3-31-1994

Ecological Studies of Wolves on Isle Royale, 1993-1994

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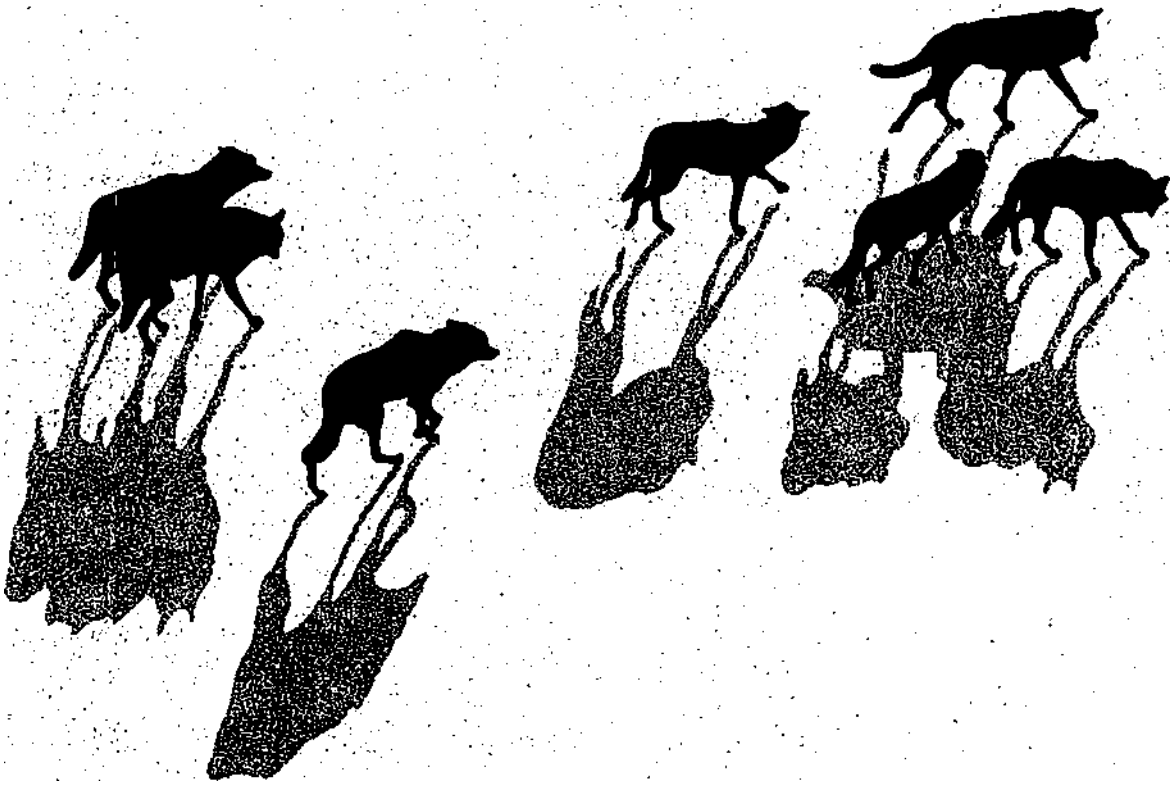
Annual Report

1993-94



Ecological Studies of Wolves on Isle Royale

Annual Report—1993-1994*

by

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31 March 1994

•During the past year major support of these studies was received from the National Park Service (Coop. Agreement No. CA-6310-9-8001), National Geographic Society, Earthwatch, Inc., Robert Bateman Endowment Fund, and the Boone and Crockett Club, with additional contributions from the following organizations and individuals: Randall F. Absolon, Toxie E. Beavers, Dorthey L. Behrend, Greg and lanet Capito. Herbert Carson, Alison). Clarke, lames E. Deignan, Lila B. Field, Edith N. Greene, Frank B. Isaacs. Steven T Karpiak, Jr., Darcy R. Rutkowski, Billie E. Smith. Linda E. Thomasma. Scott A. Thomasma, and Ameritech-MG.

At Michigan Tech. Theodore). Soldan (Computing Technology Services). William A. Tembreull. Arlene L. Johnson, and Robert J. Slater (all of Publications/Photo Services) were instrumental in producing this report Cover drawing by Fred Montague. University of Utah. Salt Lake City. Thanks to the following for equipment and logistical help: Isle Royale National Park. Canon U.S.A., Nikon. Inc., and Lake Superior Fisheries. Inc.. Hancock, Ml.

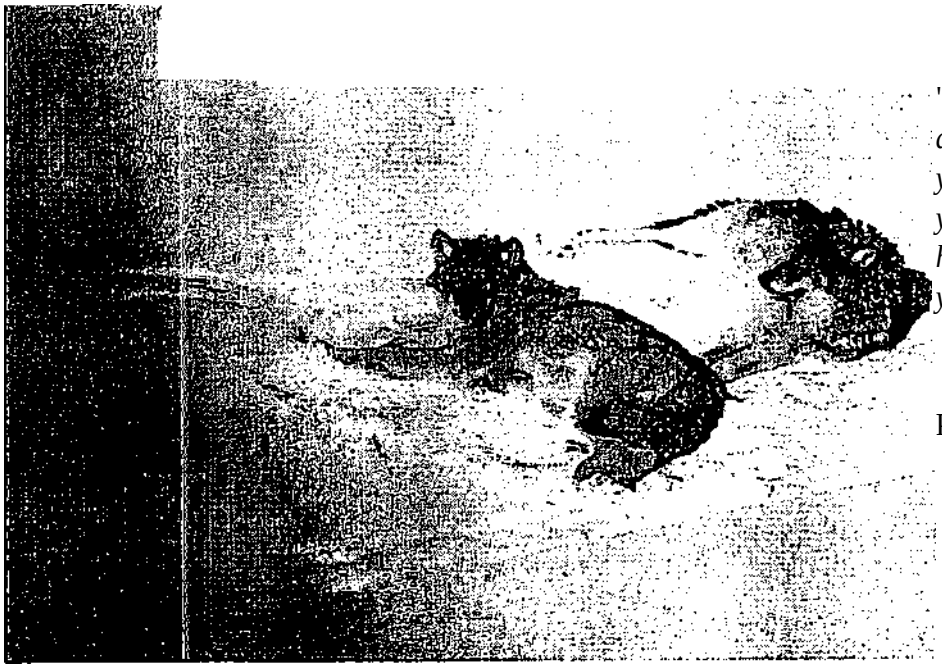
Important contributions of personal time and financial assistance from the following Earthwatch volunteers are gratefully acknowledged:

Team I:Tamara Bowman. D. lames Heaton. F. David Hudda, Bryan Kukuzke. Ronald R. Turner, and Lora Wingate **Team 2:** Barbara Hill. Paul Kuhn, Neeraj Tayal, Michael G. Thomas, and Kimberlie |. Thomas **Team 3:** lohn Alexander, Kendra Baumgartner, Robert T. Browning, Eli Gottlieb, Cathy Nowak,
David G. Pantaleoni, Lydia A. Phillips, Matthew). Starr, 111, and Brigid Wasson **Team 4:** Erin E. Barclay. Roger D. Boyd, Eileen M. Kreiner, Dean C. Mathias, Debora K. Mathias,
Elizabeth H. Miller, Jennifer K. Munday, Judith W. Niedzielski. and Cynthia M. Weber

Tax-deductible donations to support continuing research on Isle Royale wolves and moose can be sent to: Wolf-moose study, Michigan Tech Fund. Alumni House, Michigan Technological University, UOOTownsend Drive. Houghton, Michigan 49931. THANK YOU to all who help!

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

Ecological Studies of Wolves on Isle Royale



"Wrien you /oo6 inlo *the eyes of a deer, you see a mirror.* WAen *you look into the eyes of a wolf, you see intelligence.* If is *a haunting look . . . one that you will never forget.".* .. Ron Parker

Personnel and Logistics

In summer 1993 Rolf Peterson directed ground-based field work, aided by David P. Bach, Christopher |. Fink, Marco Heurich. Timothy G. Laske. Brian E. McLaren, Carolyn C. Peterson, leremy D. Peterson. Douglas W. Smith. lohn A. Vucetich, and loseph R. Zanon. Radio-collared wolves were tracked with air support from Isle Royale Seaplane Service and Superior National Forest.

In 1994 the annual winter study extended from January 11 until March I. Peterson and pilot Don Glaser participated in the entire study, assisted by graduate students Brian E. McLaren and Mary L. Hindelang, and the following personnel from Isle Royale National Park and the National Park Service: lack G. Oelfke. Ronald Hiebert. Robert K. Whaley. David C. Soleim. Elizabeth |. Amberg. Norman T. Lindsay. Eric Gdula. Larry A. Kangas.

Summary

In 1993-1994 wolf and moose populations at Isle Royale both increased (Fig. I). Building on improved reproduction in 1993. wolf numbers reached 17 in January 1994. their highest level since 1987. Mortality also increased, with four wolves dying since the 1993 count and two additional deaths during the 1994 study. In the past year three wolves were recovered dead, and all were emaciated with heavily worn teeth. Two of the three territorial packs reproduced, each raising 4 pups. The pups in one pack were orphaned in winter 1994 when both parents died. Most of the surviving wolves (11 of 15) in March 1994 were young—three years old or less. This younger generation contains both males and females. which will help secure the short-term future of the wolf population.

Improved reproduction in the wolf population calls into question the hypothesis that poor reproduction in this small population was caused by inbreeding. Wolf food supply (old moose) began increasing in the early 1990s, and wolves may now finally be responding to improved food supply, in spite of genetic losses. The outcome of the next few years should help resolve this important question.

The 1993 moose calf crop was larger than average, and the moose population continues to slowly grow Mortality during the 1994 study included some losses to accidents and malnutrition, but wolves killed 70% of the moose recovered in winter. Winter ticks were not abundant in 1994, and the moose population will probably continue to grow until it is stopped by increased wolf predation. ticks, or winterkill The previous moose increase (in the early 1970s) was evidently held in check by wolf predation.

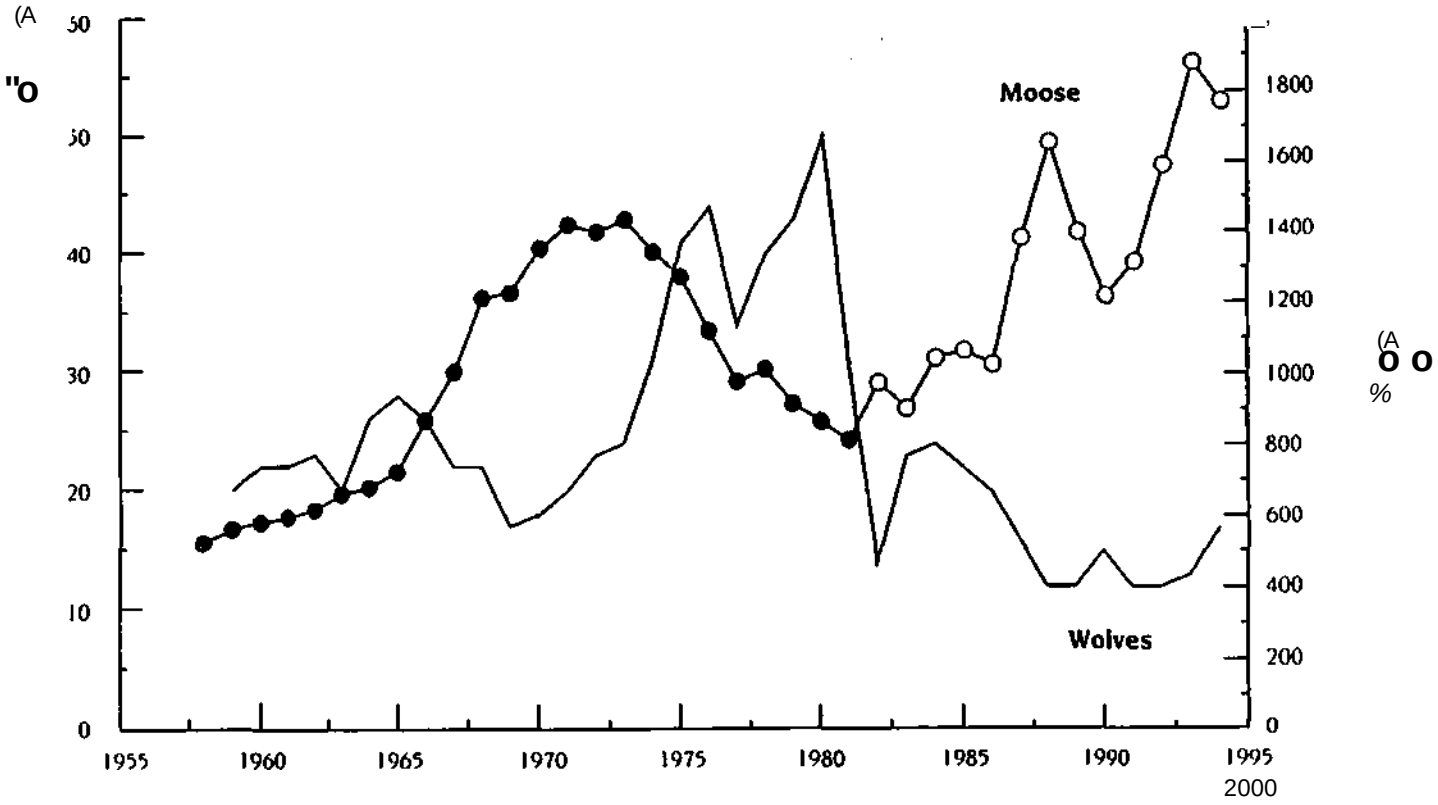


Figure I. Wolf and moose fluauations. Isle Royale National Park, 1959-1994. Moose population estimates during 1959-1981 are based on population reconstruction from recoveries of dead moose, whereas estimates from 1982-1994 are based on aerial surveys.

The Wo/f *Population*

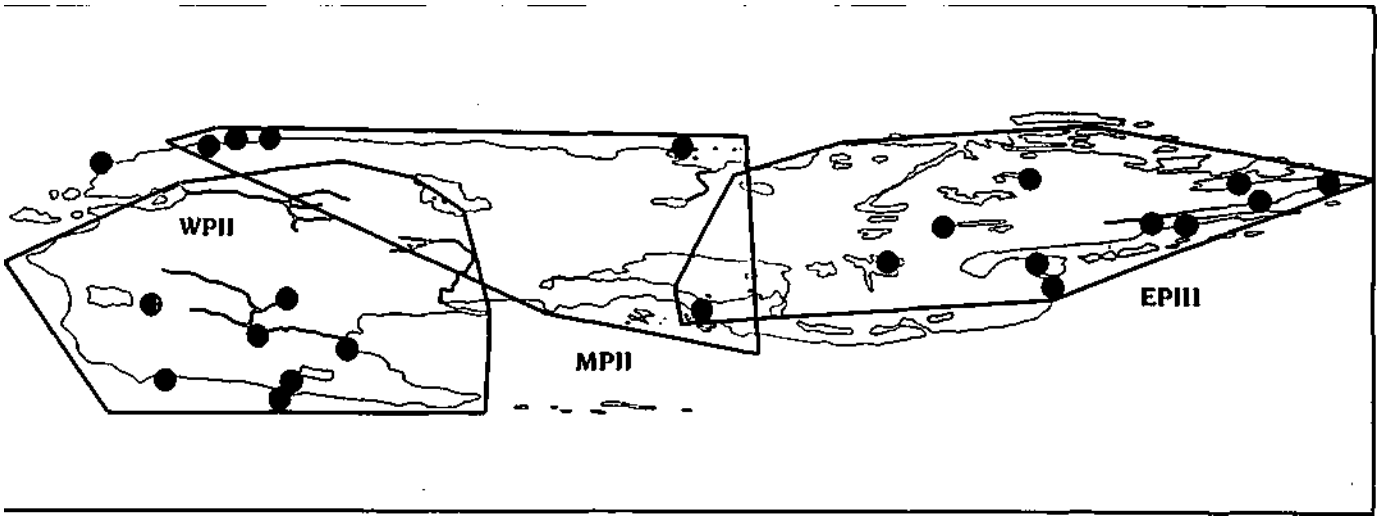


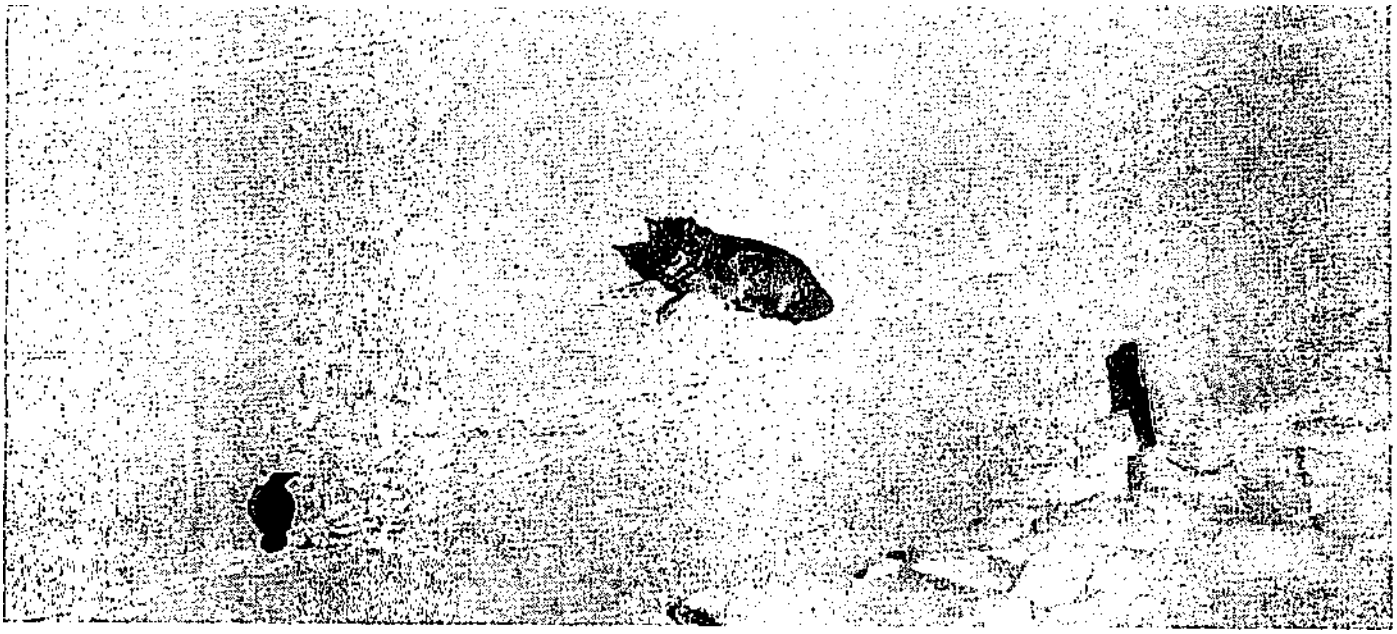
Figure 2. Woll pack territories and moose carcasses during the 1994 winter study West Pack II (WPII) was just an alpha pair, but **the** Middle Pack II (MPII) and East Pack III (EPIII) contained six and nine wolves, respectively

In 1994 the wolf population was organized as follows (Fie. 2):

East Pack 111	9
Middle Pack II	6
West Pack II	2
1994 total	17

Two of the five radiocollared wolves present a year ago (males 420 and 470) died between the 1993 and 1994 studies, and male 550 died in lanuary 1994. Female 450's transmitter expired but she was alive and identifiable. and her mate (male 410) was collared in spring I92.4-?- 'y Only two wolves (males 410 and 430) wore functioning radiocollars early in 1994.

Eleven wolves were radiocollared on Isle Royale in 1988-1993 Five of these were recovered dead, and causes of mortality were determined. One was killed by wolves, two starved to death with extremely worn teeth, one was injured and died weeks later, perhaps after an injury by moose, and one fell through the ice of Lake Superior. The



A ***Middle Pack pup with a full belly evaluates a raven that is recycling wolf scats.***

Figure 3. Woll 420. alpha male of Ihe West Pack, was only a skeleton when recovered in August 1993. Overgrown claws indicated a lingering death. perhaps after injury by a moose.

latter wolf (female 670) disappeared suddenly in February 1991 as she traversed the island and explored unfamiliar areas A hiker found her carcass washed ashore, still hide-covered. in May 1993. after more than two years ol sub-mersion in Lake Superior! No diseases have been implicated in any wolf mortalities, and evidence of canine parvovirus disappeared after 1988.

Only three elderly female wolves were known to exist in 1993, and one of these died in February 1994. Improved reproduction has now reduced the risk of extinction from random loss of one sex. although we know the sex of only four (three males and one female) of the 11 young wolves now alive.

Male 430, at four years of age. dispersed from the East Pack in the spring of 1993 and took up residence within West Pack territory. We were surprised to find him in the company of the West Pack alpha male (420). who was quite sedentary in early summer—we supposed they were near young pups, and we were encouraged by the possibility of reproduction in this group. In luly, however, the alpha male died, and we then learned that his immobility was caused not by doting behavior near pups, but by his impending death (Fig. 3). Male 430. who apparently sensed a future opening for himself, remained in West

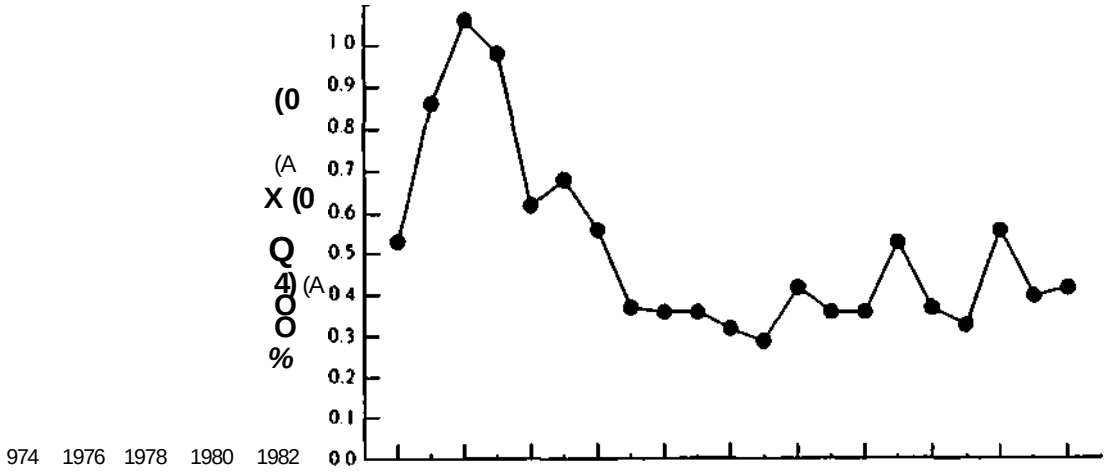
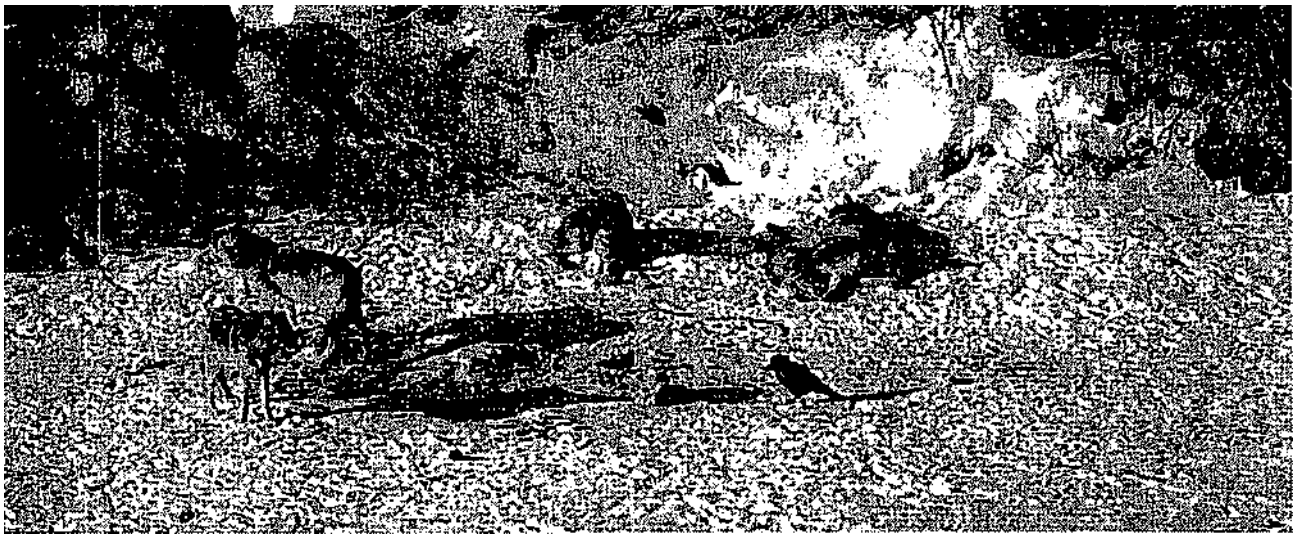


Figure 4. As moose numbers have grown in recent years, moose mortality in winter has been relatively constant



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Middle ***Pack on a moose kill. The alpha male had just died of old age)malnutrition, and the alpha female {left upper) would succumb two weeks later.***

Pack territory and became the alpha male in this pack of two in 1994. He courted the alpha female of long-standing, who appeared to accept this newcomer, and they were one of only two possible breeding pairs in 1994.

In 1994 predation rates changed little from previous years (Fig. 4). Because of extreme cold, remains of wolf-killed moose quickly froze, and full utilization of many carcasses was not accomplished until a late February thaw. In fact, for many weeks the West Pack bypassed an intact carcass of a moose that died accidentally, but with the thaw the wolves returned and ate this moose in its entirety.

In reviewing the dynamics of Isle Royale wolves during the past decade, there is strong circumstantial evidence that canine parvovirus, a virulent disease of dogs that first appeared worldwide in 1977, probably arrived on Isle Royale in 1979-1981. The unusually high mortality in 1981 and 1982. together with the loss of all pups in 1981, could be attributed to the arrival of parvovirus on Isle Royale. High mortality from unknown cause(s) continued until 1988, but then ceased at the same time that parvovirus disappeared from the island (Fig. 5).

In the 1980s the wolf population failed to follow trends in its primary prey, the old-age segment of the moose

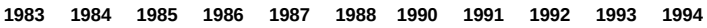

Figure 5. Wolf annual mortality and reproductive success both increased in 1994.

East Pack gathers next to the Merrill Lane dock at sunset to begin traveling. Because \sle Royale is closed to visitors in winters, wolves gain access to the entire island.

population (Fig. 6). They were limited by high mortality until 1988. and thereafter by poor reproduction. After parvovirus disappeared there were no known diseases of concern and food seemed ample for the needs of the wolves, so genetic losses in this isolated, inbred population seemed to be the most reasonable cause of reproductive failure. Of course, the turnaround in reproduction in two of the three packs in 1993 calls into question the genetic hypothesis. Much attention will be focused on this issue in the next few years, when a new generation of wolves will take over pack leadership and reproduction. Improved performance in 1993 increased scientific uncertainty about the cause of recent reproductive failure, but it also helped ensure that there will be another generation of wolves on Isle Royale to help reveal answers.

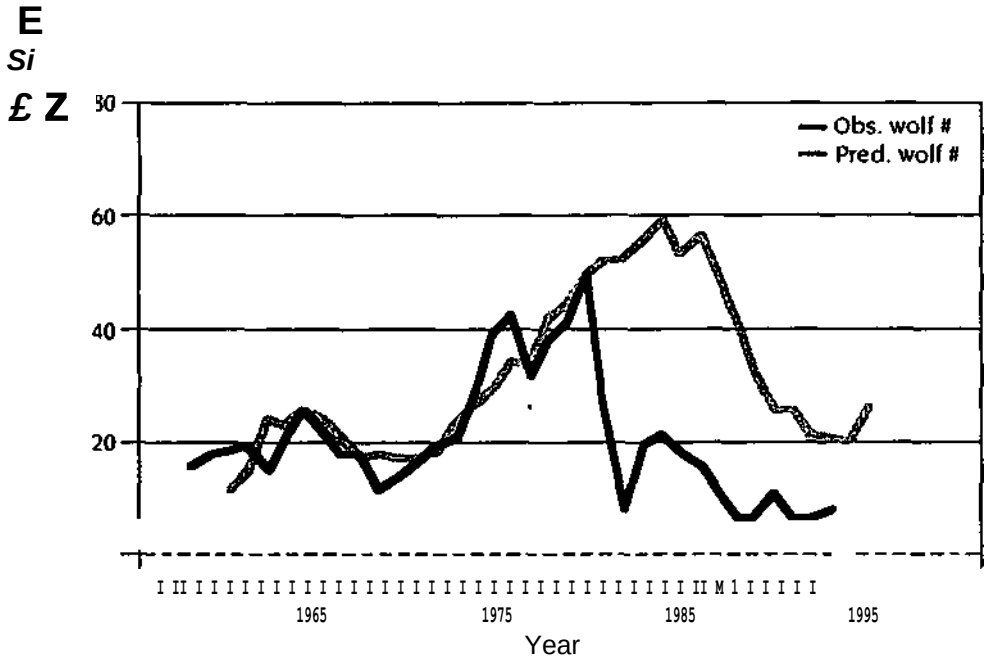

Figure 6. After a decade of unexpectedly low numbers, wolves (lower line) may be starting to catch up with their food supply, moose over 10 years old (upper line).

The Moose Population

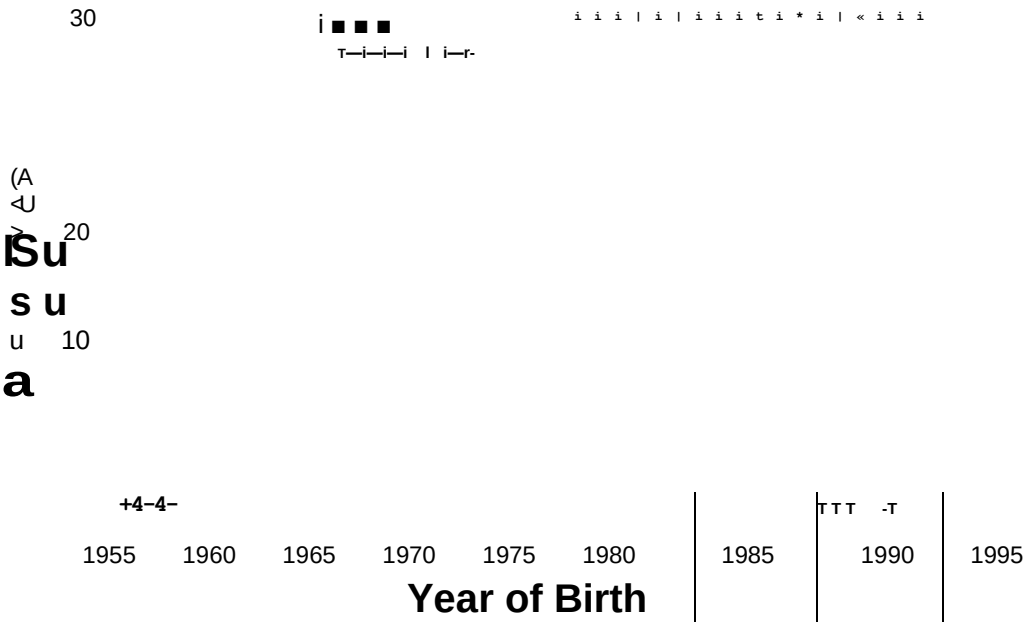

Figure 7. Moose calf abundance (at approximately six months ol age) on Isle Royale. as a proportion of the total population. These are single best estimates, the mean of all available counts for each cohort [summer ground observations and aerial counts in autumn and winter).

In spite of high density and scarce winter lorage. moose calf abundance was slightly above average in 1993. Based on summer ground counts and the winter census, calves comprised 14% of the moose population. slightly above average (Fig. 7). This should more than offset current mortality, allowing the moose population to continue to expand.

An aerial census of the moose population was conducted in February. 1994. by means of intensive counts of small plots totaling 15% of the island area (Fig. 8) On these plots 252 moose were counted, and we estimated 75% of the moose on the plots were seen. The resulting population estimate was 1,770 moose, with a 95% confidence interval of +/- 370. Although this is slightly lower than last year's estimate of 1,880 moose, the drop in estimates is probably due to random error.

Isle Royale moose have been increasing steadily since the early 1980s, except for a brief decline associated with winter ticks in 1989. This upward trend will probably continue until mortality increases from wolf predation. another outbreak of ticks, or a late winter dieoff from malnutrition. Weather patterns might well dictate the short-term outcome.

Even with the reduced wolf population, predation is still the only important cause of death for Isle Royale moose. Of 24 dead moose examined in winter 1994, 17 were killed by wolves, two died of malnutrition, and one died after lodging its foot between two birch trees. In a

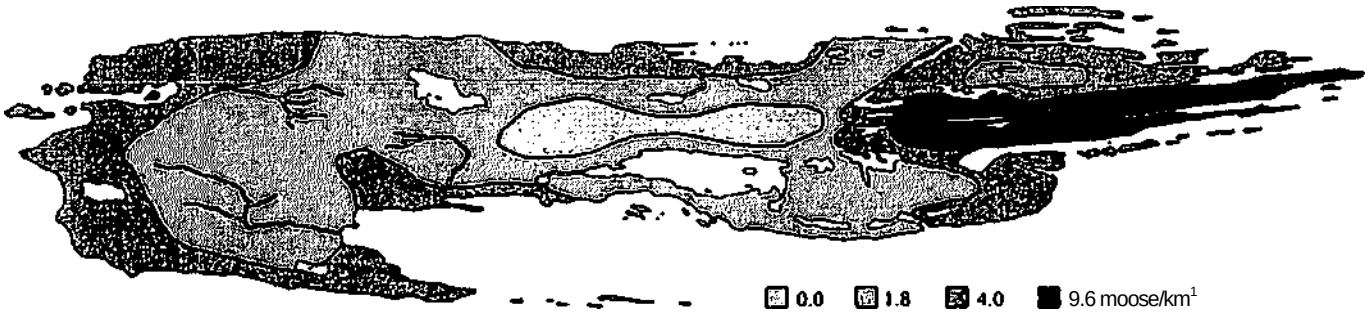

Figure 8. Moose distribution on Isle Royale during the aerial census in February 1994.

Eighleen hundred moose in \sle Royale exerl tremendous pressure on the island's vegetation, especially through winter browsing

FIsure 9. This moose calf fell 20 meters to its death off an icy north shore cliff at Isle Royale. **the** fourth to do so in a 10-day period in February 1994

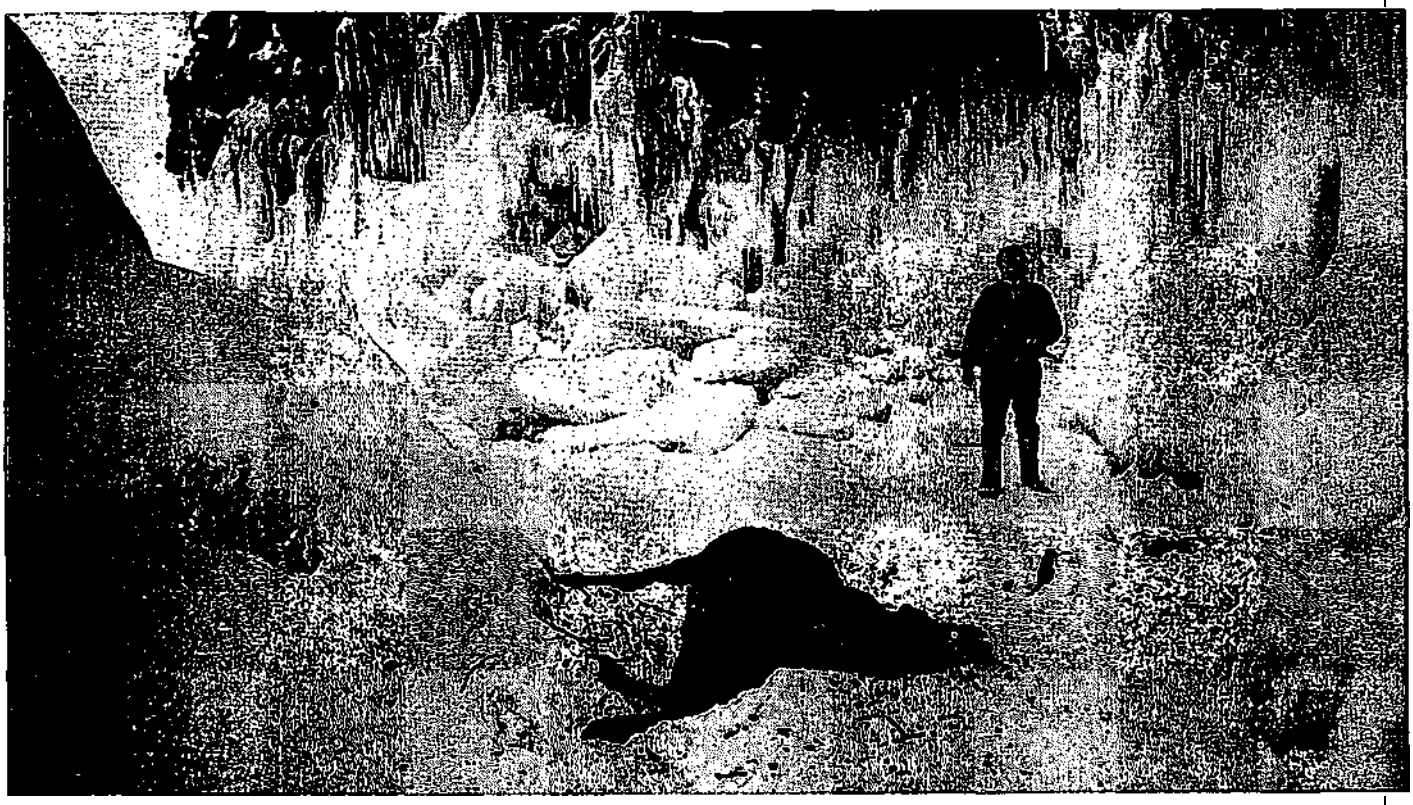

Figure 10. A moose calf survived a fall onto an ice ledge (left), and was marooned for a day (right) before successfully completing its descent to the ice below

single 10-day period, four moose died after they fell off the steep north shore of the island onto the ice of Lake Superior (Fig. 9). We observed two other moose that survived similar accidents (Fig. 10).

Fat content in bone marrow of moose recovered in winter has declined in recent years (Fig. 11), coincident with the rise in the moose population. Likewise, there has been a slow decline in the urea content of moose urine in winter, a reflection of reduced protein intake.

Highest concentrations of moose in winter were found in regenerating fir stands at the eastern end of Isle Royale. in century-old. post-fire forests. Moose habitats at the western end of the island tend to be much older. but concentrations of moose also occurred in the youngest forests there. For example. Beaver Island, near our Windigo base camp at the west end. was cleared a century ago to allow residents to view approaching ships. It now supports thick stands of regenerating fir. and attracted 20-25 moose, or about 40 moose/km^2, throughout the winter study in 1994 (Fig. 12). We collected a cow and calf from the island in February, and their body weights were the lightest recorded at Isle Royale—293 kg for the cow and 136 kg for her calf. Bone marrow fat content was <30% for both moose, indicating that their fat reserves were almost completely depleted.

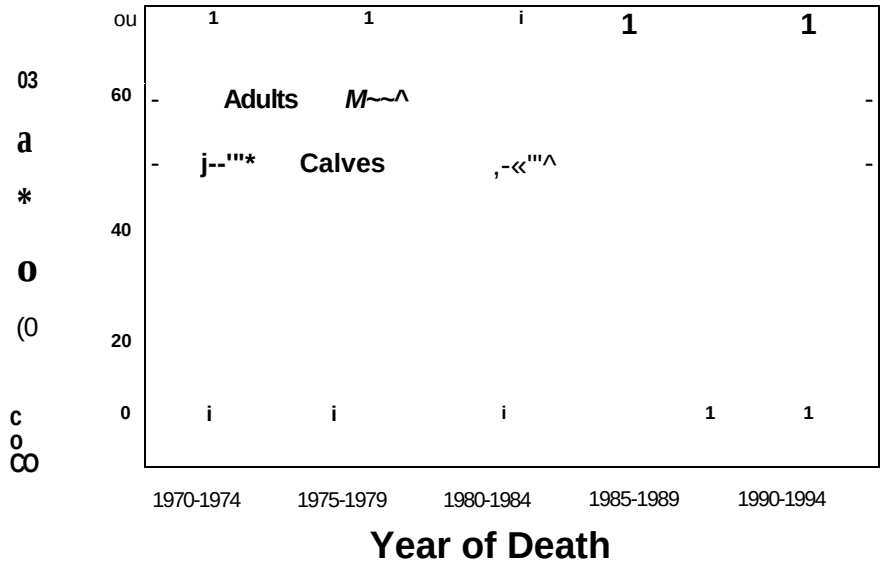

Figure 11. Long-term trends in moose bone marrow lat. Data for calves (which best reflect current conditions) represent mean levels, whereas adult data is the proportion with >70% marrow fat.

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Figure 12. A group ol moose invades a stand of regenerating balsam fir on Beaver Island, where moose density was 40 per square kilometer in February 1994.

Eartnuwlcfi volunleers *tieeraj Tayal and Michael Thomas examine two bulls that died together in the* 1992 *rutting* season.

A Tale of Two Alphas

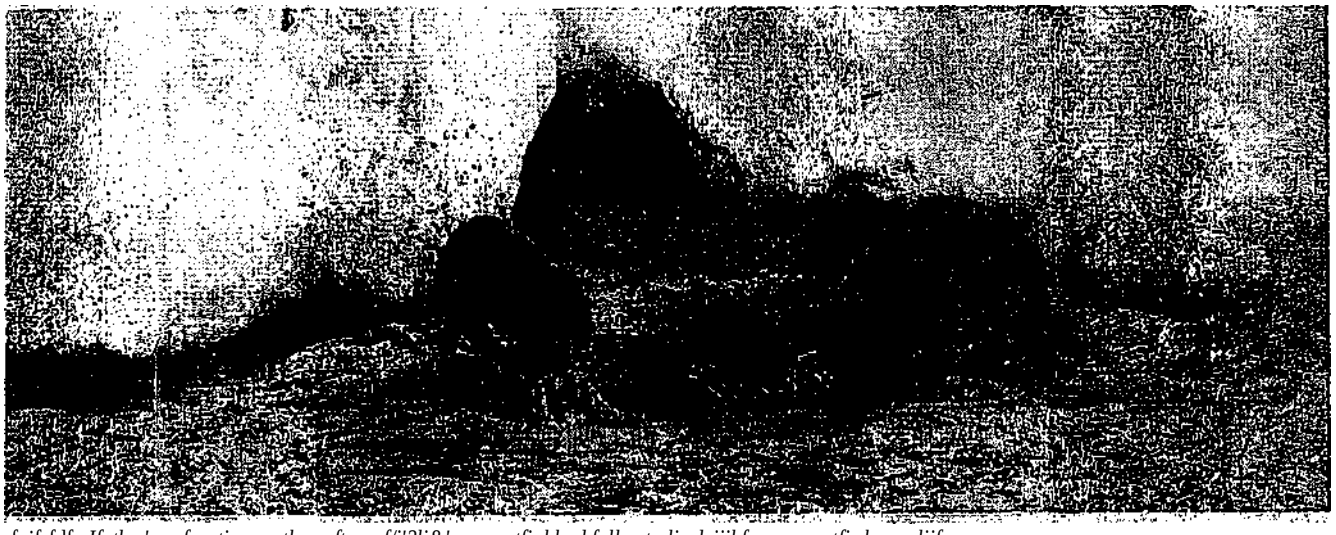
they became kriown'tb us, casually, as the "Old ' Map'; and the "Old Udy\the alpha/jjalr of the Middle Pack.- She was ol$*gray/ng aroundher muzzle" arid. 'sides,; and she, may have had.otrilfifhates earlier in ner life/ When these two wolves paifed off and claimed a territory in the middle of Isle^Royale in 19.90, they^yere the Jbest hope for renewed reproduction Their territory. dominated by mature birch, Had very few moose, and wolf packs had not ddh'e'wejl there since the 1970s, in August 1991 we radiocollared the male (550), but we found no evidence of reproduction that year. In 1992 we diligently monitored his radiosignals in summer, and again failed to locate any pups. . By 1993 there was little hope .that the Middle, Pack would amount to"much, and monitoring efforts'were shifted to the other two packs.-,,S5 it was a genuine surprise to find six wolves, in the .Middle Pack in January 1994, including four new pupsj The alpha male's collar was in mortality mode, however, and we soon recovered his emaciated carcass?,-With severely worn teeth, he had simply run out of energy when the temperature bottomed out at -36°C.""

The male had wandered away from his pack before he died and. after waiting nearby on a kill for 10 days, the female led her four offspring "on an extensive route through their territory, perhaps looking for her mate. Eighty kilometers later, the troupe .ended up back on their kill, without ever finding the' male (by then in our freezer). We wondered about the new burden on the female, having to kill moose without much assistance. As luck would have it. she led the pack outside their territory and found a moose that had fallen to its death off a north shore cliff, and ft was here that we last observed the female alive,"on February 7, 1994. We searched her territory in vain for a week without finding a trace of her/; / • • -*• .'.-.'"

For.three weeks th'e fpur" pups relaxed togetherjorv the"nbrth_ shore,, eafcmg^se^ ' mocSeiithat' fell'qff'thj-^rth; shore cliffs. "'Tfiejj..fn.a'de one qujck foray backrfnfe Middle Pack range and then-returned to finish off jthe,.carcasses"along the shore. .

On our last fligtit~qf- the.winter study, we found'a fresh fo$ track alqng-the .shore almost 20 km frorxhthe pups:! Welanded and/followed the fox tracks Qnsh.bre. and we were stunned,!to. find the old female.dead, sprawled on her chest beneath a spruce tree. Shefiad continued to travel as long as she could and, like her mate, was emaciated with heavily-worn teeth. On their qlhe-trip "home", the pups had come within a few metfefe,bf-their deackmother, and they probably knew she'wasgbne.' ' '• .-'.'

This- is not the way, wolf societies usually work, as alpha wolves tend to feed themselves first and should outlastiother pack members, even their own offspring. This,, alpha pair had been chronically undernourished for. months, judging'7r6m weight-lbssrand coincidehtly-ea'ch'neared its end-point after they successfully raised theirfifst litter of pups. The male, with an enlarged heart and a bruised liver, may have been pushed beyond the point of,survival by record-low temperatures/ And the female, gone ,a month later—what finally, triggered, her" death?. Coincidence,' perhaps.- but could it have been tfie.death of her spouse? Ernest T Seton, in 1894. caught a male wolf in New Mexico that had returned to where his mate had been killed a few days earlier. Seton chained the male overnight, but the wolf, with-no apparent injury, was dead the following morning.:. Seton thought distress over the death of his mate^triggered the male's own death. Such effects are well-documented in our own species.



fyifrfdfe *Ifatk p'ups feasting on the caftasspf/i'?li&' moose tfial had fallen to lis deiiihfrom.a.nortfi shore clijf*$

Other midlife

Red fox and snowshoe hare abundance (Figs. 13 and 14) were both low in 1994. after an eruption of hares in the late 1980s. Without many hares to support them, foxes have had to rely on scavenging the rather small number of wolf-killed moose available.

River otters have staged a remarkable recovery at Isle Royale in the last decade (Fig. 15). Populations of lake herring recovered dramatically in the early 1990s, and this fish may be an important food source for otters.

Bald eagles and ospreys are slowly increasing at Isle Royale after disappearing completely in the 1960s. In 1993 the National Park Service recorded 5 active eagle nests, probably fledging 8 young, along with 2 successful osprey nests. With little open water in winter 1994, eagles were seen only twice during the winter study.

Marten were reportedly extirpated from Isle Royale

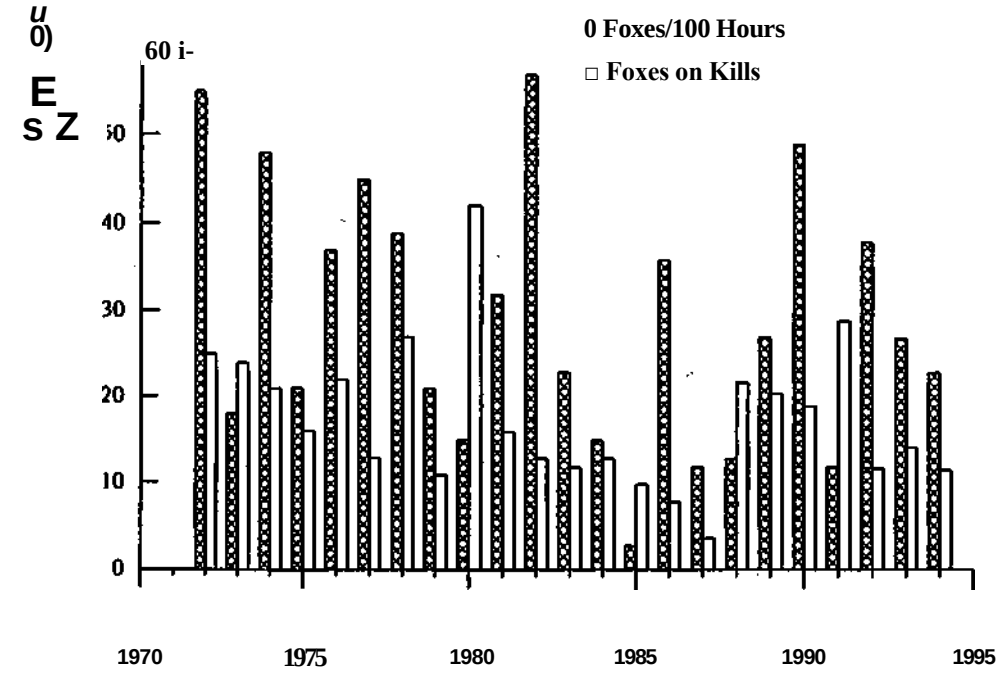
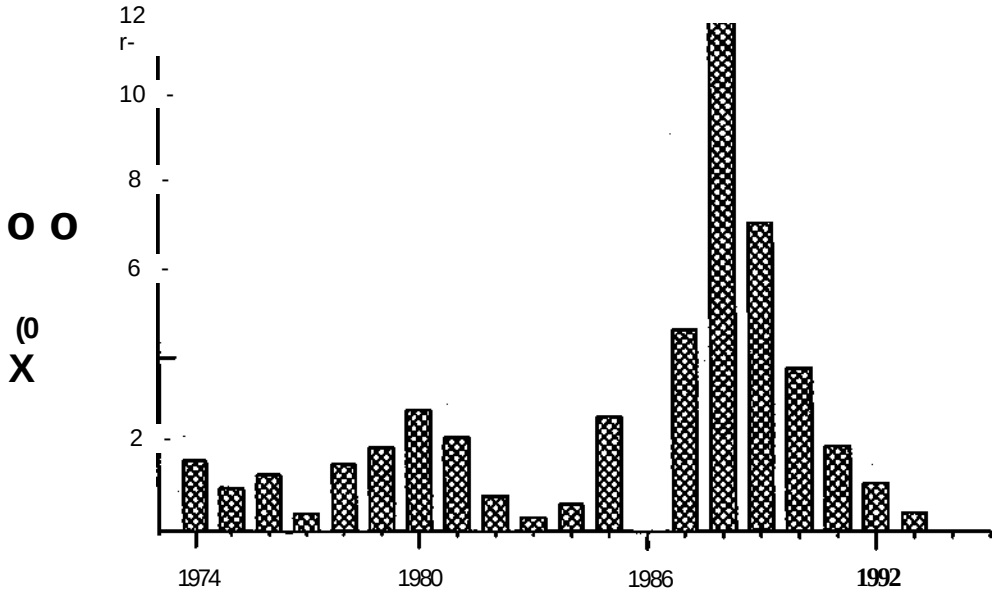


Figure 13. Relative abundance of red foxes from aircraft observations. 1972-1994. Hatched bar is the number of foxes seen away from moose carcasses/100 hours, while the open bar is the maximum number of foxes seen on carcasses.



Fteure 14. Snowshoe hares on Isle Royale have declined to very low levels after a population irruption in the late 1980s. Index is the number seen per 100 km hiked in summer.

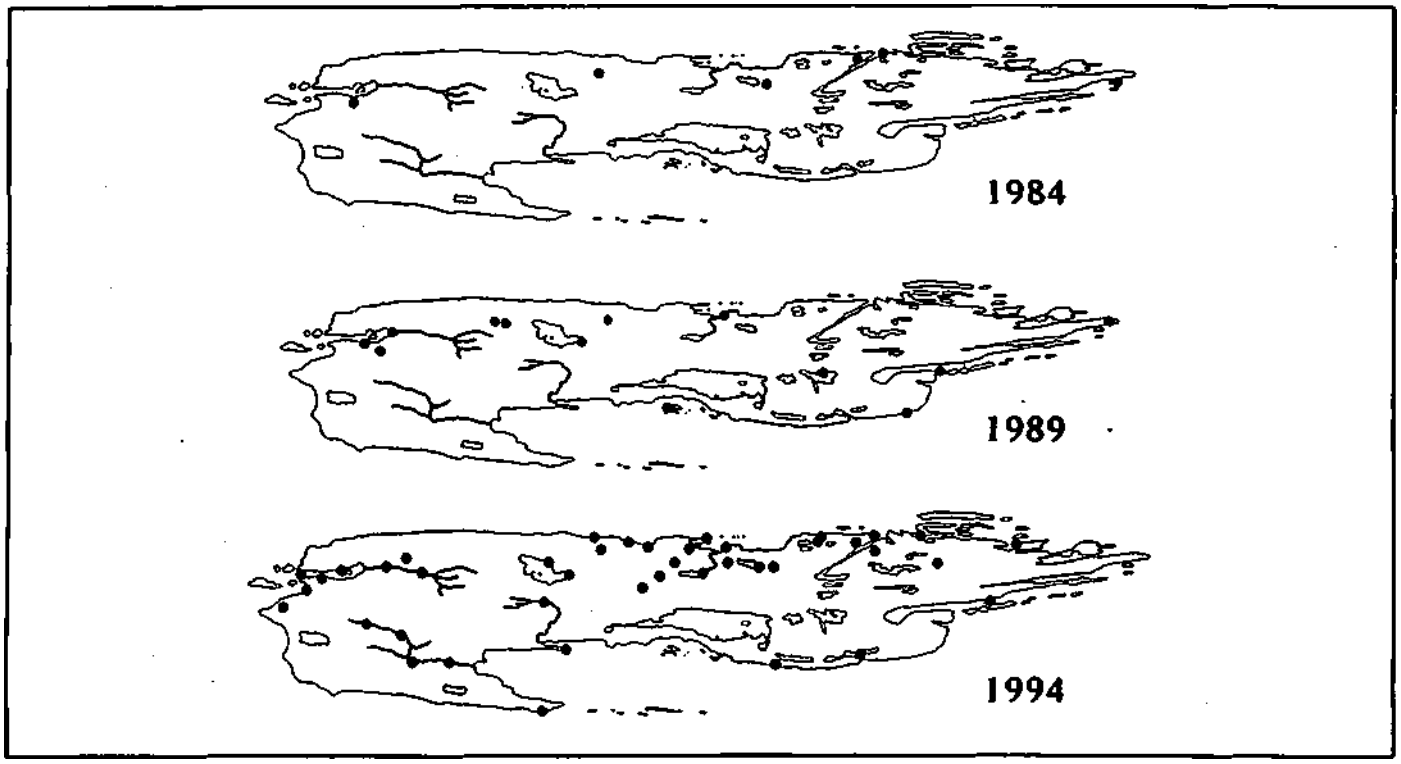


Figure 15. Otter sign (tracks and slides) in winter has increased dramatically in the past decade.

early in the 20th century, as in most of the Midwest U.S. Marten-like tracks were observed near Windigo in winter, 1991 and 1992, and a photo of a suspected marten was taken by a visitor in 1993 (Fig. 16).

Figure 16. Park visitor Thomas E. Rogers (Sheboygan. WI) snapped this photo of a suspected marten near Little Todd Harbor in summer 1994. If they persist, another mammal species will be added to the Isle Royale fauna (and thanks to Stanley Johns, President o(the Upper Peninsula Trappers Association. Baraga. Mi, for an expert opinion on this animal).

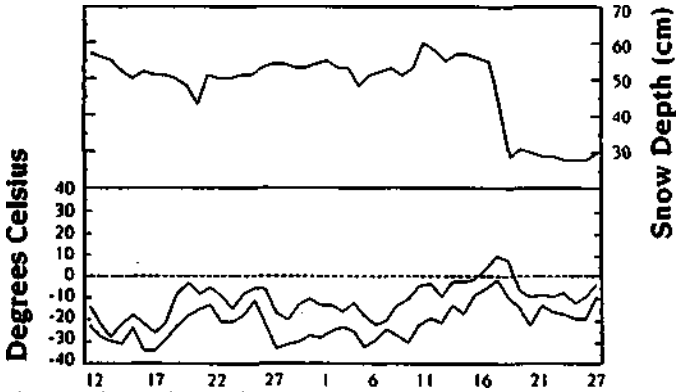
Weather, Snow and Ice Conditions

Record-low temperatures dominated the winter study period, with daily minima < -20°C for all but 6 days during the first month of the winter study (Fig. 17). By the end of lanuary a firm ice bridge extended from Isle Royale to mainland Ontario, and all of Lake Superior was frozen for a brief period, on February 9-10. The ice bridge to the mainland lasted throughout February, and was probably intact for about a week after our departure on March I. No wolf movements over the ice were detected.

The weather was very dry during the 1994 winter study. and average snow depths were maintained only because of unusually cold weather (Fig. 18). A major thaw occurred in late February, exposing much bare ground. Lack of snow will probably alleviate the scarcity of browse for moose in late winter.

lanuary **February**

Figure 17. Snow depth (top) and temperature extremes during the 1994 winter study on Isle Royale.



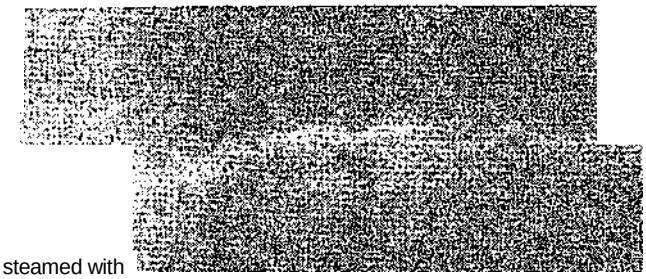


Figure 18. With the temperature at -30°C at mid-day. Lake Superior steamed with "lake effect" cloud

For *the first time in* 35 *years, skis were removed and the research plane was mounted on wheels after a sudden thaw in late February* 1994.

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' Scattered through, die history of Isle Royale wolv.es. area fe^individuals.'df extraordinary importahce,.*wfiq; Have ,sh'ape"d. the course bf'the'population.': Thei'r'jndir' vidual Jives include; complex-relationships with' otfi'er wolves; inside and\outside -their packs. Recently, - because;so'me .of the,wolves have beeniiye-trapped and genetically.fingerprinted;-wethavejearried;[1] that'- family relationships were not always what'tfiey" seemed. .< . -;' . . -;

- When female-450 was radiocollared in 1988 sh&had • never reproduced, "even though she was -middle-aged! ■ and she was loosely "associated with two other wolves. This group made a living, but they had no exclusive territory-and they gave littlehint of future success;- In ; 1989 female 450 left.this little group forever;_an"d' moved into the East Pack.' which comprised an alpjia male and female and their offspring. Female 450, soon stole the pups, became alpha female, and mated, with . the alpha male the next year; The real-mother was^no longer tolerated near the pack, but she often followed the group, watching them from a safe distance. Although the unchallenged leader of the East Pack, female 450 did not have pups of her own until *I99l ; and her eight pups in 1991-1993 helped stay the threat of wolf extinction.

As all'alpha wolves of long tenure must be. female 450 is an exceptional hunter. In January. 1994, with the temperature hovering at -32°C. we watched the pack surprise a bedded bull moose in early evening. The bull was suddenly beset by wolves on his rump, his back, and even his nose. In a. frenzy the bull shook off all the wolves and bolted. Undaunted, female 450 gave chase and regained her hold on a rear leg. Singlehandedly she stopped .the moose's flight while the alpha-male with seeimng" indifference' stood'and watched his mate's heroic-struggle: Meanwhile, the pups were engrossed in a game of tag .just out of harm's,way. Weiin':the research plane-seemed to be the.only ones interested, in this impressive contest between the tough"oTd* mbbse>and.the determined old. wolf.- Forty minutes later darkness forced us to leave the scene", but the next day we found the wolves a mile, away.< on another kill, while the wounded. moose was still standing. Female 450's efforts were,- finally rewarded' three days later, when the wolves - returned to claim their victim.

< On average,.female 450 brought down a.moose once" every four days in 1994, usually with some help from-' the alpha male. In one unusual case the male held o.n to a cow moose while the female caught her,calf. The male was quickly shaken off. and trie cow abandoned hel-calf to save herself.

. One afternoon we found female 450 bedded on a ridge, her head and chest drenched in bright red blood, and-we thought ,she had finally met her match. An antlered bull moose stood nearby, wounded yet" still aggressive. Unable to tell whether the blood on 450 was the moose's or her own, we watched as pack members crowded around her, licking her thoroughly.- Minutes later she sought solitude to curl up and sleep. • She moved slowly and deliberately, as if measuring the cost of each step. Perhaps a dozen years old, she had probably killed hundreds of moose, and- she knew when to persist andwhen to rest. The next day we found the moose, half-eaten, and the engorged wolves, including 450. sleeping soundly.

The *East Pack jemale works alone to bring down a moose calf*