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Ecological Studies of Wolves on Isle Royale, 1991-1992

Rolf O. Peterson
Michigan Technological University, ropeters@mtu.edu

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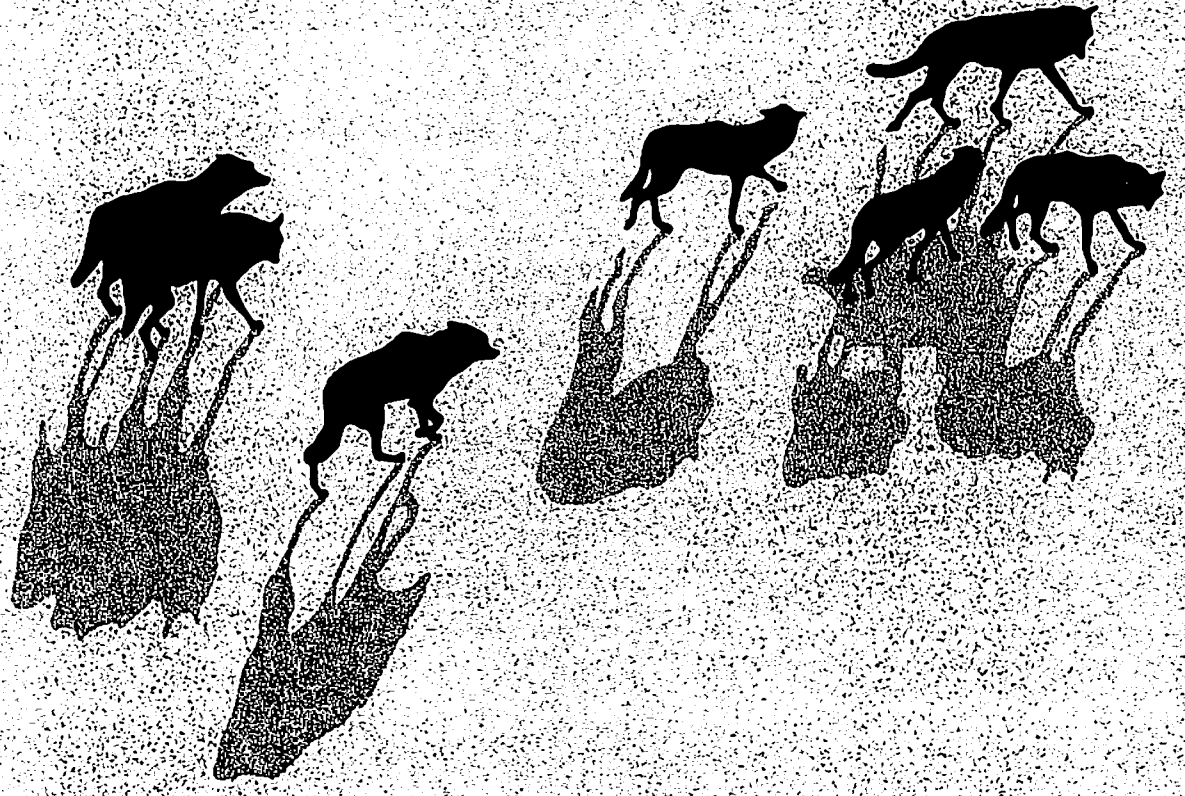
Annual Report

1991 - 1992



Ecological Studies of Wolves on Isle Royale

Annual Report - 1991-1992*

by
Rolf O. Peterson
School of Forestry and Wood Products
Michigan Technological University
Houghton, Michigan U.S.A. 49931

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(Results reported here are preliminary, and in some cases represent findings of collaborators; please do not cite in publications without consulting the author.)

"Few laymen realize that every bone that one holds in one's hands is a fallen kingdom . . . a unique object that will never return through time." . . .Loren Eiseley

Personnel and Logistics

In summer 1991 Rolf Peterson directed ground-based field work, aided by Daniel J. Fehringer, Brian E. McLaren, Carolyn C. Peterson, Anthony J. Schwaller, Douglas W. Smith, and Joanne M. Thurber. Steve Schmitt (Michigan Department of Natural Resources) and Margaret Callahan (Minnesota Zoo and Carlos Avery wolf colony) assisted with wolf-capture efforts in April and May. Radio- collared wolves were tracked with air support from Isle Royale Seaplane Service.

In 1992 the annual winter study extended from January 14 until March 3, although departure was delayed by bad weather until March 9. Peterson and pilot Don Glaser participated in the entire study, assisted by Joanne Thurber (MTU), Tim Timmermann (Ontario Department of Natural Resources), and the following personnel from Isle Royale National Park: William J. Coponen, Larry A. Kangas, Robert K. Whaley, Elen H. Maurer, David C. Soleim, William O. Fink, Stuart L. Croll, and Jack G. Oelfke.

Summary

During 1991-1992 the wolf population in Isle Royale National Park remained at the same level as last year, an all-time low of 12 individuals (Fig. 1). Two wolf pups were produced in one pack and two wolves died, resulting in no net change in population size. Three territorial packs continued to partition the island, and an additional potential breeding pair formed during late February. Among the four male-female pairs, there was no mortality or turnover of individuals from last year. Two additional wolves were radio-collared in 1991; half of the current population has been live-captured and collared since 1988. The number of old moose in the population is now increasing rapidly, so if wolves are food-limited they should increase in number within two years. If not, genetic deterioration will remain as the likely cause for low reproduction.

The moose population stood at about 1,600 animals in 1992, approaching the highest level documented in the past four decades. Calf abundance in midwinter was still moderately high, probably because of relatively low wolf numbers. However, moose calves were generally small, in poor condition, and highly vulnerable to wolves. If wolf predation on moose calves is maintained at a high level, further growth in the moose population will likely cease within two to four years. Compared to wolf predation, winter ticks are a significant but less predictable mortality factor for moose, contributing to uncertainty in short-term projections.

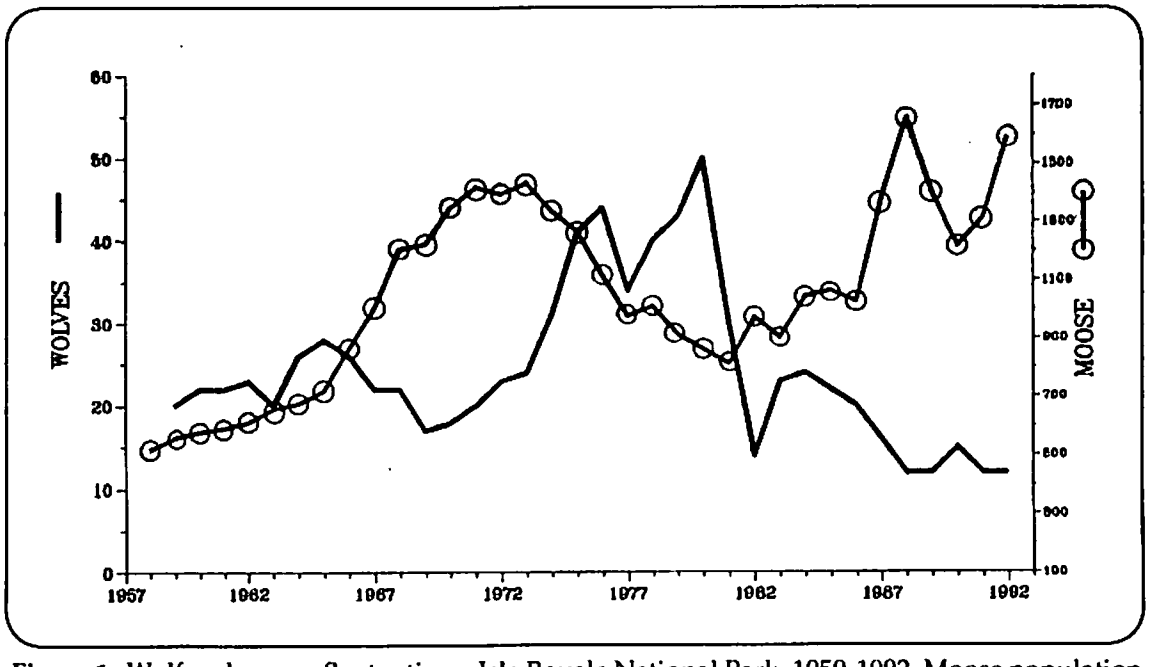

Figure 1. Wolf and moose fluctuations, Isle Royale National Park, 1959-1992. Moose population estimates during 1959-1981 have recently been revised, based on population reconstruction from recoveries of dead moose. Moose estimates from 1982-1992 are based on aerial surveys.

The Wolf Population

After years of decline in the late 1980s, Isle Royale wolves reached a low point of just a dozen wolves in 1988, 1989 and 1991. In 1992 there was no change, with low reproduction offsetting low mortality over the past year (Fig. 2). The wolf population includes the following:

450 Pack - 5
550 Pair - 2
West Pack II - 2
Loners - 3
1992 total - 12

While the sex of two pups in the 450 Pack remains unknown, the remainder of the population includes six males and four females. Three out of four wolves that have recently died were females.

Since 1988 10 wolves have been live-captured, blood-sampled for disease and genetic studies, and released wearing radio- collars. Six collared wolves remained alive in 1992, including two wolves captured for the first time in spring 1991:

Female 450, the alpha female of the 450 Pack, probably at least eight years old;

Male 430, born in 1989 in the 450 Pack, now the beta male in this pack;

Male 550, born in 1988 in the West Pack II, now alpha male of the 550 Pair;

Male 420, at least eight years old, since 1987 the alpha male of the West Pack II;

Female 590, usually alone in the past three years, except for breeding season pairing with male 470, probably at least six years old;

Male 470, usually a loner, bonded with female 670 for two years until her death in 1991, temporarily paired with female 590 in 1989, 1991 and 1992 breeding seasons, probably at least eight years old.

Four radio-collared wolves (three females and one male) died during 1988-1991. Female 490 was killed by the West Pack II, male 550(A) died of malnutrition at a very old age, and females 600 and 670 died (along with their radio-signals) of unknown causes.

In 1992, as in recent years, the island was again partitioned intothree territories claimed by scent-marking packs (Fig. 3). The 450 Pack of five wolves occupied the eastern end, and consisted of an alpha pair, a two-year-old male, and two pups born in 1991 (Fig. 4). Resident in the middle of the island was a bonded male and female, the 550 Pair (Fig. 5). The West Pack II, also a mated pair, claimed the western half of the island. We documented no interactions between territorial packs, each of which contained a potential mating pair.

An additional male-female pair (470 and 590) formed during the 1992 breeding season, but they possessed no territory and exhibited no scent-marking. While together these two wolves lived within the 450 Pack's territory, and on one occasion they were chased by this pack and separated for a day, but then reunited. These two wolves also paired off in February 1991 but by May they had separated.

During summer 1991 pups were detected only in the 450 Pack . Two or three pups were heard howling in summer, and 2 pups were present in

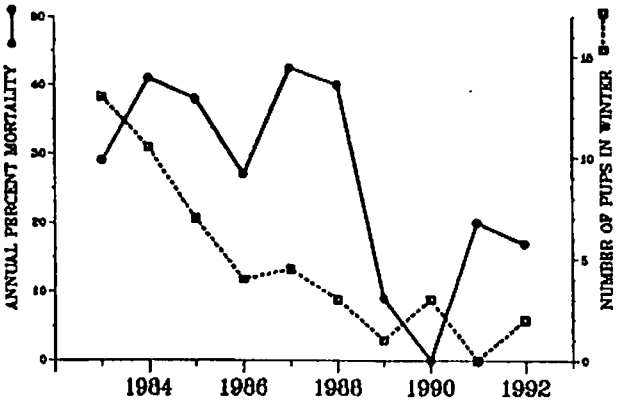

Figure 2. Wolf annual mortality and reproductive success on Isle Royale, 1983-1992.

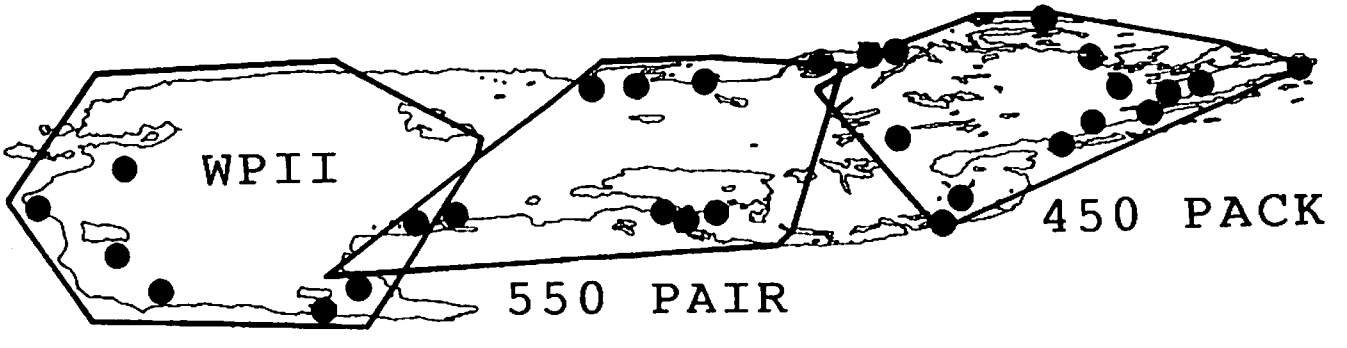

Figure 3. Wolf pack territories and moose carcasses during the 1992 winter study. WPII (West Pack II) and 550 Pack were just alpha pairs (male and female), while the 450 Pack contained five wolves.

Figure 4. Alpha pair (center) of 450 Pack pauses on snow-covered log as other pack members approach; a group greeting ceremony soon ensued.

Figure 5. Occupying the center of the island in 1992 was the 550 Pair, including a radio-collared male (left) and uncollared female (right).

winter 1992 (Fig. 8). There was no evidence of pup production in the other territorial packs, although two other alpha females had been in estrus in the previous winter.

Offsetting the appearance of two pups was the disappearance of two adults, leaving no net change in population size in 1992. In addition to female 670, who disappeared in February 1991, an uncollared two-year-old wolf from the 450 Pack, sex unknown, is also presumed dead.

In late February, 1992, alpha females were obviously in heat in the 450 Pack and the 550 Pair, and they both presumably mated with alpha males in their respective packs. The alpha pair of long-standing in the West Pack II often split during January and February and rarely slept in close proximity, as mated pairs commonly do. In one observation the alpha female exhibited a pronounced limp and there was no direct evidence that she came into heat. Male 470 and female 590 traveled together beginning 19 February, but no courtship behavior was observed.

Since 1988 the wolf population has been studied more intensively, in order to understand their recent decline. The status of hypotheses that might explain the wolf decline can be briefly summarized as follows:

H1: Disease.

Canine parvovirus is present on the island, but there is no evidence of current mortality from this potentially lethal disease. Only some of the wolves have been exposed to the virus, and red foxes do not appear to be a carrier. There was some serological evidence of Lyme disease exposure in Isle Royale wolves, but these tests are problematical and there is still no evidence that wolves are susceptible to Lyme disease.

H2: Food shortage.

Although wolves frequently kill moose calves, most prey biomass for wolves comes from old moose (Fig. 6). New data on moose age structure have revealed a close dependency between wolves and the number of old moose in the population from 1959 through 1980 (Fig. 7). Since that time, however, wolves have persisted at a lower level

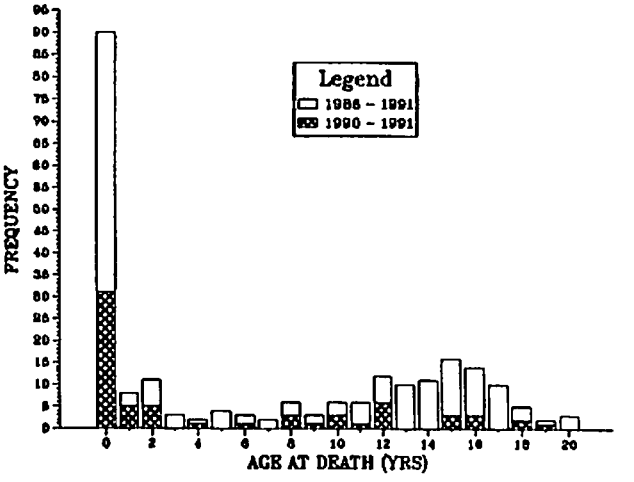

Figure 6. Age distribution of moose dying on Isle Royale in 1986-1992 (last 2 years highlighted). Even though calves provide most prey, numerically, old moose provide most food for wolves because of large body size.

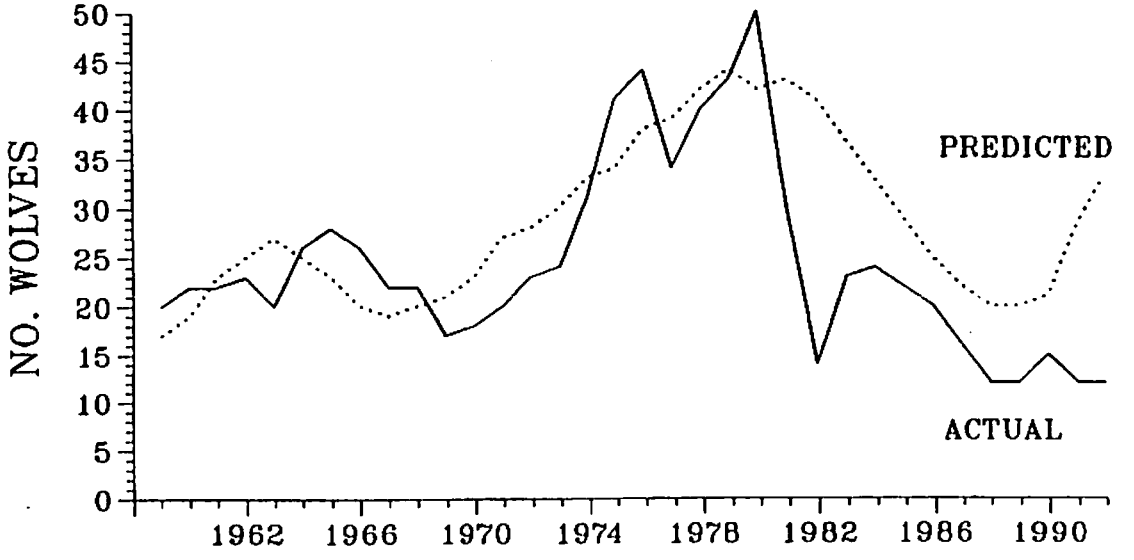

Figure 7. Predicted vs. actual wolf numbers on Isle Royale. Predicted wolf level is derived from the close correlation in 1959-1980 between the number of moose greater than eight years old and total wolf numbers.

than that predicted by old moose density. Nevertheless, wolves were expected to remain at a relatively low level during the late 1980s because of a dearth of old moose (greater than eight years old) available for prey. Allowing wolves a two-year lag to catch up, the current rise in the number of old moose resulting from high calf production and survival in the early 1980s should enable wolves to increase by 1994, according to this hypothesis.

H3: Genetic deterioration.

Genetic studies of Isle Royale wolves by Robert Wayne (Univ. California, Los Angeles) have shown that genetic variability has been lost, the population is inbred, and all the wolves sampled are close relatives. These findings may explain the low reproductive success of Isle Royale wolves which is currently limiting the wolf population. However, all other possible causes of low reproduction must be discounted before genetic problems can be considered the only reasonable explanation.

Of course, it is possible that more than one of these influences may have played a role in the wolf decline. For example, disease-caused mortality may have hastened the loss of genetic variability. When canine parvovirus initially arrived on Isle Royale, probably no later than 1981, it may have contributed to a dramatic increase in mortality. High wolf mortality of unknown cause persisted until 1988. In such a small population, substantial genetic deterioration should occur with the passage of each generation, so the rate of genetic loss was probably high during the 1980s.

Figure 8. (Left) Two pups carefully watch passing research aircraft. Pups are sometimes afraid of the plane upon first exposure, but soon they adopt the nonchalant attitude of their parents. (Right) Body size of nine-month-old pup (rear), 450 Pack, compared favorably with male 430 (front), who weighed 42 kg (92 lbs) in May, 1991, suggesting normal pup growth and development resulting from adequate summer food supply.

One Step Closer

When hearing about recent studies of Isle Royale wolves, visitors commonly ask "How do you catch the wolves?" The only available method in heavily forested areas like Isle Royale is a leg-hold trap, modified to be as safe for the wolf as possible. The official records of "trap-nights per wolf" (a trap-night is one trap set for one night) tell little of the individual dramas that accompany this effort.

Since live-capture of Isle Royale wolves was initiated in 1988, a major goal has been to collar at least one wolf in each pack. For three summer seasons the West Pack II eluded all attempts at capture. This pack of two wolves claims about half the island's area, over 250 km^2. This territory has few lakes and a large number of dense cedar forests, and winter aerial-tracking of these wolves when uncollared required an inordinate amount of time and was often unsuccessful. In winter 1991, using only visual tracking from the air, this pack was observed only twice in 50 days.

In spring, 1991, we once again targeted the West Pack II for capture. This time we tried a new area, burying traps along park trails in April before visitors arrived. Once set, all traps were checked each morning.

Operating on foot, only a few miles of trails could be trapped at a time. With two wolves traveling over 250 km^2, a long wait is sometimes unavoidable. On the fourth day of trapping, we approached an important trail junction where a trap was set. When only 50 m away, we frightened away a wolf as it approached the trap. Its whitish fur showed clearly as it ran off through the brush, and from this fleeting glimpse we surmised that it was the elderly alpha male of the West Pack II, scared off when only a few seconds away from capture.

After this close call, we delayed our daily checking of traps by 30 minutes. Five days later, as we approached the *same junction*, wolf scent was strong in the air. Luck was finally with us; we found the alpha male just a few minutes after he had stepped into the trap. Handling went smoothly, and soon he was up and on his way, now labeled wolf 420 and wearing a radio-collar. That evening, however, we were reminded of *his* priorities as his long, deep howls filled the valley.

Male 420, alpha male since 1987 in West Pack II. When captured in early May, 1991, he weighed 45 kg (100 lbs).

Figure 9. Alpha female of 550 Pair pauses after entering forest, Siskiwit Lake.

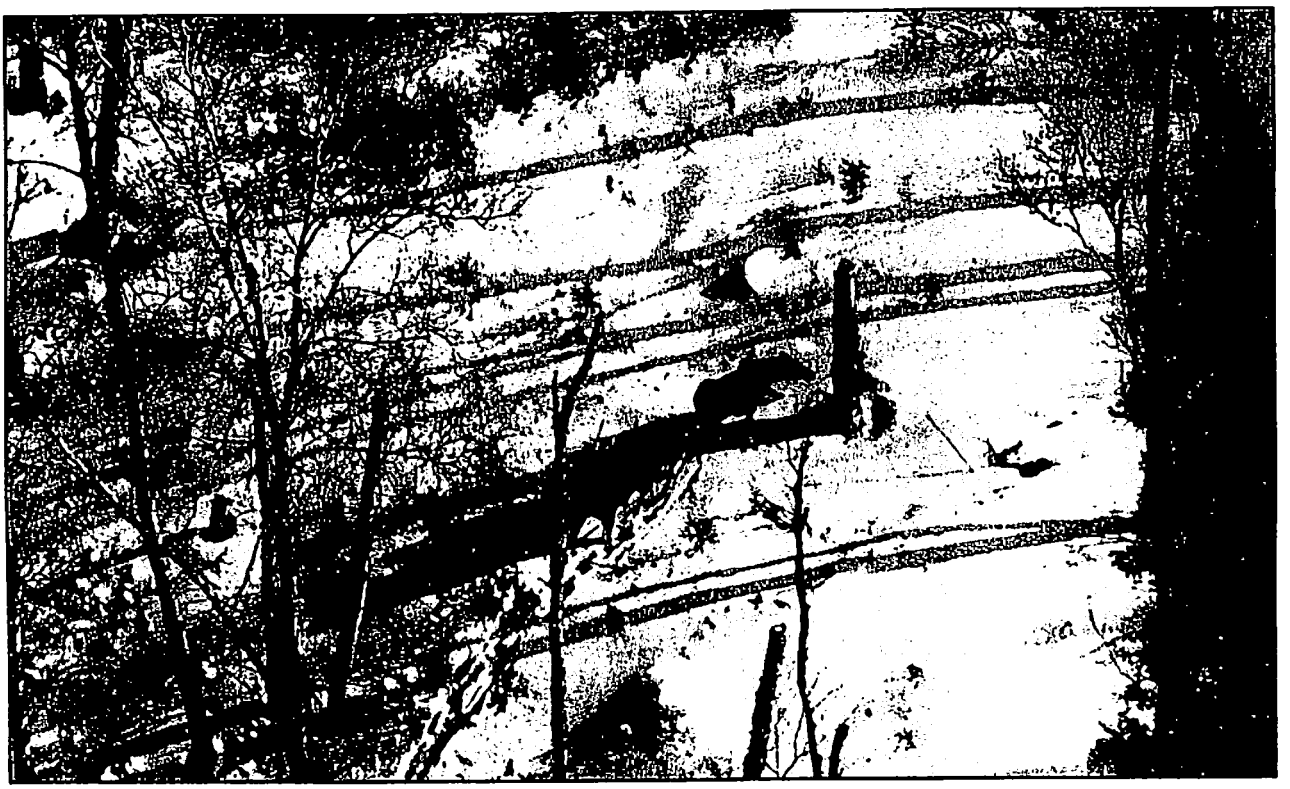

Figure 10. Cow and calf trot away from wolves in typical defensive formation. With calf in front, its mother protects the calf's vulnerable rear end. However, when snow is deep the pair often is unable to move quickly away from wolves.

The Moose Population

The Isle Royale moose population continued to expand in the past year, and by February 1992 it was estimated to contain about 1,600 animals. This is approximately the same level as in 1988, prior to an outbreak of winter ticks, a major mortality factor.

An aerial census of the moose population was flown during 21 January - 17 February (Fig. 12). Small plots averaging one km^2 in size, comprising 18% of the island, were intensively searched by circling aircraft. A total of 252 moose were seen, and the population (± 95% confidence interval) was estimated at 1,596 ± 361.

Midwinter calf proportion was relatively high, at 18%, but summer ground counts suggested a lower level. In the past decade, as moose density increased, recruitment of calves has generally declined (Fig. 11). Calves, highly vulnerable to wolf predation, comprised 50% of wolf-killed moose in winter 1992. Many of these calves were obviously small and in poor condition, probably because of high population density and chronic undernutrition.

Isle Royale moose in winter inhabit old forests with a "stable" but relatively low supply of forage. Ken Risenhoover's studies of moose foraging behavior in the mid-1980s revealed the singular importance of balsam fir in their winter diet. During Tom Brandner's subsequent study of moose impacts on balsam fir it became clear that, while fir "escaped" from moose on the east half of Isle Royale, fir has not regenerated successfully on the entire western half of Isle Royale. Here all fir "trees" less than 80 years old are suppressed, unable to grow to seed-producing height because of browsing by moose. Fir in the canopy, providing the only existing seed source, is now declining at about five percent per year. This obvious instability will probably eventually impact moose, although "when?" and "how?" remain to be determined.

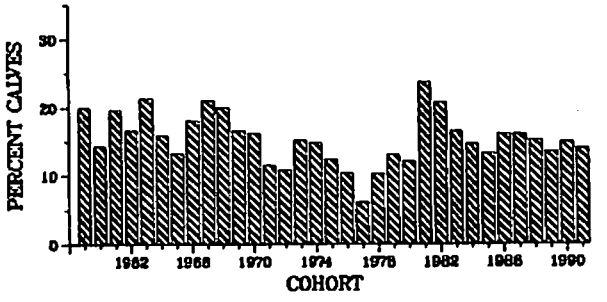

Figure 11. Moose calf abundance (at approximately six months of age) on Isle Royale, as a proportion of the total population. These are single best estimates, the mean of all available counts for each cohort (summer ground observations and aerial counts in autumn and winter).

In 1991 Ph.D. student Brian McLaren initiated an in-depth study of balsam fir ecology, focusing on questions about germination and growth. From this effort we hope to understand why there are such distinct differences between fir populations on both halves of Isle Royale. Another Ph.D. student, Mary Hindelang, will be using our large collection of moose skeletal remains to study aspects of several noteworthy moose pathologies: osteoporosis, degenerative joint disease, and periodontal disease.

Average bone-marrow fat content of moose dying in winter 1992 was lower than in any year in the previous decade, suggesting gradual deterioration in moose condition (Fig. 13). However, the animals killed by wolves represent a select subsample, possibly unrepresentative of the population at large. Analyses of moose urine in snow (in collaboration with Glenn DelGuidice of the Minnesota Department of Natural Resources) suggest midwinter condition of moose improved somewhat in the past four years, following a tick-related moose dieoff in 1989.

Mortality of moose in winter was relatively high in 1992 (Fig.14). High losses among calves were attributed to greater intrinsic vulnerability to predation; other possible explanations, such as deep snow or high wolf density, were not tenable.

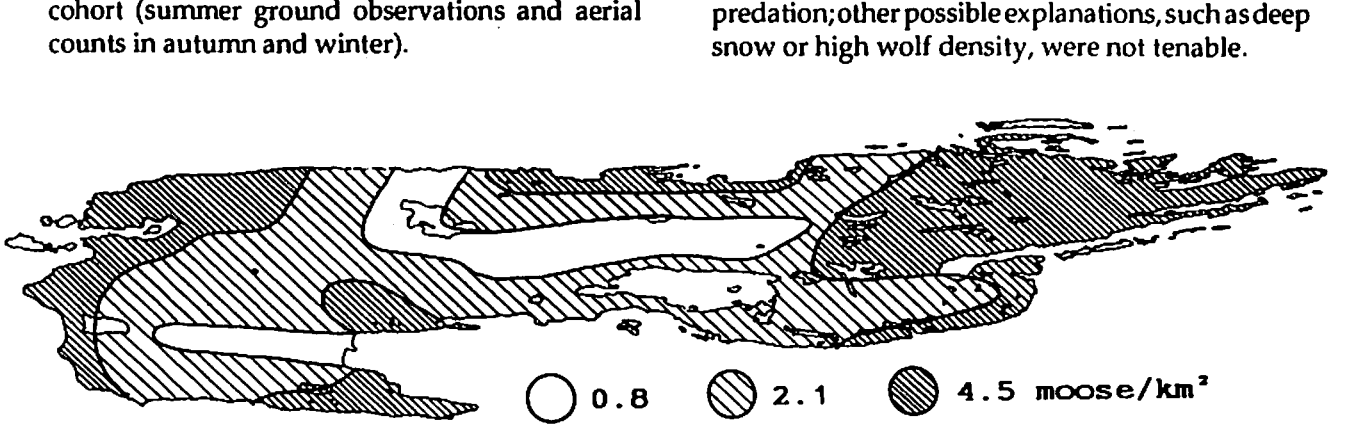

Figure 12. Moose distribution on Isle Royale during aerial census in February, 1992.

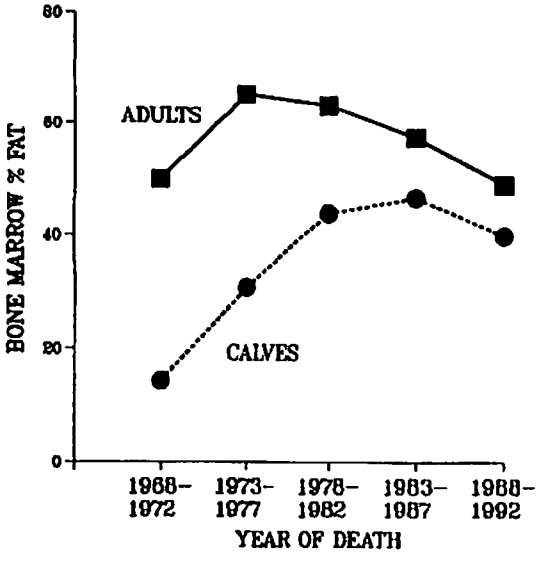

Figure 13. Long-term trends in moose bone marrow fat suggest a deteriorating forage base for moose in the 1980s, as moose density steadily increased.

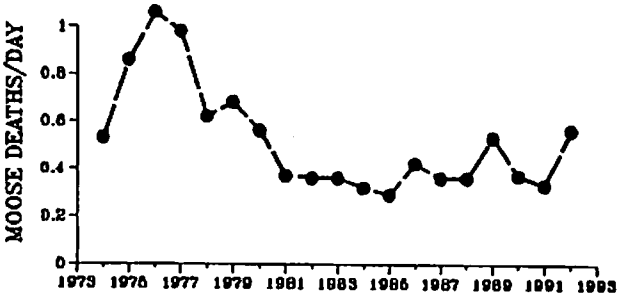

Figure 14. Moose mortality rate in in 1992 was the highest of the past decade.

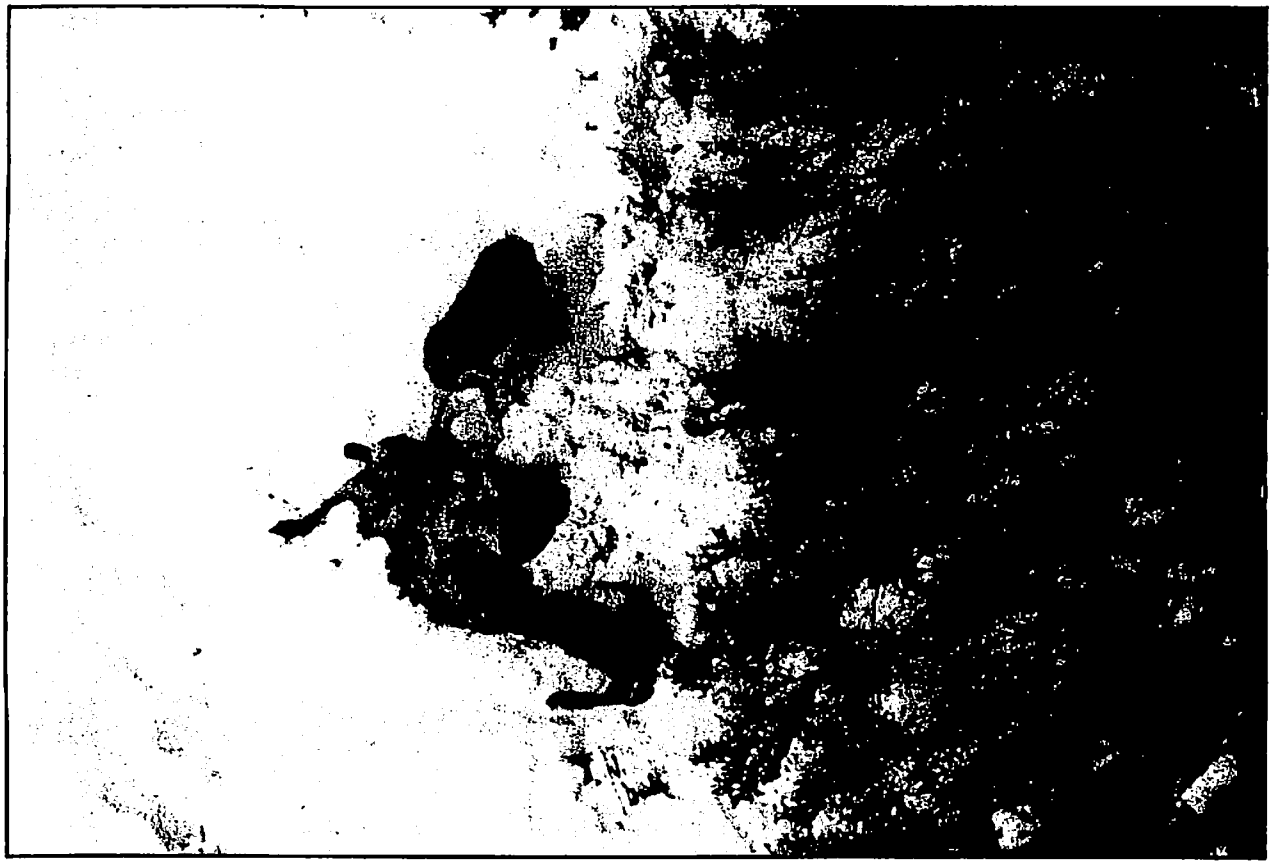

Figure 15. West Pack II alpha female next to carcass of moose calf killed the previous night.

Expectations for Wolves and Moose

The future for Isle Royale wolves depends critically on whether or not reproduction can continue to offset mortality, which has been very low since 1988. Over the past four years there have been only six surviving pups in three packs, an exceptionally low rate of reproduction. As the current group of six alpha wolves (the pool of potential breeders) ages, the mortality rate will increase and numbers will likely dwindle. The next generation is very small, just four younger wolves, all originating in a single pack. While the prognosis for the current wolf population is not favorable, large uncertainties in our knowledge of small populations in nature allow plenty of room for surprises.

In the short term we expect undernutrition in moose to increase and persist. The wolves remaining on the island are expected to maintain their high kill rate. If calf vulnerability to wolves continues to be high, moose population growth should soon level off. Additional mortality in the moose population is likely to be driven by unpredictable external events, such as a renewed outbreak of winter ticks (very possible with present weather trends) or an unusually severe winter (unlikely given present trends).

Other Wildlife

Beaver colonies were censused in 1990 by Philip C. Shelton and Douglas W. Smith. Their count indicated that beaver density has stabilized at a modest level after reaching a low point when the wolf population was at its peak (Fig. 17). Beavers living in streams show the greatest variation in numbers from year to year, probably because they are more vulnerable to wolves than those living in large ponds or lakes.

In 1991-1992 the fox-snowshoe hare component of Isle Royale's fauna continued to decline as hare density dropped from a recent high in 1988. Our only available index of hare density, the relative number observed during summer hiking (Fig. 18), suggests that hares have almost returned to the long-term low level characteristic of previous decades. Although fox observations in winter may fluctuate for several reasons, they suggest that foxes increased during and after the peak in hares (Fig. 19).

Otter sign was more abundant than in any previous winter in recent decades, and their movements were facilitated by completely open water

Figure 16. Two moose drink from sodium-rich springs along the shoreline of Hidden Lake, while another moose (foreground) awaits its turn, February 1992.

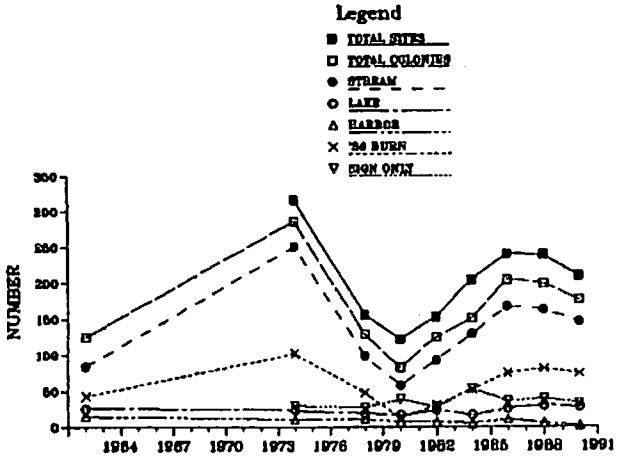

Figure 17. Beaver population trends on Isle Royale, by specific habitats.

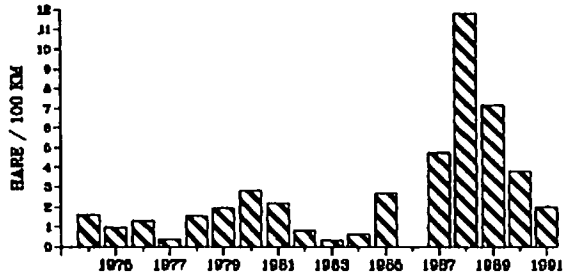

Figure 18. Snowshoe hares on Isle Royale continued to decline in 1991 from a recent historic high level.

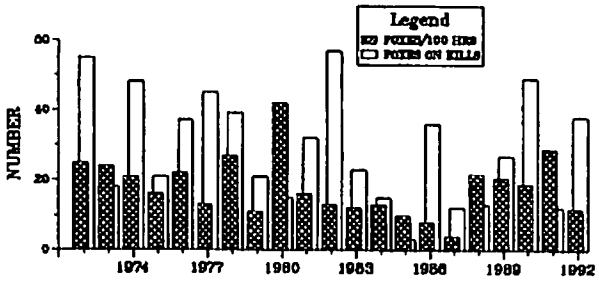

Figure 19. Relative abundance of red foxes from aircraft observations, 1972-1992. Hatched bar is the number of foxes seen away from moose carcasses / 100 hours, while the open bar is the number of foxes seen on carcasses.

Figure 20. Rare antlers of old moose that died of malnutrition in February 1992. Perpetually-retained antlers such as this probably indicate lack of normal testosterone influence on the antler cycle.

along Lake Superior shorelines (Fig. 21). The otter population appears to have been building steadily, perhaps aided by a major recovery of the lake herring around Isle Royale. Large schools of young herring have been observed in the last two years.

Since 1985 bald eagles and ospreys have returned to nest on Isle Royale, and since then they have been monitored closely by Park staff. In 1991 there were two productive bald eagle nests, fledging four young, and four active osprey nests were documented, with at least five young produced. Single bald eagles were seen several times during the 1992 winter study, and one pair of mature bald eagles was observed. One immature golden eagle was seen on February 22 and 25, 1992 (see page 16).

A dozen peregrine falcons were released by the National Park Service on Isle Royale in 1991, the fifth and final year of a reintroduction program. In separate projects, 12 peregrine falcons were also released at Pictured Rocks National Lakeshore on Lake Superior's south shore, and 10 were released in the Thunder Bay region on the adjacent north shore. It is hoped that these releases will re-establish a breeding population of falcons in the region, but it is too early to evaluate the success of these efforts.

Weather, Snow, and Ice Conditions

In recent years, warming of the North American mid-continent in winter has been evident, and snowfall has been correspondingly less (Fig. 22). The winter of 1991-1992 was certainly one of the warmest to be endured in recent years, with considerable fog and thawing conditions both before and after the winter study. During the study itself temperatures were not far from seasonal norms, and fortunately no major thaws occurred until early March (Fig. 23), when our departure was delayed for a week. In mid-January snow depth on Isle Royale was far below average, but snow depths gradually increased to usual levels by late February.

One important consequence of the warming trend is that opportunities for mainland wolves to travel to Isle Royale have vanished because ice bridges to the north shore have been absent. In 1992 there was less ice around Isle Royale than in the previous 34 years. Only the interior lakes on Isle Royale and the most protected bays of Lake Superior were frozen during the midwinter study.

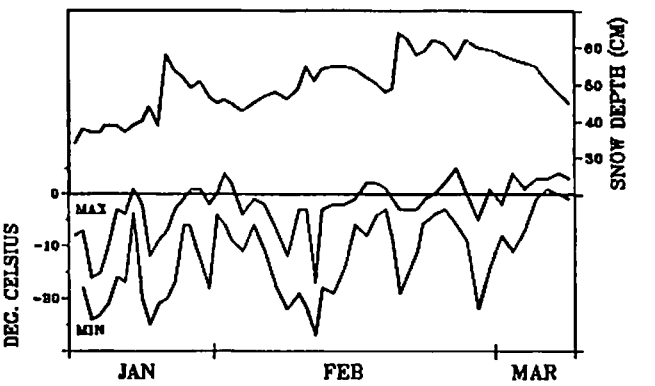

Figure 23. Temperature extremes and snow depth during the 1992 winter study on Isle Royale.

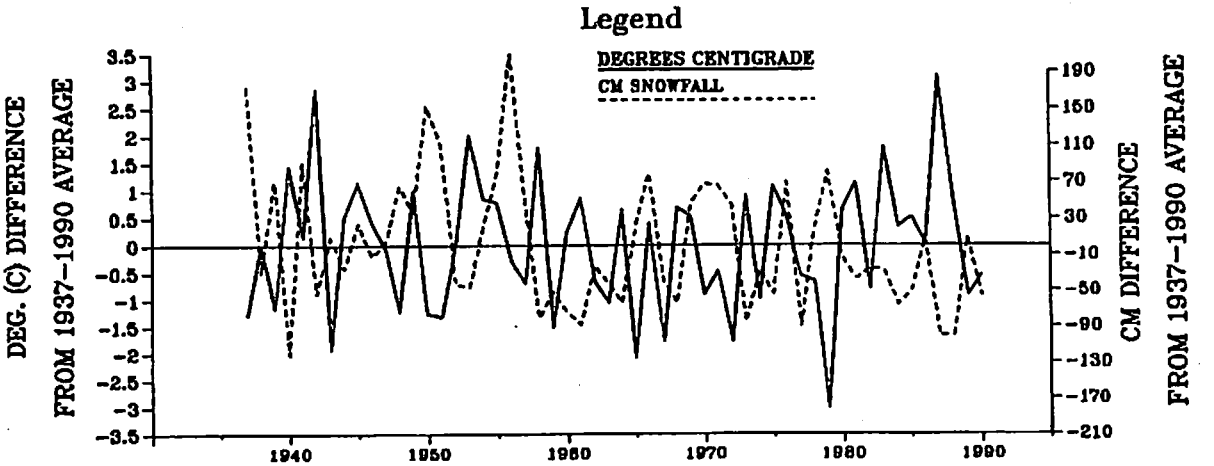

Figure 22. Long-term records of snowfall and mean monthly temperature (November-April) in Thunder Bay, Ontario, the year-round weather station closest to Isle Royale. The past decade had consistently warm winter temperatures, with below-average snowfall. "1940" refers to winter, 1940-1941.

Figure 21. Entrance to otter "house" in old beaver lodge, Lake Desor.

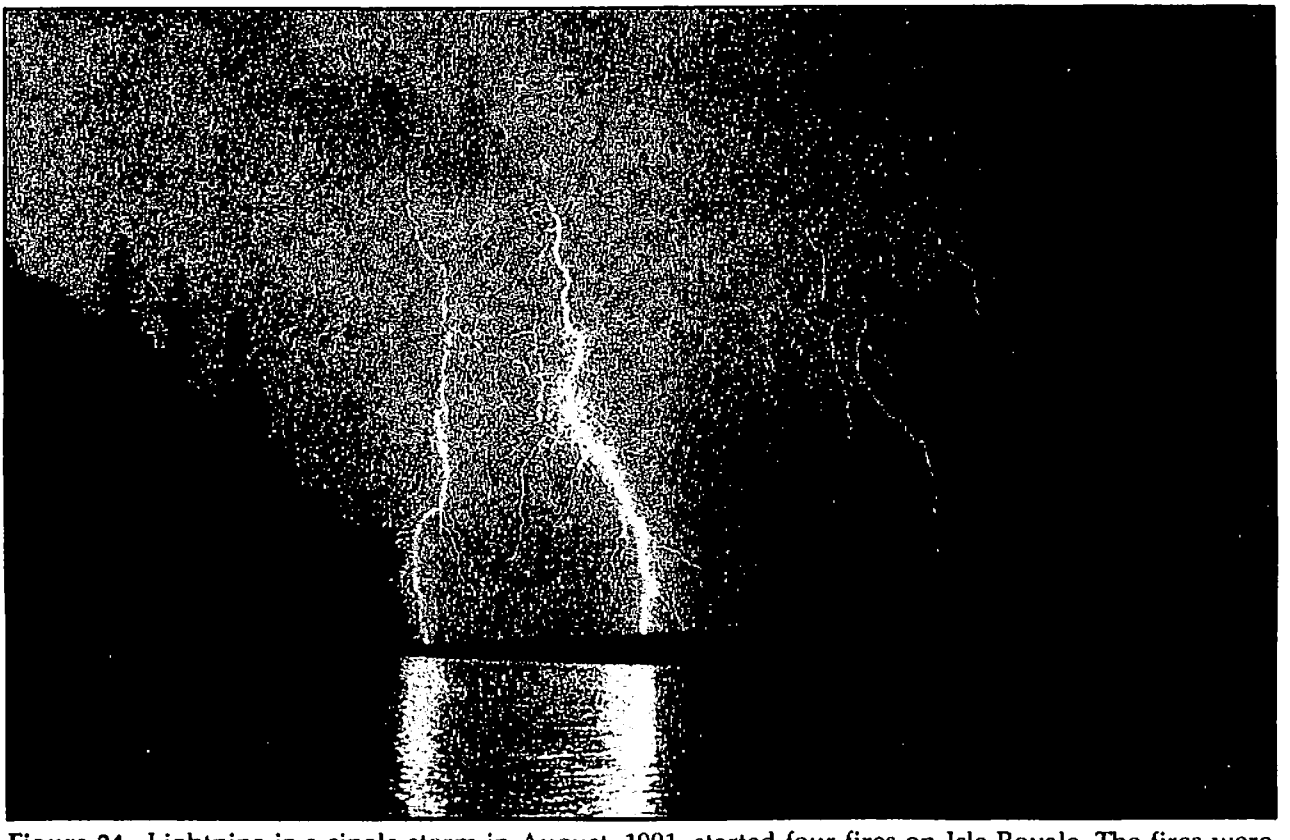

Figure 24. Lightning in a single storm in August, 1991, started four fires on Isle Royale. The fires were extinguished by fire crews pending approval of a Fire Management Plan for the park, one that will include allowing naturally-ignited fires to burn provided they meet certain criteria. Following the 1988 Yellowstone fires, all national parks had to review and update such plans.

Flying With Eagles

In late February, while aerial-tracking the 450 Pack near Duncan Bay, we found a large bird feeding on a carcass in the old trail of the pack, on a frozen beaver pond. This bird was certainly no raven, the most common avian scavenger, as its body was huge compared to its head, mostly buried in the carcass of a furry creature. Binoculars revealed an eagle, whose large form obscured the animal on which it fed. Anticipating a dead wolf, we quickly landed and snowshoed to the site, waving off the eagle from a distance before it consumed any more. As it circled the pond to gain altitude, we saw white bars on the tail and white windows in its wings— perhaps a rare golden eagle!

The carcass was that of a red fox, an adult female evidently in the prime of life. Piecing together the evidence at the scene, we concluded that the eagle had killed the fox as it slept, curled up in a ball. Taken totally by surprise, the fox had not moved from the beaten wolf track in which it slept. In the short interval between the kill and our arrival, the eagle had consumed most of the internal organs, while in the surrounding trees ravens waited expectantly for leftovers.

Three days later, while flying near the same pond, we came almost head-on up to an eagle soaring high over the trees. This time we had an excellent vantage point and, having studied the diagnostic features of eagles, we were able to clearly identify a golden eagle with juvenile markings. The golden eagle, a common resident of western North America, was last recorded in winter on Isle Royale 29 years ago.

Juvenile golden eagle flying over Isle Royale, 25 February 1992. Three days earlier this eagle killed and consumed an adult red fox.