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Ecological Studies of Wolves on Isle Royale, 2004-2005

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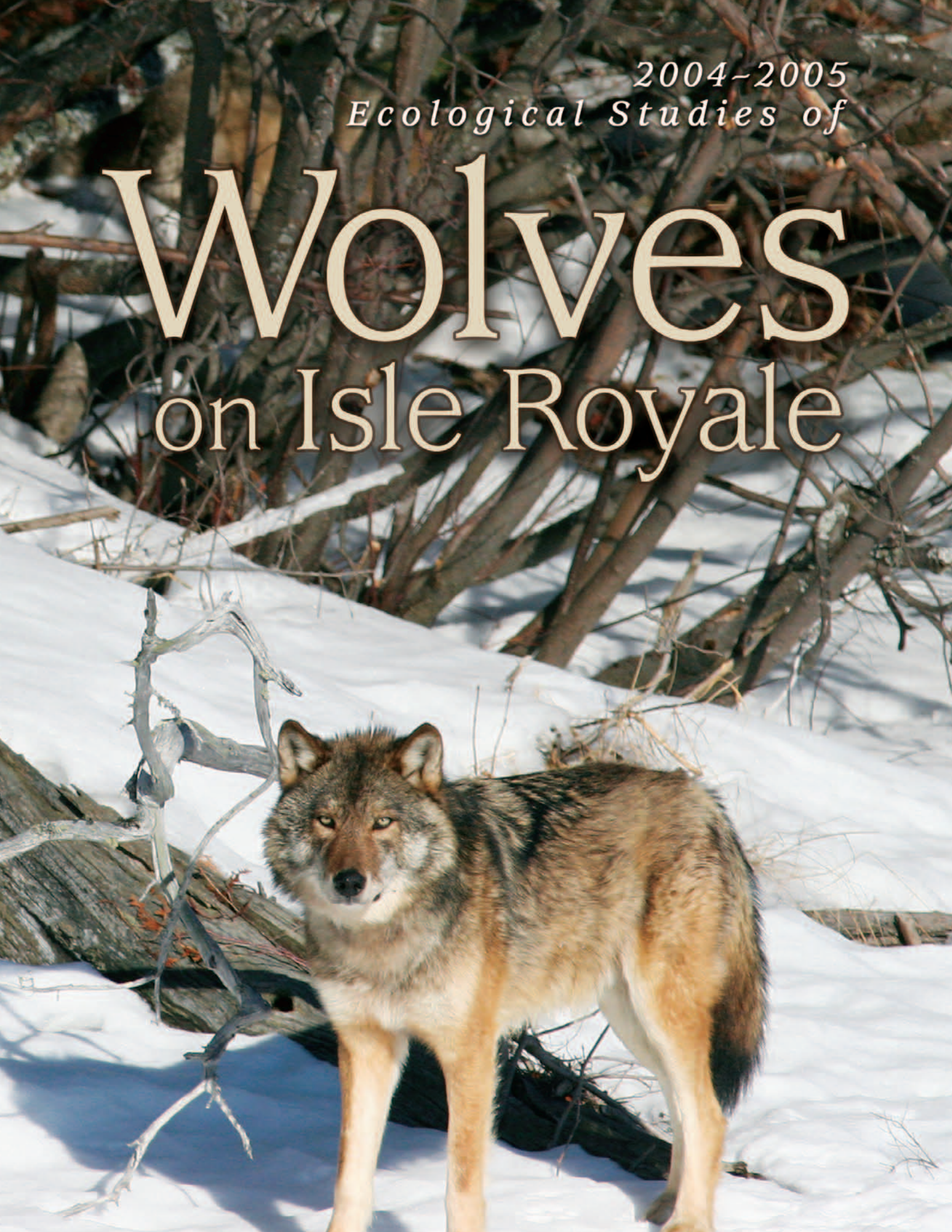
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Dedicated to the memory of
Robert M. Linn,
1926-2004

"One of the oldest dreams of mankind is to find a dignity
that might include all living things.
And one of the greatest of human longings must be
to bring such dignity to one's own dreams,
for each to find his or her own life exemplary in some way.
The struggle to do this is a struggle because an adult sensibility
must find some way to include all the dark threads of life.
A way to do this is to pay attention to what occurs
in a land not touched by human schemes,
where an original order prevails."

— Barry Lopez, Arctic Dreams

Ecological Studies of Wolves on Isle Royale

Annual Report 2004-2005*

by
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and
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Team 4B: Mike Dundas, Matthew Ludwig, Rebecca Pollack, Aly Raw, and leader Liz Clement.

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Results reported here are preliminary and, in some cases, represent findings of collaborators; please do not cite without consulting the authors.

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Ecological Studies of Wolves on Isle Royale

"We're not just afraid of predators, we're transfixed by them, prone to weave stories and fables and chatter endlessly about them, because fascination creates preparedness, and preparedness, survival. In a deeply tribal sense, we love our monstors." —*E.O. Wilson (2002)*

Personnel and Logistics

In summer 2004, Rolf Peterson and John Vucetich directed ground-based field work, aided by Elizabeth Clement, George Desort, Emily Grosvenor, Tim Pacey, Carolyn Peterson, Jeff Plakke, Leah Vucetich, and John Weisel. Fieldwork continued from early May through August. In 2005 the annual winter study extended from January 11 to March 1. Peterson, John Vucetich, and pilot Don E. Glaser participated in the entire study, assisted in the field by Joseph Bump, George Desort, Leah Vucetich, and the following personnel from Isle Royale National Park: Beth Campbell, Chris Lawler, Steve Martin, Marshall Plumer, and Mark C. Romanski. During the winter study, U.S. Forest Service pilots Wayne Erickson, Dean Lee, and Pat Lowe flew several supply flights to Isle Royale from Minnesota.

Summary

During 2005, there were thirty wolves on Isle Royale, up one from 2004, and moose, estimated to number 540, continued to decline for the third straight year (fig. 1). There are now only eighteen moose alive for each wolf, a ratio seen only twice before at Isle Royale. Three territorial wolf packs raised a total of eleven pups, offsetting a high mortality rate of 34 percent in the past year. Wolves preyed heavily on moose, but they exhibited no territorial trespassing that might indicate food shortage. Moose calves were relatively numerous in 2004, but few remained alive in winter 2005. The effect of moose ticks continued to increase, and this parasite may be an important factor in the moose decline. Winter severity in the past two years and chronic food shortage in winter have also impacted the moose population. However, wolf predation is presently the major direct cause of moose mortality and should hold moose at a low level over the next year.

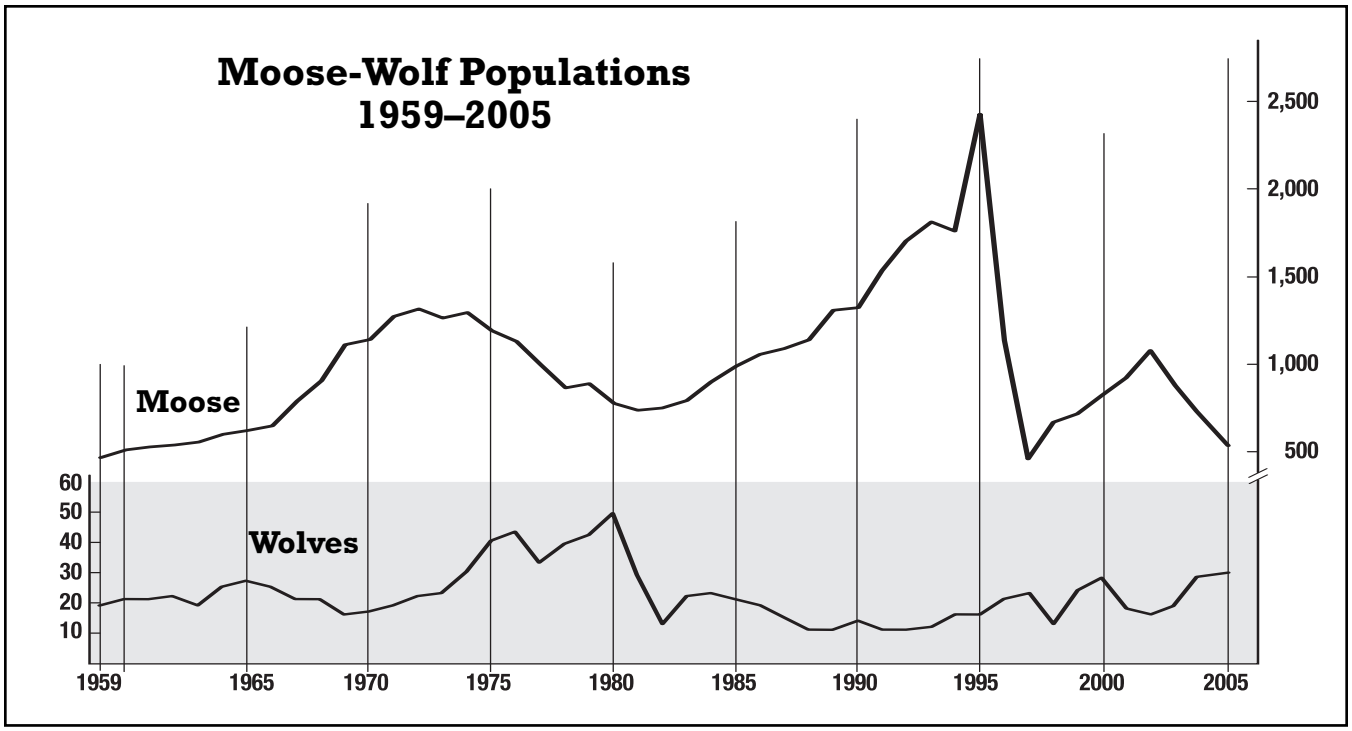

Figure 1. Wolf and moose fluctuations, Isle Royale National Park, 1959-2005. Moose population estimates during 1959-1993 were based on population reconstruction from recoveries of dead moose, whereas estimates from 1994-2005 were based on aerial surveys.

The Wolf Population

During the 2005 winter study, the wolf population contained thirty individuals, up one from the previous year (fig. 2). This is the highest wolf population since the outbreak of canine parvovirus in 1981 and suggests that the previous year's surge in numbers from nineteen to twenty-nine was not an anomaly. The social organization of the wolf population changed little from last year:

East Pack III 9
Middle Pack II 11
Chippewa Harbor Pack.....7
Singles 3
Total 2005 30

Two radio-collared wolves continued to provide data: male 670 (alpha male in East Pack, collared in 2001) and female 410 (alpha female in Chippewa Harbor Pack, collared in 2003). Alpha female 1071 from the Middle Pack, collared in 2001, is still alive and recognized by her radio-collar, but the radio has failed. Two-year-old female 1060 apparently died just prior to the 2005 winter study, but her collar continued to transmit from its position under about ten meters of water in Siskiwit Bay. We hope to recover her carcass with the help of NPS divers in spring 2005.

In 2005 four of the six breeding individuals in the wolf population were identified by radio-collar or appearance (fig. 3) as the same breeders as in 2004. All three of the breeding pairs have successfully produced large litters of surviving wolf pups, critical to maintaining the high

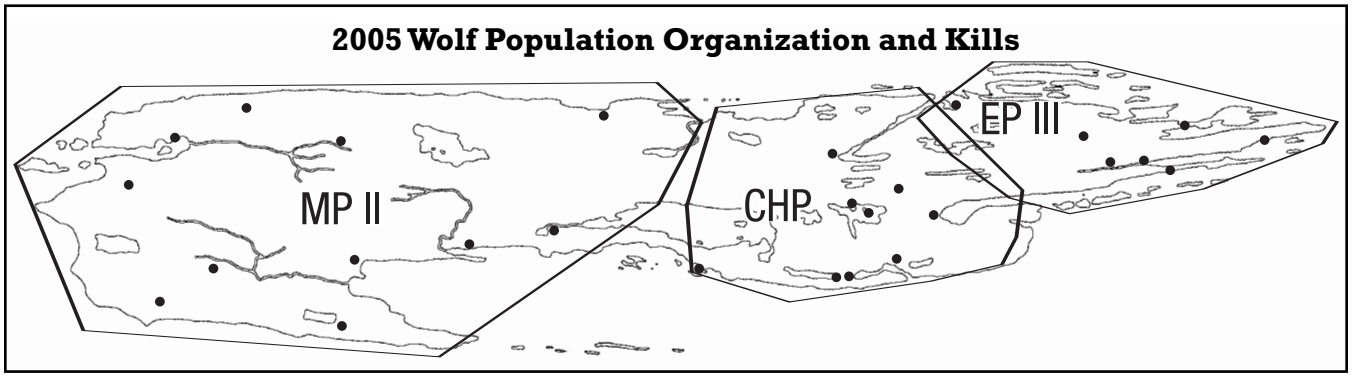

Figure 2. Wolf pack movements and moose carcasses (all fresh wolf-kills but one) during the winter study in 2005. Scent-marking by all three of the packs was observed.

population in 2005. Mating was observed in all three territorial packs during 22-24 February (figs. 4 and 5).

Annual mortality (34 percent) during 2004-2005 was above average (fig. 6), but the causes of this mortality were unknown because no dead wolves were recovered. It is noteworthy that the breeding wolves in all three packs appear to be surviving very successfully in recent years, and the packs have been very stable in maximum size and territory.

Pack-splitting was common in winter 2005, making a total count difficult (fig. 7). The final count of thirty was finally attained on 23 February, when nine wolves were traveling as singles or in groups that were temporarily as large as three wolves. On that day the East Pack (fig. 8) aggressively repelled a foreign group of three wolves, and three days later the alpha pair in the East Pack was still following tracks of alien wolves.

Wolves dealt with a wide variety of snow conditions during the 2005 winter study. In January, the snow was very deep and soft, and wolf travel was largely single file and limited to shorelines. A week of thawing

Figure 3. The alpha male in the Middle Pack is getting whiter as he ages, and he can readily be distinguished from his packmates. Here he enforces the "rules of the pack" by threatening a subordinant male.

Figure 4. The contortions of mating wolves were shown in the East Pack on February 22. Breeding wolves may remain tied for a half hour, although most copulations are shorter.

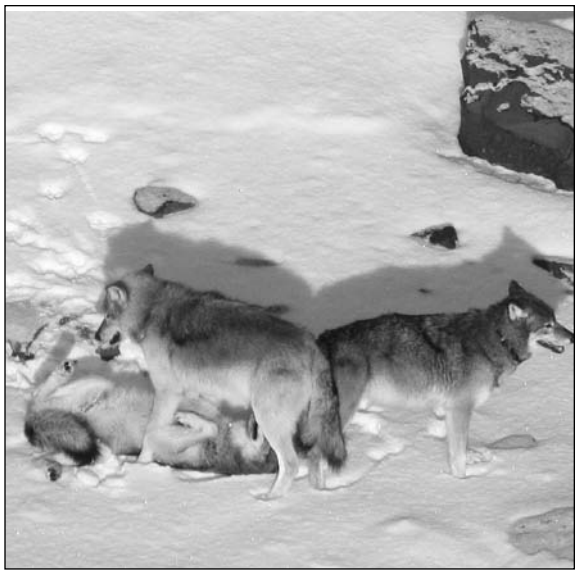

Figure 5. Mating is often interesting and sometimes exciting for non-participating wolves (left). The aspirations of subordinant wolves, however, are usually quickly squelched by the dominant pair. Here the alpha male in the Middle Pack, still tied, punishes a male onlooker on February 24 (right).

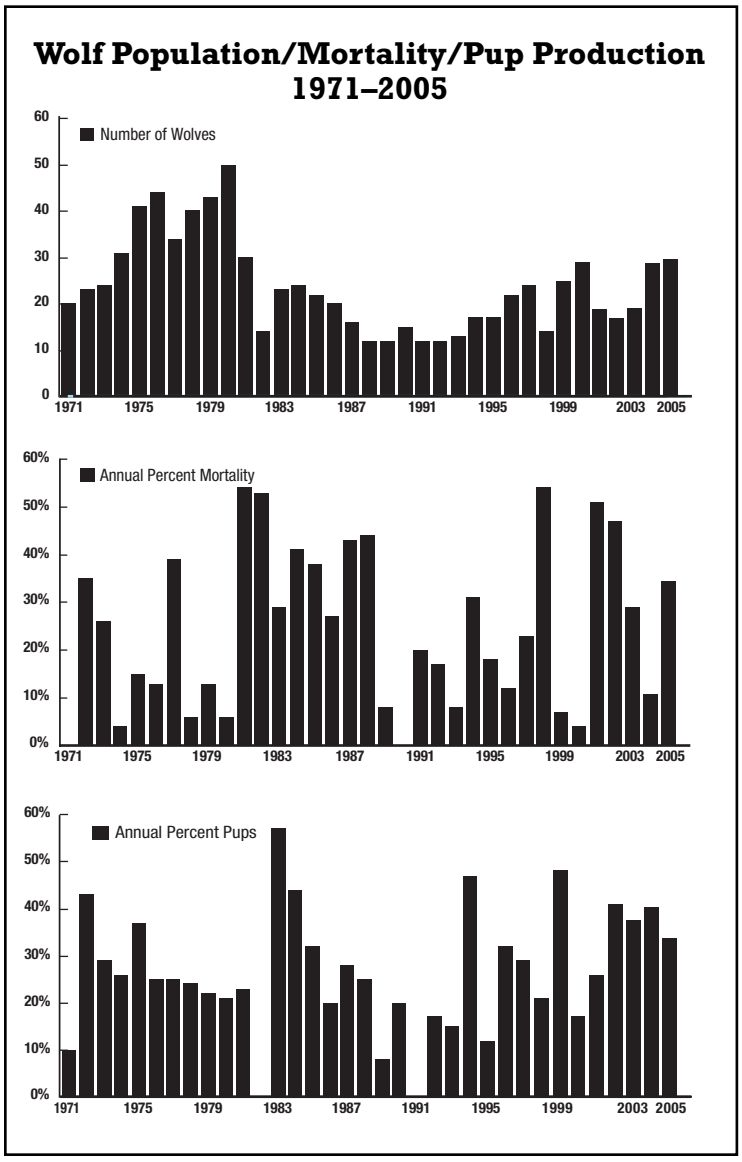

Figure 6. Wolf population size (top) is explained by patterns of mortality (middle) and reproduction (bottom).

temperatures in early February was followed by more normal, below-freezing temperatures, resulting in a surface crust that easily supported wolves but not moose. This allowed widespread travel throughout the island interior during the breeding season and probably favored wolves over moose.

Predation rates for the three packs in 2005 ranged from 2.2 to 2.9 moose per 100 days per wolf, slightly above the long-term average of

Figure 7. Wolves that disperse out of their home territory are always at risk. Here an injured wolf rests several hundred meters from the Chippewa Harbor Pack. The identity of this wolf will hopefully be revealed through DNA analysis of blood from its bed.

Figure 8. The East Pack (left) seemed more secure in 2005, perhaps because they finally outnumbered the neighboring pack. In late February, the breeding pair was actively courting (right) as they made scent-marking rounds of their territory, amounting to only 20 square miles.

about 2 per 100 days. Kills were generally well-used, providing scavengers with the barest of pickings (fig. 9). The present island-wide ratio of eighteen moose per wolf is very low, matched only in 1980 (when the wolf population hit a record fifty individuals) and in 1996 (when moose reached a historic high of over two thousand). The wolf-moose system has not persisted at this level for long in the past, but in the past three years wolves have prospered and increased as the moose-to-wolf ratio has dropped rapidly (Table 1).

Table 1. Wolf Pack Territory Characteristics, 2003–2005

Pack	Percent of island	Percent of moose	Three-year change in moose/wolf ratio
Middle	62	53	67 to 24
Chippewa Harbor	25	27	45 to 20
East	10	20	54 to 12

The genetic characteristics of the wolf population are now being routinely monitored by analysis of fecal DNA, collected during both summer and winter (fig. 10). This work, by Leah Vucetich at MTU, was initiated by Robert Wayne and John Pollinger at UCLA, who have been instrumental in applying the latest techniques in molecular genetics to wolf population analysis. DNA analysis will allow us to double-check our population estimates, follow apparent genetic "decay" in this isolated population, and determine age and survival for all individuals in the population.

Jannike Raikkonen, at the Stockholm Museum of Natural History, recently examined all bones of wolves collected

Figure 9. Gray jays compete with ravens and foxes for parts of kills left behind by wolves.

Figure 10. Silvery checkerspot butterflies were common visitors to fresh wolf scats in June, 2004, where they probably extracted scarce sodium.

at Isle Royale since the early 1960s. Her studies of wolf vertebrae, in particular, were prompted by anomalies documented in inbred Scandinavian wolves during their recent reestablishment. She found similar bone abnormalities in Isle Royale wolves, including extra vertebrae and asymmetrical shape (fig. 11). In spite of severe inbreeding and documented congenital abnormalities, the wolf population on Isle Royale continues to reproduce at normal levels. Furthermore, breeding wolves, at least, survive to old age. The continued success of this small, isolated population is presently one of our most interesting and important scientific issues. It has been impossible to accurately predict year-to-year developments in this protected population, and the wolves themselves are clearly defining what is possible.

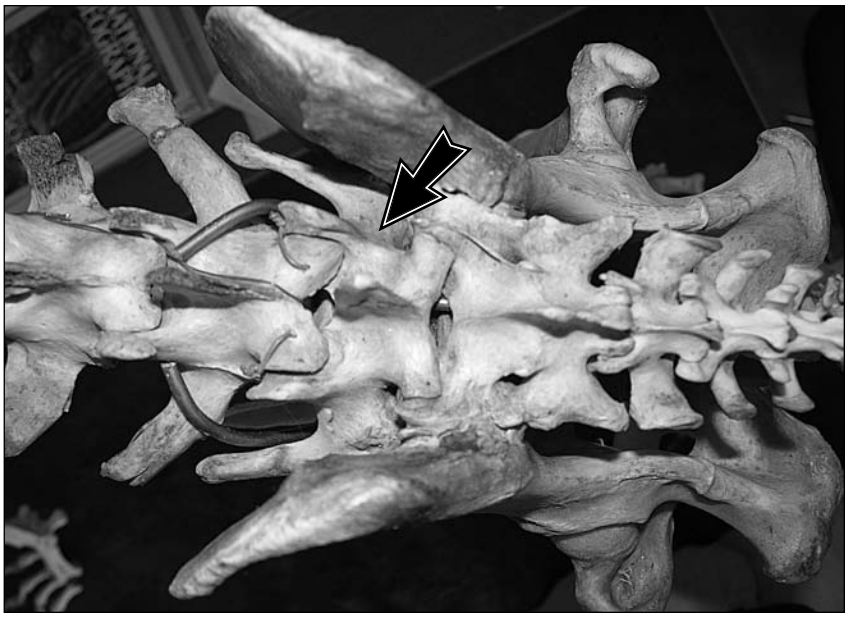

Figure 11. Recent studies have revealed abnormalities in the vertebral column of Isle Royale wolves, including various kinds of asymmetry as well as extra vertebrae (arrow).

The Moose Population

During February 2005, the moose population was estimated at about 540 animals (+/- 90 percent confidence interval of 400-700), or 1.0 moose/km2 (fig. 12), a decline to about half the level of three years ago. The 112 moose counted on ninety-one census plots comprised 8 percent calves (fig. 13), a relatively low level that is consistent with the past three years of population decline. Only one set of twin calves was observed during the 2005 winter study.

While wolves have clearly taken advantage of high moose vulnerability, it is not so obvious what factors are responsible for the moose decline. Probably several phenomena have brought the moose population down to a historic low level. It is likely that moose age structure (the most important predictor of wolf density at Isle Royale in the past) has led to the wolf increase. Current prey are predominantly old moose, over ten years old, born in the early 1990s. Relatively few of these moose perished in the massive dieoff in 1996, when they were young adults, but they are now reaching senescence.

Another important factor in the moose decline may be an increasing presence of winter ticks, an important parasite of moose that removes blood from moose in late winter. At that time, moose are clearly challenged by lack of food and deep snow. We currently map hair loss patterns for moose that we observe in spring, and these surveys reveal the serious nature of tick infestation for moose on Isle Royale (fig. 14). In 2004 average hair loss for moose was 68 percent. It has been well-documented that a high load of winter ticks on moose leads to anemia and reduced feeding and may result in direct mortality (see W. Samuel. 2004. *White as a ghost*. Federation of Alberta Naturalists—available from Isle Royale Natural History Association at www.irnha.org). Wolves searching

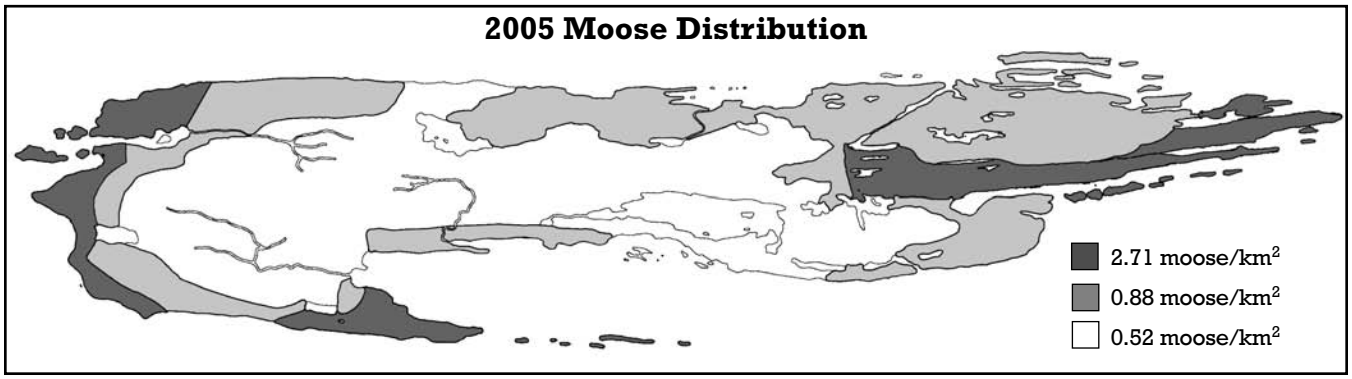

Figure 12. Moose distribution on Isle Royale was highly stratified in winter 2005 because snow was deep. Four strata were delineated based on habitat types and results of the aerial counts on 91 plots shown here.

for vulnerable moose can probably readily detect and kill moose weakened by winter ticks. Summer weather in 2004 was relatively wet and cold, favorable for moose, in contrast to many recent years of above-average temperature that were associated with an increasing tick population.

Carcasses of twenty-seven dead moose were discovered during aerial surveys in the 2005 winter study, and all but five were inspected on the ground (fig. 15). One of these moose appeared to have starved to death, and the rest were killed by wolves (fig. 16). Adult moose predominated among wolf-kills, probably because calves were already scarce. Most of the moose killed by wolves were old animals that had survived the devastating 1996 die-off. Marrow fat levels in both adults and calves were generally low, comparable to the previous year but lower than most recent years when winters were less severe (fig. 17).

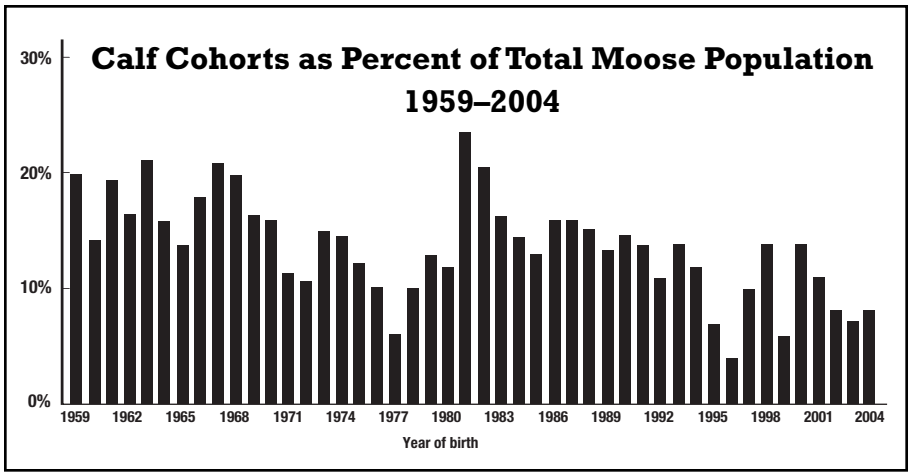

Figure 13. Moose calf abundance (at approximately six months of age) on Isle Royale, as a proportion of the total population. These are best estimates, a weighted mean of aerial counts in fall and/or winter.

Snow accumulated rapidly in December, and during the 2005 winter study snow depth was 60–80 cm, enough to seriously restrict movement, make calves highly vulnerable to wolves, and restrict moose to conifer cover. The previous winter was similarly challenging for moose on Isle Royale. Winter forage is extremely limited, and feeding movements become energetically expensive in deep snow. After a hard snow crust formed on 7 February, moose were rarely seen outside thick conifer habitats (fig. 18). After this time, two moose that were carefully watched on the ground ingested mouthfuls of snow and did not ruminate (chew their cud) when they bedded down—perhaps eating snow provided water that would normally be ingested as a component of forage.

For many years, we have known that fir is a dominant part of winter diet for Isle Royale moose. We've also known that fir is relatively rare and declining on the western two-thirds of Isle Royale. Because fir is less abundant on the west end, moose (and wolves) are less abundant on this end. Graduate and undergraduate students have recently begun new techniques to document moose feeding patterns.

Marcy Erickson, an undergraduate student supported by the Research Experience for Undergraduates program of the National Science Foundation, used microscopic identification of plant fragments in moose fecal pellets to determine the proportion of balsam fir in the diet of individual moose in winter (fig. 19). Marcy's work demonstrates the importance of balsam fir for moose.

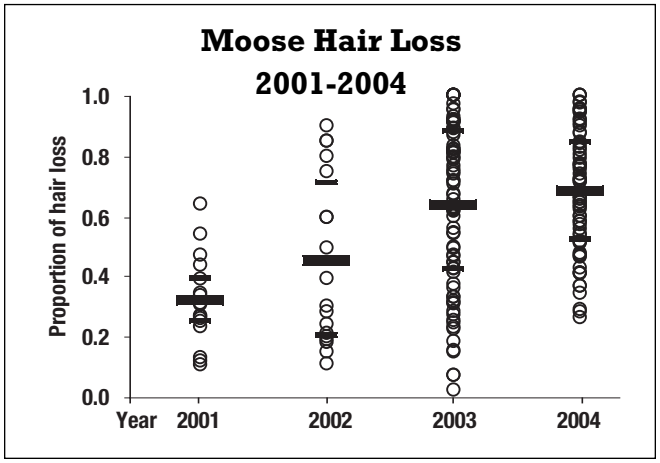

Figure 14. The extent of moose hair loss in spring, caused by winter ticks, has increased steadily in the past four years.

Figure 15. An aggressive cow moose protected her dead calf, killed the night before, from wolves and any other predators or scavengers, but she gave up the cause before sunset.

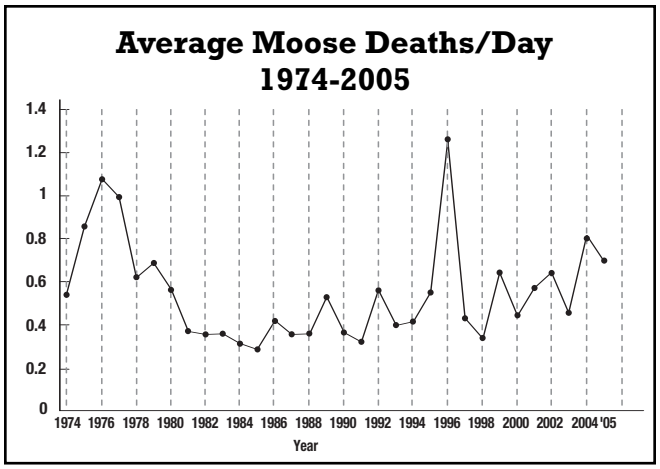

Figure 16. Moose mortality rate in midwinter was above average in 2005. All but one of the recorded moose mortalities resulted from wolf predation.

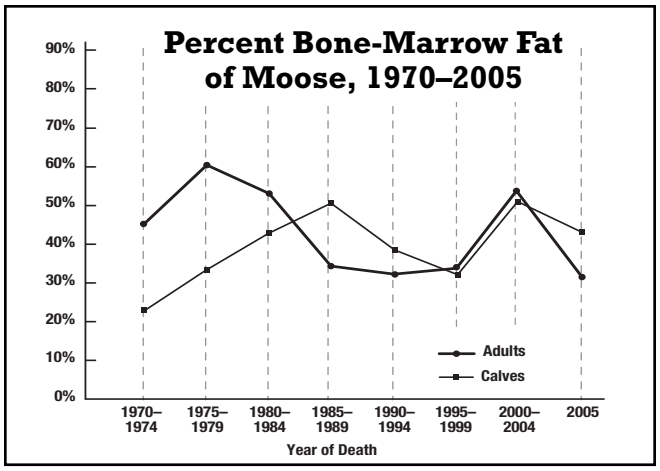

Figure 17. Long-term trends in moose bone-marrow fat. Data for calves (which best reflect current conditions) represent mean levels, whereas data for adults is the proportion with greater than 70 percent marrow fat.

When fir is common in the environment, fir comprises 50 to 70 percent of moose diet in winter. Even when fir is rare in the local environment, fir comprises 15–30 percent of moose diet. The second most common winter forage is cedar, which can comprise up to 33 percent of the diet of some moose. Lichens and the twigs of deciduous trees and shrubs make up the remainder of moose diet.

For each pellet group that Marcy collected and analyzed from Isle Royale, she also determined the relative abundance of balsam fir in the local area, and she could then assess the relationship between prevalence of balsam fir in the environment and balsam fir in the diet of individual moose (fig. 20). She found that the proportion of fir in the moose diet declined as fir becomes rare, but when fir is rare in the environment (say 10 percent), moose diet still includes 10–30 percent fir. Under these circumstances, moose could drive balsam fir to local

Figure 18. Prime-age bull moose, with testosterone-darkened nose, primarily ate snow during an active period in February when he was relatively immobilized by a strong surface crust on the snow. Perhaps snow met a water intake requirement when forage intake was exceptionally low.

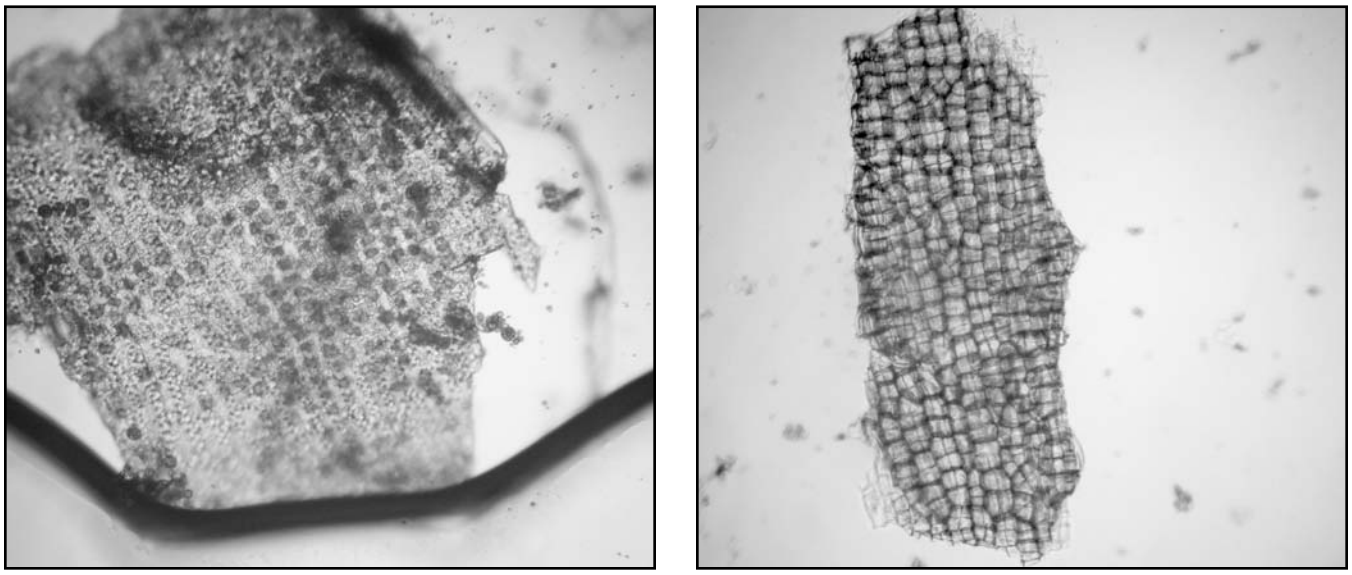

Figure 19. Microscopic appearance of cell structures in moose winter fecal pellets, as in balsam fir (left) and aspen (right) fragments, were used to determine the proportion of moose diet comprising balsam fir.

extinction (see below). Continued study and monitoring are required to better understand the future fate of balsam fir and the consequences for wolves and moose on both the east and west ends of Isle Royale.

M.S. student Keren Tischler recently determined that the major components of diet for Isle Royale moose (woody trees and shrubs, submerged aquatic plants, and lichens) can be distinguished using stable, naturally-occurring isotopes of carbon and nitrogen. Keren was able to document seasonal patterns of aquatic feeding from the record laid down in growing moose hooves. Her analysis suggests that 10–37 percent of summer food intake for Isle Royale moose consists of aquatic plants, and that these plants provide a valuable source of protein (fig. 21). Forage abundance in winter is extremely low, especially for moose inhabiting the old forests on the western two-thirds of Isle Royale, so abundant summer forage of high quality is critically important for year-round survival.

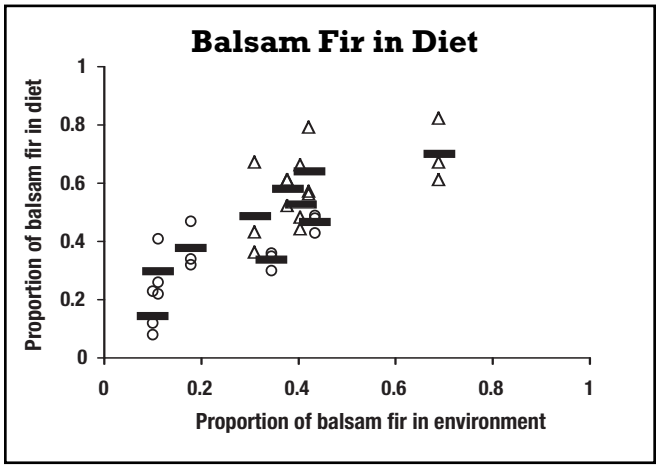

Figure 20. As balsam fir becomes more abundant in an area, moose eat proportionately more of it. When fir is very scarce, however, moose still search it out, thereby maintaining high herbivore pressure on a scarce plant species.

Figure 21. Filmed underwater with the help of a remotely-operated-vehicle (ROV) and staff from the Isle Royale Institute, this moose searched visually for protein-rich aquatic plants (see inside back cover for close-up).

Forest Vegetation

While policies of the National Park Service would allow most naturally-occurring fires to continue to burn, since 1948 there have been no forest fires large enough to significantly influence moose habitat (fig. 22). Yet the forests on the east end of Isle Royale are predominantly post-fire stands, with a gradually increasing proportion of coniferous trees (fig. 23), especially balsam fir. Most aquatic habitats also occur on the east end, contributing to higher densities of moose and wolves in this portion of the island.

The forest community at the west end of Isle Royale, on the other hand, has been largely unburned for hundreds of years. Growth rate and stocking density of new balsam fir is very low at the west end, resulting in a much higher impact from wintertime foraging of moose. Here, for almost a century, moose have prevented balsam fir saplings from growing into the forest canopy, so the number of reproducing fir trees has been steadily declining as the mature trees die.

Semiannual counts of tagged mature balsam fir trees at the west end indicate a steady and linear decline in the number of live trees (fig. 24). Consequently, the mortality rate of the remaining trees is steadily increasing, as expected for old individuals. About one-quarter of the trees tagged in 1988 are still alive, and there are virtually no new fir saplings. All mature trees appear to have rotten cores, and many die after cracking off near the base during windstorms. Others are uprooted by wind, and a significant number simply decline over many years and remain standing as snags after they die. We project that all tagged trees will have died by 2009-2010.

Figure 22. Forest regrowth now has transformed this moose pasture, burned in 1936 and photographed here in 1951, into a mature forest with little forage for moose.

Figure 23. Looking northeast from Ojibway Fire Tower in 1951 (left) and 2004 (right), the establishment and growth of forest cover are evident. This was the site of the last lek, or breeding area, for sharp-tailed grouse on Isle Royale, a bird that requires extensive open habitats. No grouse were seen here after 1986.

A Winter Journey

It was late January 1955. Because the ice in Siskiwit Bay was too rough to land a plane, Jim Cole and I were left off at Lake Halloran at about noon. The plane that brought us there left before we had donned our heavy back packs with everything we needed for the next month. Our destination, Siskiwit Camp, an old CCC settlement, abandoned in the late '30s, lay about a mile ahead. Jim was the regional biologist (one of about 3 or 4 biologists in the Service at that time) who was assigned to determine the size of the wolf population. Naturally-occurring wolves were first reported by Ranger Bob Hakala several years before. The radio we had at the camp usually didn't work, but we managed. For water we had a large kettle-like arrangement above the stove into which we fed snow several times a day. We made pancakes for breakfast and used left-over pancakes for sandwiches filled with jam or peanut butter, which we carried in our pockets for lunch. During the daytime we snowshoed the many miles of moose trails around Siskiwit Bay (often these coincided with the park's trails), tracking moose and observing the clever way in which wolves stalked them. By the end of the month we calculated that about 23 wolves made up the population on Isle Royale (calculated by counting wolf tracks, circumstances of killed moose, and guesswork). This alarmed Jim, who thought that the wolves were sure to wipe-out the moose. I remember arguing that this would probably never happen.

When it came time to depart for home the ice in Siskiwit Bay was decidedly unsafe, since cracks were noted and the typical booming of cracking ice was heard quite often. We opted for Washington Harbor and its protected interior site at Windigo. This, of course, meant we had to get there. Following trails meant a far greater mileage than we wanted, but a straight shot (8 miles) wasn't so bad—over the Big Siskiwit Swamp shouldn't be so bad this time of year.

The day came for our final assault, the camp was prepared for evacuation, and all was set. We began by following the trail to Feldtman Tower and about a mile up the trail we turned west-northwest toward Windigo. It began to snow. Then it snowed harder—so hard that that constant use of the compass was in order. Finally we began an uphill climb that made it seem like it must be Red Oak Ridge. But this happened more than once! Clearly the lack of a good topographic map was keenly felt! By this time it was getting dark, but also it quit snowing; in fact the moon shone brightly. But it was too dark to travel and we made a bow bedding from balsam fir for sleeping. We had sandwiches from camp, but that was all. Sleeping was a joke. When daylight appeared, we thanked God that the night had passed. And it turned out that we weren't on Red Oak Ridge after all, that it was the Greenstone. We could see water below and it had to be Washington Harbor. At last we stood on its shore. We were about 2 miles from Windigo, which we could see, but getting there with nothing but tea under our belts was something else—I guess we stopped about 4 times to rest on the way.

NPS biologist James E. Cole snowshoeing near Island Mine, 1953. Photo by Bob Linn.

Windigo was Heaven! District Ranger Dave Stimson had given us permission to use his place to rest and recuperate, which we did. Windigo had a root cellar with food, which we liberally used. In a day or two the plane arrived and we were on our way home. Not a bad trip, all said and done. There was only one dispute between Jim and me, and it was in no way mean. Jim was convinced that the wolves would decimate the moose population, and I didn't think so. Not a bad ending for two guys in the woods.

—Bob Linn, 2004

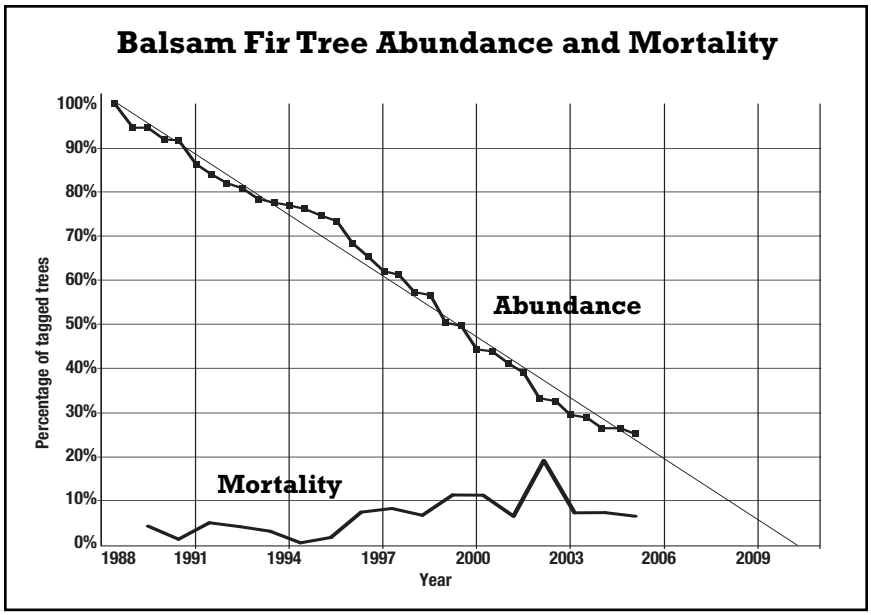

Figure 24. Balsam fir trees in the forest canopy that were tagged in 1988 at the west end have steadily died off, without replacement. The remainder are expected to die by approximately 2010, and at that point a seed source for this species will be absent over 75 percent of Isle Royale. The demise of this species is ultimately caused by moose herbivory.

Figure 25. Relative snowshoe hare density reaches a peak around the beginning of each new decade, both at Isle Royale and on the mainland in Minnesota. Counts were made at Isle Royale during all hikes in May-August, while hares were counted in Minnesota on routes used to count drumming ruffed grouse in spring (Minnesota Department of Natural Resources, with thanks to William E. Berg).

Other Wildlife

The National Park Service conducts aerial surveys of known osprey and bald eagle nests each summer. There was some improvement in reproduction in 2004, probably due to more favorable springtime weather. Active eagle nests increased from eight to ten, with eight young fledged. The number of osprey nests was again six, as in 2003, with eight young fledged.

Snowshoe hare observations were low in summer 2004, consistent with a cyclical decline following a peak at the turn of the decade (fig. 25). Red fox, a major hare predator, have likewise declined to low levels (figs. 26 and 27). Long-time beaver researcher Philip C. Shelton conducted an aerial survey of beaver colonies during October 2004, but a total count was not completed. Beaver appear to be steadily dwindling as forests mature and increasingly become dominated by coniferous trees.

River otters continue to thrive in all parts of the island, and their ability to feed on Lake Superior fish probably explains why they recovered to high levels while their mustelid cousins, the American mink and the short-tailed weasel, remain very rare. Two reliable

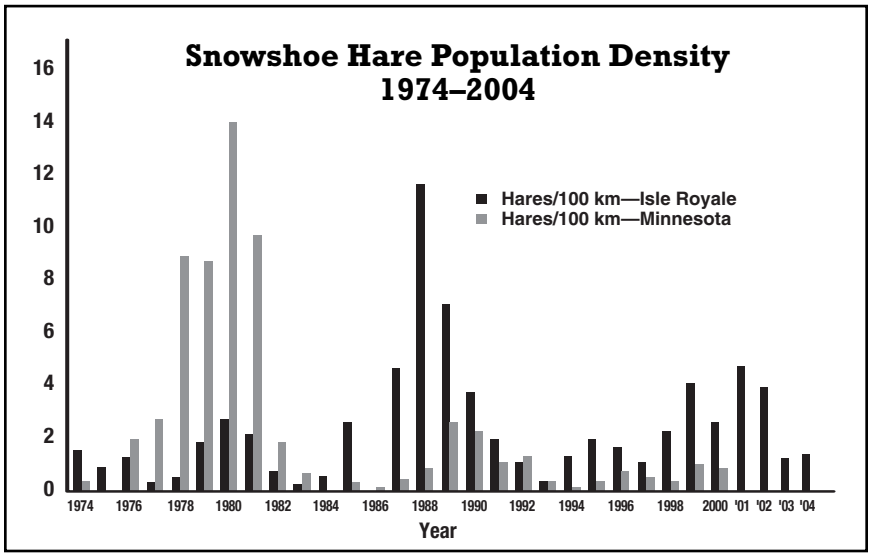

Figure 26. Red foxes rely heavily on snowshoe hares for food, but moose carcasses left by wolves help maintain foxes at a relatively high density.

observations of American marten were recorded by project personnel in 2004-2005 (one in summer and one in winter, both at the west end), only the third and fourth sightings of this newly-arrived mammal. Fecal DNA analysis in 2004 confirmed that marten are present, though rare, in many locations at the west end of the island. This species appears to have colonized the island early in the 1990s, and track observations in winter confirmed a continuing presence since that time.

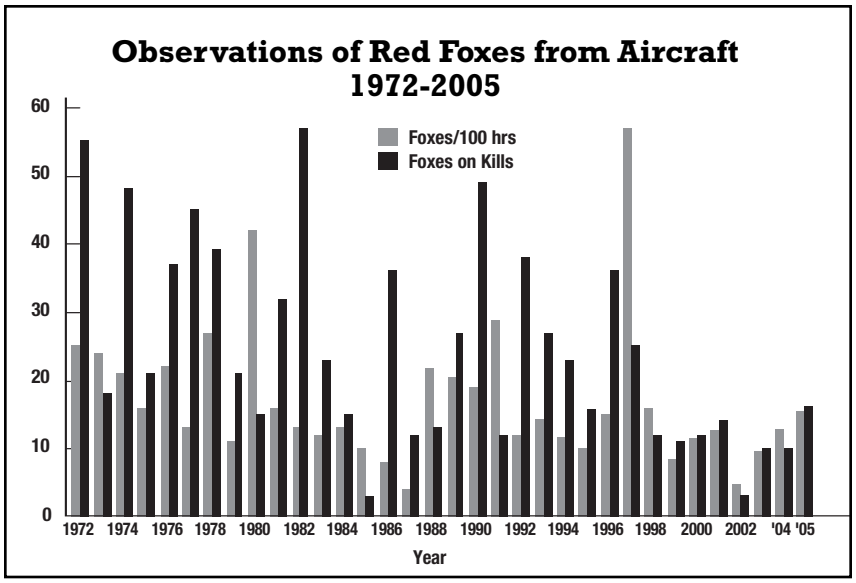

Figure 27. Relative abundance of red foxes from aircraft observations in winter, 1972-2005. Grey bar is the number of foxes seen away from moose carcasses/100 hours, while the black bar is the maximum number of foxes seen on carcasses.

Robert M. Linn, 1926–2004: A Remembrance

We lost one of the most important long-term supporters of Isle Royale science in 2004 when Bob Linn passed away in October. In the 1950s, Bob was the first naturalist assigned to Isle Royale, when he participated in the first winter study (see sidebar) and, in 1958 he was instrumental in establishing a cooperative research project on wolves and moose, headed up by Durward Allen at Purdue University. Before the research even started, Bob strongly defended the wolf population itself from those who wanted to somehow rein it in. In 1960 Bob arranged for the Bangsund Fishery to house summer field operations for wolf-moose research, following the death of friend and fisherman Jack Bangsund—it is still in use 45 years later. Then, as the chief scientist for the National Park Service, Bob helped protect this long-term research program from administrative and political sabotage. At least three times, in the 1960s, 1970s, and 1980s, he preserved the integrity and continuity of the work in the face of serious challenges from within the NPS or Department of the Interior. Bob could always be counted on for wise counsel and, in many ways, he provided an enduring framework for the wolf-moose research at Isle Royale. The following tribute by Dave Harmon of the George Wright Society is reprinted, with permission, from *The George Wright Forum:*

Robert Maurice Linn was born May 12, 1926, in Cleveland, Ohio. As a youth he was active in the Boy Scouts of America, attaining the highest possible rank, that of Eagle Scout. After serving in the Army in World War II, Bob enrolled at nearby Kent State University, majoring in biology. At the same time he became a Scout Leader and also joined the Explorer Scouts, where he again reached the highest rank, that of Explorer Ranger.

It was while leading a scout camping trip to Isle Royale that Bob began a lifelong association with the national park, the place he loved more than any other in the world. His devotion to this island wilderness was nothing short of remarkable. No matter where he was stationed, Bob managed to make at least one trip to the island each year. As anyone who has visited the park can tell you, this is no easy thing to do, since it lies at the far end of Lake Superior, a six-hour ferry ride from Michigan's Upper Peninsula, which itself is roughly nine hours north of anyplace you've ever heard of. In all, he visited Isle Royale for 58 consecutive years, making his last trip in July 2004.

After getting his Bachelor's degree, he continued at Kent State, earning a Master's in plant ecology by doing botanical and ecological research at Isle Royale. He then went on to receive a Ph.D. in plant ecology from Duke University, studying under the eminent ecologist Henry J.

Bob Linn playing the marimba at Rock Harbor Lodge in 1959, (photo from Bob Linn)…

Oosting, who authored the classic text *The Study of Plant Communities*. Bob's dissertation, on Isle Royale forest succession, was very much in this tradition.

Following completion of his studies at Duke, Bob joined the National Park Service at Isle Royale, where he became chief park naturalist, serving in that position from 1958 to 1963. During this period he also participated in some of the first winter research sessions of the park's world-renowned moose–wolf study, working closely with that

…receiving an award from Interior Secretary Rogers B. Morton in 1973 (NPS photo)…

study's founder, Durward Allen.

Bob left Isle Royale in 1963 to work at NPS headquarters in Washington. He made the move with great reluctance, commenting that "a week's enough; a month in Washington would be unbearable." As it turned out, he would spend the heart of his NPS career in the Washington Office. At the time he arrived in the capital, the climate was auspicious for science in NPS. The seminal Leopold and National Academy reports had just come out. Their reviews—and, in the case of the National Academy report, barbed criticism—of NPS science and natural resource management shook the agency out of a 25-year torpor that had descended upon it in the years following the death of George Wright back in 1936. So, just as Bob arrived in Washington, and for the first time in a generation, science seemed poised to become a major factor in NPS decision-making.

The reality proved to be different. As recounted by Richard West Sellars in *Preserving Nature in the National Parks: A History*, during the 1960s and early 1970s attempts to revive and build scientific management in NPS ran headlong into deeply entrenched agency traditions, such as the indifference of most park superintendents. The bureaucratic tangles that Bob knew lay waiting for him were all too real. Bob worked first with George Sprugel during his tenure as chief scientist from 1964 to 1966. After Sprugel's resignation, Bob was acting chief scientist for a short time until he became deputy to Starker Leopold, who had himself been lured to Washington from the University of California by NPS Director George Hartzog to become chief scientist. However, Leopold came to Washington even more reluctantly than Bob, and left after just a year to return to Berkeley. Bob then succeeded him as chief scientist, a post he held until 1973, when he was succeeded (under a different title) by Theodore W. Sudia.

Although agency reorganization undercut the high profile that science had briefly achieved while Leopold was with the NPS, and frustrated many of Bob's efforts as chief scientist, he was successful in bringing into the Park Service a cadre of young scientists who formed the core of the agency's research capacity from the late 1960s into the 1980s. Bob's tenure as chief scientist became, in essence, a long-term exercise in scientific capacity-building. This sort of work requires a person of persistence, and, perhaps even more, of vision. That was a quality Bob had in abundance, but it was often hidden to all but his closest associates because of his natural reticence and great personal modesty. As it turned out, he would have to wait until his retirement from NPS to give full rein to that vision.

After departing from Washington, Bob finished his NPS career by returning to the Keweenaw Peninsula and helping to create a Cooperative Parks Studies Unit at Michigan Technological University in Houghton, the mainland headquarters of Isle Royale National Park. That CPSU eventually was moved to the campus of the University of Minnesota, where it is now part of the Cooperative Ecosystem Studies Units Network.

Shortly after his retirement, Bob co-founded the George Wright Society in 1980 along with Ted Sudia, and established its headquarters in Hancock, just across the Keweenaw Waterway from Houghton. (There you have the answer to the question we've been asked innumerable times: "Where is Hancock, Michigan, and why is the GWS headquartered there?") The necessity for an organization such as the GWS was deeply felt by Bob and Ted, and, as Bob recounted in the first issue of *The George Wright Forum*, "the aims and goals of the Society grew out of intensive discussions":

> The George Wright Society grew out of a need that became apparent during the first and second conferences on Scientific Research in the National Parks [1976 in New Orleans and 1979 in San Francisco]. The need: an instrument of continuing duration, dedicated to the exchange of information within the community of researchers, managers and other professionals, to give continuity to the broad range of topics having to do with cultural and natural park and reserve management and preservation.... The emphasis is on multidisciplinary synthesis and the aim is to promulgate and disseminate integrated information in a form useful to the goal of improved park and reserve management. Existing scientific, cultural and conservation organizations tend to be subject-oriented and do not address such process-oriented issues except peripherally. Existing organizations fill other very important needs.

An initial membership drive targeted registrants at the 1976 and 1979 science conferences; NPS science and technology professionals; NPS historians, archeologists, and anthropologists; and NPS headquarters areas. However, as Bob went on to note, "the Society is designed to include much more" than just NPS employees: "state and provincial park personnel, local area park and reserve system personnel, as well as national park and reserve system personnel worldwide."

Thus the Society was launched with a set of inclusive ideals of global reach. But the basic reality of starting up an organization is more mundane, more local: somebody has to show up every day to do the mailings, write the letters, ask for the donations, and perform all the other thankless tasks that are necessary to get a nonprofit off the

ground. For the first ten years of the GWS, Bob was that someone. To be sure, he had strong support from the early Boards of Directors, and many other people contributed to the effort. But Bob was the linchpin. The organization was run from his home on Elevation Street, and—in the tradition of George Wright himself—many of the expenses were paid out of Bob's own pocket.

During the earliest years of the GWS, his house was crammed with the cumbersome machinery that was the do-it-yourself publisher's stock in trade before the advent of computer-based desktop publishing. Things like paper-cutting guillotines and collating machines vied for space in his living room with more personal objects, such as a splendid marimba (Bob was an accomplished player of that instrument). Once the personal computer came of age in the mid-1980s, Bob dove right in to the world of digital outputting, becoming a fierce Macintosh partisan. The earliest issues of *The George Wright Forum* had been produced by him on an IBM Selectric typewriter; these gave way to the wonderful world of Macs, with such unheard-of luxuries as an 8-inch black-and-white screen and a whopping 128k of memory. It was, in its own way, a revolution, but still the work had to be done, and it was Bob who was there to do it on a day-to-day basis.

That was the situation until 1990, when a generous gift from Sherry Wright Brichetto (one of George Wright's daughters) and her husband Dick enabled the GWS to open an executive office. Bob became the Society's first executive director, a position he held until 1998. Characteristically, he declined to be paid, using the money instead to bring me aboard as his assistant. As the years passed, the organization developed to the level that exists today. Bob was instrumental in all phases of that development: building up the biennial conferences, expanding the size and quality of the *Forum*, and extending the influence of the GWS by networking with other groups. After he stepped down from the executive director's position, Bob continued to work daily for the GWS until August of this year, handling membership matters, laying out the *Forum* and other GWS publications, processing payments, coordinating mailings, doing whatever he was asked.

People today throw around superlatives like "incredible" as if they were so much loose change. What Bob Linn did for the George Wright Society was, quite literally, incredible. All his work for the George Wright Society—24 years of full-time labor—was done entirely on a volunteer basis. He could have had a salary any time he chose; he never asked, and when offered, he refused. His devotion to the organization and its principles never wavered, no matter what the ups and downs of the moment. He testified before Congress, edited conference proceedings, provided guidance and leadership on all kinds of park matters—and took out the office trash every week because nobody else wanted to do it. He baked legendary chocolate chip cookies and kept the office cookie jar full for years; anybody who walked through the door was welcome to them (and there were people who dropped in just to have a cookie or two). He never complained when things went sour, and never looked to take a bow—not once.

Those who knew Bob solely through his Park Service and GWS careers will not be aware of how important he was to local and regional community groups in Michigan's Upper Peninsula. While working at Isle Royale in the 1950s, he was a founding member of the park's cooperating association, the Isle Royale Natural History Association (IRNHA). Bob was responsible for starting IRNHA's publications program, which has gone on to become nationally recognized for its excellence. IRNHA remains a vibrant, independent park cooperating association today. On top of this, Bob also was instrumental in creating the Upper Peninsula Environmental Coalition in 1975. UPEC remains the only environmental advocacy organization focused exclusively on environment of Upper Michigan. Bob had a Ben Franklin-like affinity for the printing profession, and over the years supplied letters, brochures, placards, placemats, and other information for such local groups as Kiwanis, the Barbara Kettle Gundlach Women's Shelter Home, Little Brothers–Friends of the Elderly, the League of Women Voters, and more.

In recognition of his many accomplishments in the local community, Bob was honored in 2002 with the Heart and Hands Award, which is given each year to a person who works for peace, justice, and the environment in the Keweenaw region. Bob also received—but only after a lot of persuasion—the GWS's highest honor, The George Melendez Wright Award for Excellence, in 2001, sharing it with Ted Sudia.

Bob richly deserved these honors, but he did not seek them. A man of great personal integrity and humility, he was truly happiest when working quietly in the background, and was always content to let others take the credit. Bob let his actions speak for him. What he said with his life was this: National parks and other protected places deserve the best research and resource management we can muster; if we give them that much, then the public will understand them better and will always support them. Simple enough on paper, but difficult to achieve on the ground. That is why there is a continuing need for organizations like the George Wright Society, and for people like Bob Linn.

—David Harmon

…and saying goodbye during his final trip to Isle Royale in 2004 (photo by Rolf Peterson).

Weather, Snow, and Ice Conditions

Snow depth was average or above-average for the entire winter study in 2005 (fig. 28). Temperatures reached a minimum of –30C in January, followed by a major thaw in early February and then a very hard surface crust (fig. 28). High winds kept Lake Superior ice-free for the entire winter period, and at no time was there an ice bridge to the Ontario mainland.

During the 2005 winter study, winds were somewhat stronger than average. Excellent flying conditions require wind speeds of less than ~25 km per hour. In a typical year, calm conditions prevail about 40 percent of the time. This year, however, winds were less than 25 km/hour for 32 percent of the time (fig. 28). Also, winds exceeded 50 km/hour for 11 percent of the time (typically, winds exceed this value for about 8 percent of the time).

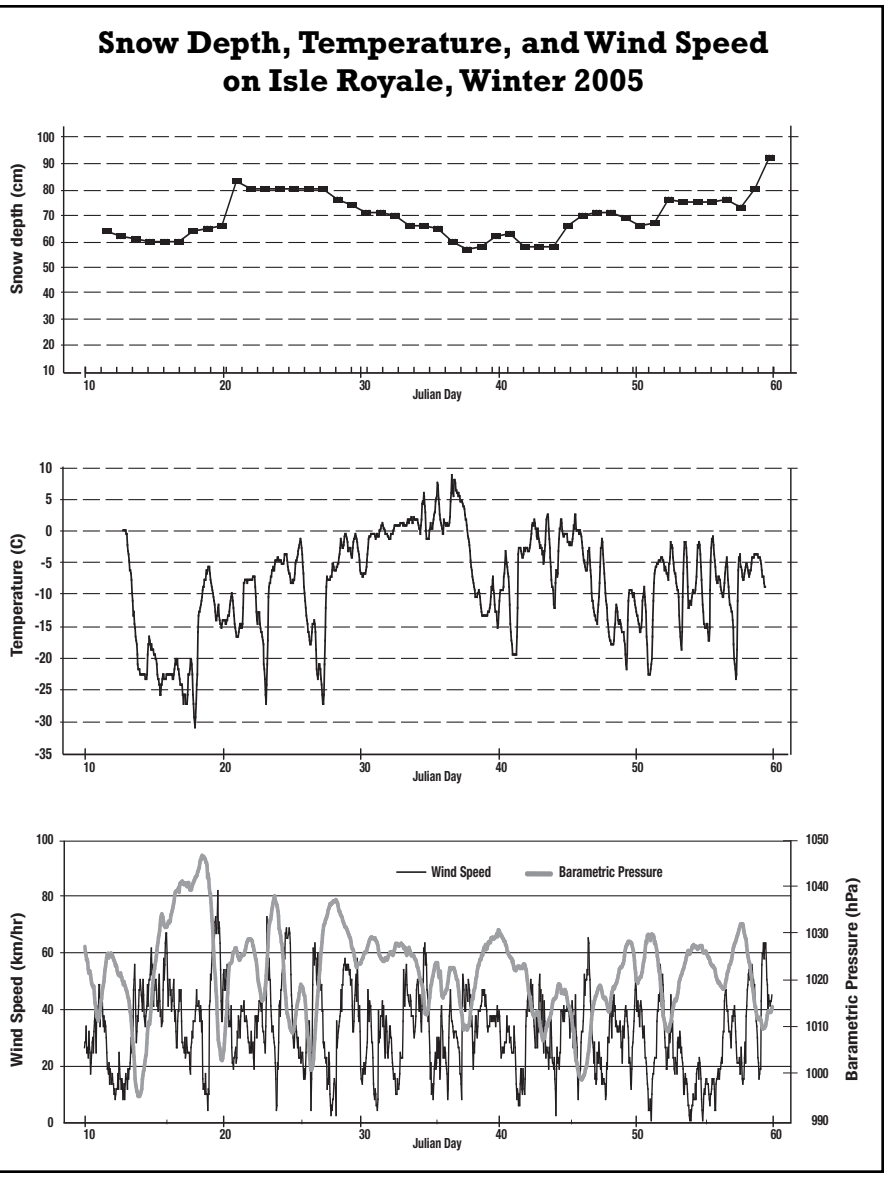

Figure 28. Snow depth (measured daily at Windigo), ambient temperature (hourly), wind speed/barometric pressure (every ten minutes), measured at Rock of Ages lighthouse during the 2005 winter study on Isle Royale.

Natural Design

Excerpted from *A View from the Wolf's Eye* by Carolyn Peterson

"As I came to know Isle Royale, I learned to respect the hardship inherent in nature. A wolf must catch and kill an animal whose skill at evasion has been evolving as long as the wolf's predatory skills. It risks its life every time it tackles a moose, which can kick ferociously. A moose has problems of its own—processing 40 pounds of leaves and twigs a day is hard on the teeth, and broken bones and injured joints cannot be set or replaced. Yet the hardships are what make the whole system beautiful, spare, and healthy. And, completely engaged in the present and not aspiring to live forever, wild animals seem content, unencumbered by guilt about the past, envy in the present, or worry about the future. The whole system is without malice. Wolves attack out of need, not anger, and in so doing perform their role in the scheme of things by protecting the trees that moose need to live…We, uncertain of our role in nature, are whiners and worrywarts, forever devising methods to avoid hardship, alleviate pain, and prolong life, cursing bad fortune, ungrateful for blessings. We cling to a culture of materialism and control that enslaves us and robs us of the sense of well-being. I am careful who I call a "dumb animal."

Photo by L.M. Vucetich.

To read *A View from the Wolf's Eye*, go to **www.isleroyalewolf.org/candy's_book.htm**

$3.95
Available from

International Wolf Center
1396 Highway 169
Ely, MN 55731-8129
218-365-4695
www.wolf.org

Isle Royale Natural History Association
800 East Lakeshore Drive
Houghton, MI 49931-1869
800-678-6925
www.portup.com/irnha/home.htm

MichiganTech

Tax-deductible donations to support continuing research on Isle Royale wolves and moose can be sent to

Wolf-Moose Study
Michigan Tech Fund
Michigan Technological University
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Houghton, MI 49931-1295

THANK YOU to all who help!