Isle Royale, 1971-87.

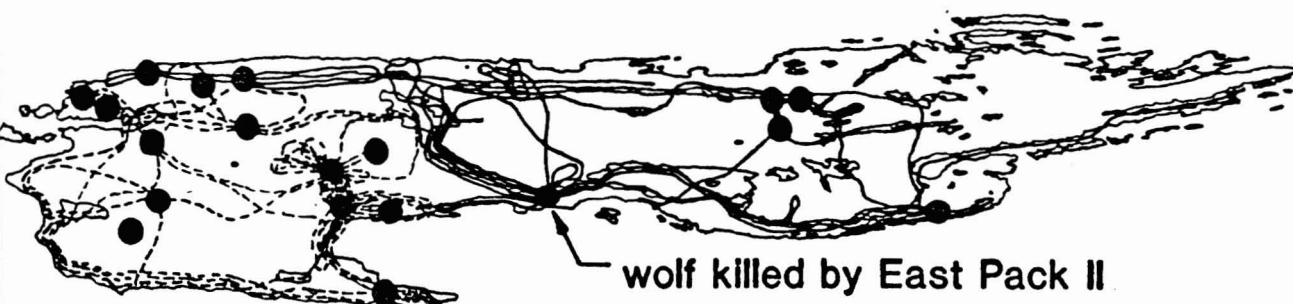


Figure 4. Distribution of travels and kills for the East Pack II and West Pack II in 1987.

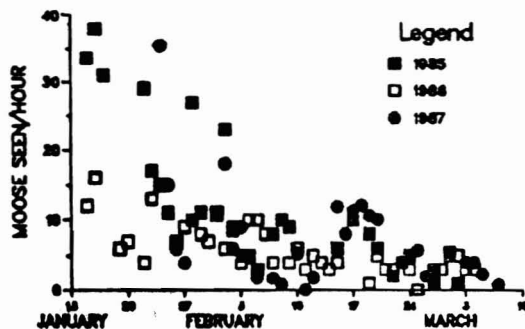


Figure 5. Moose regularly shift into coniferous cover in midwinter. This leads to a decline in moose sightability, the extent to which moose on census plots are actually seen and counted.

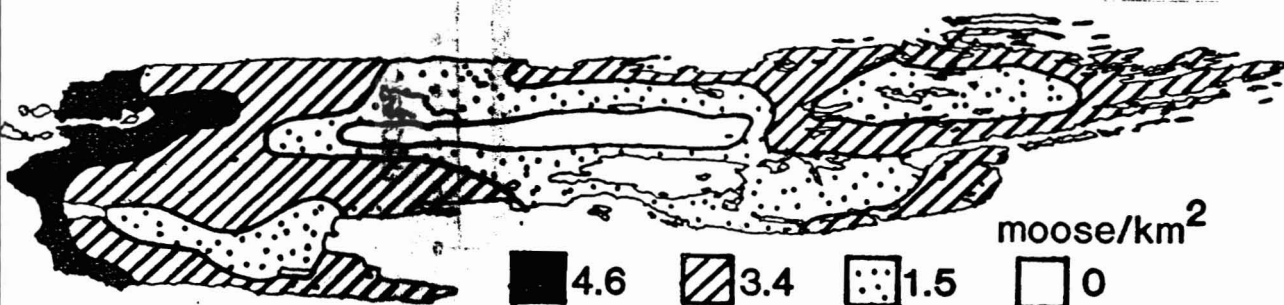


Figure 6. Moose distribution during the 1987 moose census.

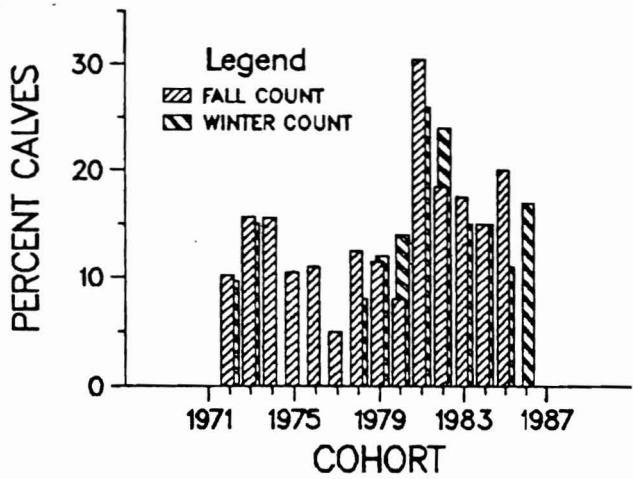


Figure 7. Moose calf percentage on Isle Royale for cohorts born between 1972 and 1986.

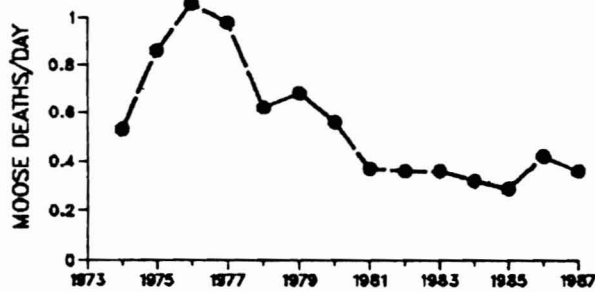


Figure 8. Moose mortality in midwinter on Isle Royale has been relatively constant at a low level during the 1980's.



Figure 9. Age structure of moose dying during the 1986 winter study. Wolf predation accounted for 86% of this mortality.

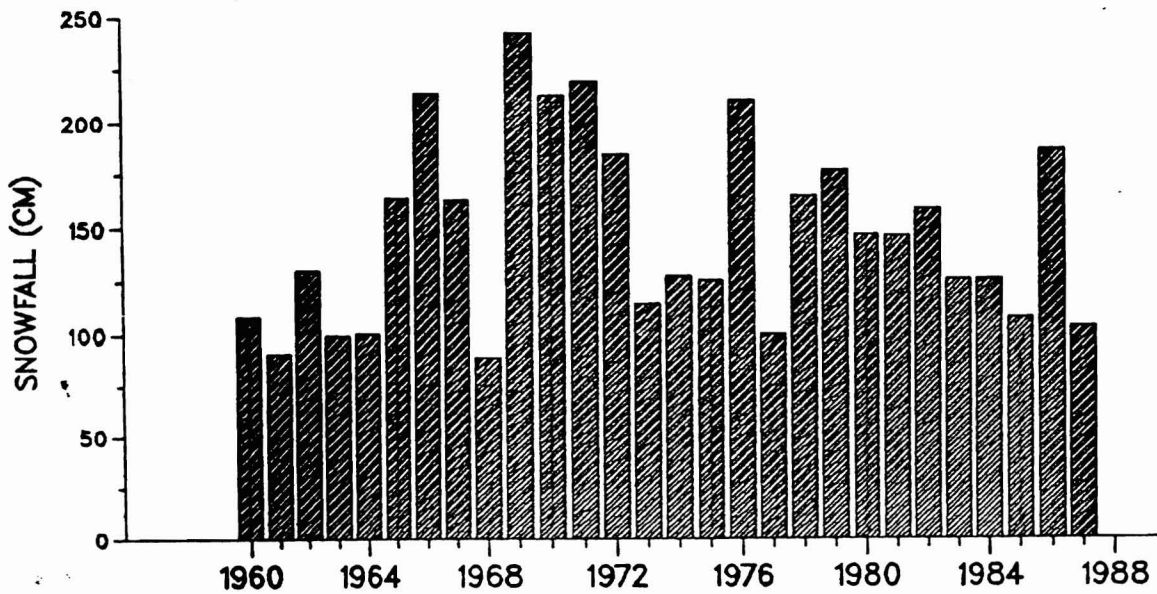
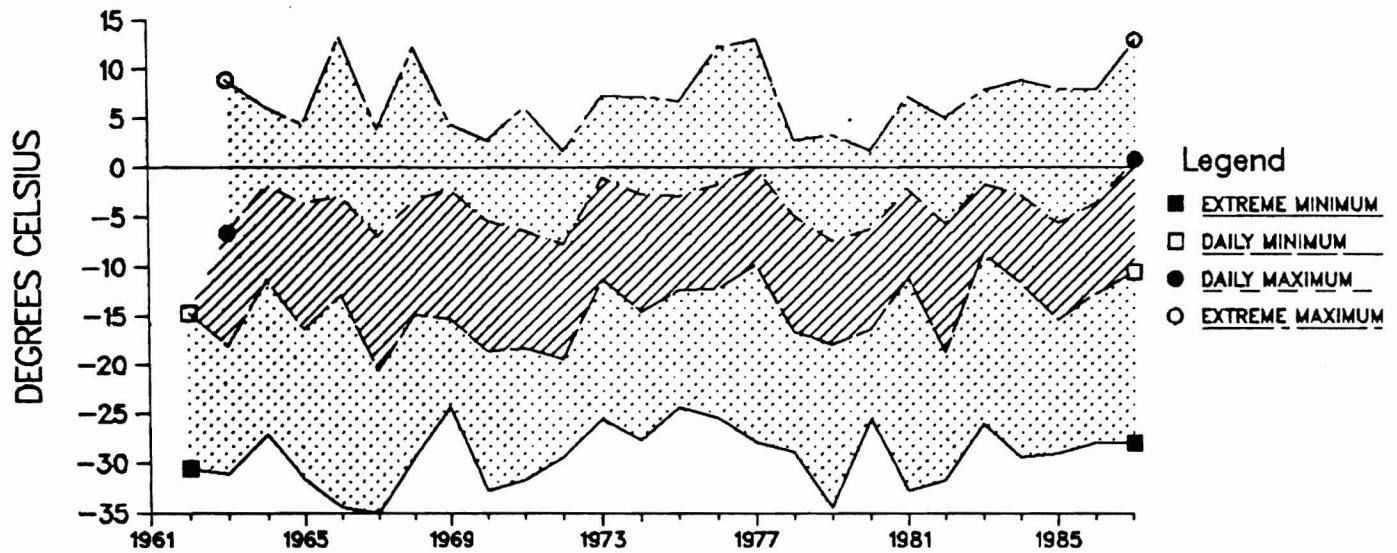


Figure 10. Top, winter temperatures at Isle Royale, 1962-87. Bottom, total October-February snowfall, 1960-87, in Thunder Bay, Ontario, on the mainland adjacent to Isle Royale.

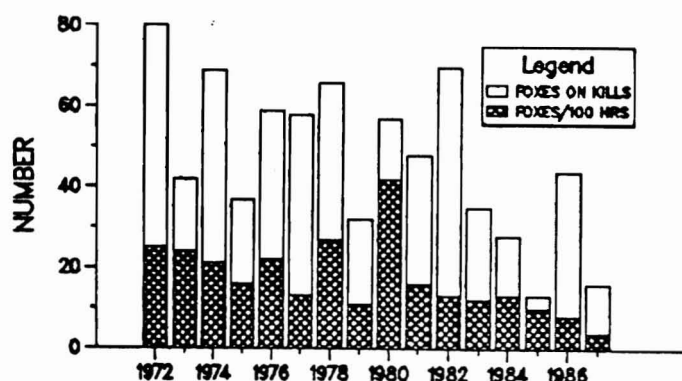


Figure 11. Index to fox observations from aircraft, 1972-87. Lower bar is the number of foxes seen away from moose carcasses/100 hours, while the upper bar is the sum of the maximum number of foxes seen at each carcass.

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Table 1. Travel and kill rates for Isle Royale wolf packs.

	<u>WP</u>	<u>EP</u>	<u>1971-86 Average (sample size)</u>
<u>Pack Size</u>	8	4	7.9 (40 packs, 16 years)
<u>Travel/day (km)</u>	8.5	12.6	9.6 (11,396 km/1,186 packdays)
<u>Kill interval (days)</u>	6.4	9.0	5.4 (1,716 days/316 kills)
<u>Travel between kills (km)</u>	42.6	81.0	42.7 (10,709 km/251 kills)