The Decline of the Isle Royale Wolf:
An Analysis of the Implications of Reintroduction

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I. Introduction

"If one were to look throughout the world for a bounded, discrete population of wild wolves that is free of threat from humans, the search would begin and end at Isle Royale" (Peterson 2007, p. 19). One of America's least visited National Parks quietly sits in the northwestern section of frigid Lake Superior, nearly 20 miles from the mainland. Isle Royale, designated in 1940, is a craggy archipelago comprised of more than 570,000 acres of wooded islands and rocks rising from the waves (Nature and Science- Isle Royale), and is the site of the longest predator-prey study ever conducted. The wolves and moose of the main island retain a unique relationship as the island's sole species of large mammals, and are commonly viewed as symbols of the park's pristine wilderness. Their interactions have been meticulously documented by researchers of the Isle Royale Wolf-Moose Project since 1958. In the 60 years of the study's operation, population equilibrium between the two species has not been met, and a combination of human and natural factors have contributed to trends of boom and bust that have greatly shifted the island's ecosystems. Now, with the lowest recorded number of wolves in Isle Royale's history, the future of this special predator-prey relationship and the study itself lie in doubt.

In 2016, the National Park Service proposed an option for reestablishing sizeable wolf packs with consideration of how they would impact the park and its other populations. Though

park policy has historically avoided direct human intervention in wild spaces, the situation on Isle Royale has become drastic enough to break this precedent. Reintroduction offers the potential to keep the now rapidly growing moose in check, and in turn sustain the healthy state of the forests and public perception of the park. It also would allow for a continuation of the important research on the nuanced interactions between these mammals and their ecological roles. But before assessing the ramifications of reintroduction, an understanding of the forces that have shaped the island's ecology is crucial.

II. A Brief History of Isle Royale

Isle Royale is the largest island in Lake Superior, spanning 45 miles long by nine miles wide and harboring a multitude of lakes, streams, and wetlands. Primarily composed of boreal forests, many of the island's prominent trees include balsam fir, white spruce, aspen, mountain ash, willow, and sugar maple. Due to its distance from shore, it contains only about a fourth of the nearby mainland mammal species. This provides researchers an especially uncommon opportunity to study populations and biodiversity with limited variables with which to contend (Peterson, 2007). Prior to the 20th century, lynx and caribou were the dominant mammals before hunting and trapping eliminated them from the island (Cochrane, 2013). Moose are believed to have first swam over from the Canadian-Minnesotan mainland sometime in the early 1900s. However, historical and genetic evidence points to some moose being shipped in crates from northwestern Minnesota (Cochrane, 2013), leading to doubts over the ungulates' true origin. Wolves, less ably suited to swim 20 miles in the icy waters of Lake Superior, likely crossed an ice bridge between 1948-1951, with the first physical evidence of the canines documented in the latter year (Peterson, 2007). Interestingly, after a breeding population was already established, a

wolf advocate from Michigan introduced four Detroit Zoo-bred wolves to Isle Royale in 1952 but achieved little success. Being too reliant on people to feed them, three were killed or removed shortly after. Though the fourth wolf escaped, it is not believed to have reproduced, as genetic testing of various wolves through the years has traced their DNA to a single female likely hailing from Ontario or Minnesota (Cochrane, 2013). As the population solidified, scientists began to consider using the island as a living laboratory in which to examine precisely how wolves and moose are intertwined.

III. The Wolf-Moose Relationship

The Isle Royale Wolf-Moose Project began as an effort to study a uniquely stripped-down food web, as wolves and moose are the only two species that directly impact each other's numbers (Nelson et al., 2010). The distinct lack of bears, lynx, deer, or caribou presented an enticing opportunity for researchers to study a predator-prey relationship based almost entirely off birth and death rates. Leading scientists of the study cite interest in understanding wolf behavior as well as their effect on ecosystem health as early motives that have continued to intrigue them to this day (Peterson, 2007, Nelson et al., 2010). In the first 20 years of research, the populations of both species rose and fell at nearly parallel rates, with wolf numbers rising and falling along with moose (Peterson, 2007). Aerial and land observations indicated that the wolves generally killed the oldest and weakest or the youngest and most vulnerable moose. Because a shortage of calves hampers the population's ability to reproduce in the long run, by the mid-1970s the ungulates' birth rate had significantly diminished, resulting in less moose overall (Peterson, 2007). These trends confirmed wolves as crucially intertwined with moose on

the island, as the amount of predation directly impacted the amount of moose. But then, beginning in 1980, wolves began to die out at a rapid pace.

Drastically, 52 wolves perished in just two years though evidence of reproduction continued to occur (Peterson, 2007). Researchers scrambled to decipher what had caused such a plummet, as such a fast and high mortality rate had hitherto never been recorded. Through continual testing of deceased wolves in the 1980s, scientists determined that an outbreak of canine parvovirus (CPV) had wracked the population, killing adults and pups alike (Vucetich et al., 2012). Later reports traced the source of the outbreak to a pet dog that had been illegally transported to the island by tourists, proving that even Isle Royale's isolation did not safeguard it from human effects. The wolves of Isle Royale suffered extensively from the virus due to its destructive effect on breeding- even after it disappeared in 1988, reproduction rates stagnated around zero well into the 1990s, and inbreeding became unavoidable (Peterson, 2007). Predictably, with the rapid decline in wolves, the island's moose soared in numbers- but at a high cost.

Isle Royale's boreal forests and harsh winters permit limited food options on which moose can feed. Their diet consists largely of balsam fir, with deciduous trees such as willow and aspen and aquatic plants supplementing the evergreen. In the 1930s, prior to wolf presence, the moose population speculatively reached over 3000 individuals, which quickly starved and bottomed out (Vucetich et al., 2012). The island was reportedly littered with bodies of the dead ungulates for several years, as the excessive numbers led to a shortage of fir and other browse resulted in a mass die off (Peterson, 2007). This shifted the composition of much of Isle Royale's forests, because overconsumption of favored kinds gave rise to the moose's non-preferred trees including spruce and birch. A mirrored circumstance occurred in the 1990s following the

devastation wrought by CPV as the declining wolves permitted moose to once again exceed their carrying capacity. This led them to overconsume available plants on the island, which altered the makeup of the forests just as it had in the 1930s. Nearly 2000 moose died between 1995-98, worsening conditions for the already crippled wolf population by limiting their sole food source. In the years following the CPV epidemic, an interesting shift arose in the wolf-moose relationship. Findings of the study show that wolves had become (and continue to be) the *least* impactful limiting factor to moose numbers, with environmental factors such as severe/mild winters, disease and parasites, and food scarcity all rising to paramount status (Nelson et al., 2010; Vucetich et al., 2012). The unpredictability of these causes means that future trends in the island's moose population will be difficult to hypothesize. Greater doubts hover over the future of Isle Royale's wolves, however.

The island's wolf population has never stabilized in the six decades of research and has been very tough to predict (Nelson et al., 2010), but it has never again consistently enjoyed the numbers prior to the introduction of CPV. Only two wolves now reside on Isle Royale, the lowest recorded number since their advent in the 1950s (Mlot, 2016). Generations of inbreeding have resulted in a severe lack of genetic diversity, limiting the wolves' ability to successfully reproduce. DNA testing has shown an astounding 50% of variability lost since 1980, with the remaining wolves being genetically close to half siblings (Peterson and Vucetich, 2017). Current predation rates indicate under one quarter of 1% effect on the moose population (Peterson and Vucetich, 2017), a woefully insignificant amount. The wolves' position as the sole apex predators in their food chain gave them a precise role in maintaining the stability of the island's ecosystems, a service they no longer are able to offer. The extreme lack of wolves on Isle Royale means few factors currently exist to cull the moose, and little indication exists that the highly

inbred pair will be able to successfully reproduce. Land use changes around the Ontario-Minnesota mainland, coupled with a warming climate producing fewer and shorter lasting ice bridges, means natural wolf immigration will be nearly impossible in the coming years (Vucetich et al., 2012). With the future of the island's wolves shrouded in uncertainty, debates and discussions over reintroducing new wolves have begun to stir amongst academic, public, and governmental communities alike.

IV. The Implications of Reintroduction

The history of U.S. Wilderness Policy, shaped by the Wilderness Act of 1964, generally stands by a doctrine of non-intervention in cases of limited human interference, "so as to provide for the protection of these areas, [and] the preservation of their wilderness character" (Wilderness Act (1964)). But on Isle Royale, humans *have* interfered with the environment- arguably numerous times. As previously mentioned, moose are at least partially present due to their shipment in crates in the early 1900s, and the ravaging canine parvovirus was sparked at the fault of people. Additionally, while wolves were artificially introduced in the 1950s, the relatively small number of individuals shipped to the island offered little in terms of additional genetic material as only one survived. Even on one of the most remote islands in the United States, in a National Park barely trammeled by man with few visitors and fewer inhabitants, human actions have and continue to impact Isle Royale.

From a scientific perspective, the question arises of how reintroducing wolves would affect the island's moose and ecosystem as a whole. The current moose population is predicted to continue to rise (Peterson and Vucetich., 2017), conceivably to crash spectacularly once again as it did in the 1930s and 1995. Such a trophic cascade would undoubtedly have profound

ecological affects by altering the composition of the forests and their inhabitants, thus negatively affecting the park's image and wilderness character. Leading conservationists of the 20th century including Adolf Murie, Aldo Leopold, and Sigurd Olson advocated for the introduction of wolves in the 1930s following the decimation of forage from the overabundant moose (Vucetich et al., 2012). Given the drastic situation of Isle Royale's wolves today, for the predation rate to once again reach a level of significance numerous wolves would need to be brought to the island. The National Park Service itself stated, "Wolves play a critical role as apex predators on the main island in managing the abundance and spatial distribution of moose and, by extension, the distribution, type, and abundance of island vegetation" (Draft Environmental Impact Statement to Address the Presence of Wolves, 2016, p. iii). The NPS's current plan of action is to introduce a limited number of wolves immediately, with subsequent introductions to occur over the next three years for a total of 20-30 individuals added. This plan would offer much needed genetic diversity to the wolf population, along with the potential to establish multiple breeding packs across the island. Such wolf numbers have not been stable on the island since before the infection of CPV in the 1980s, when moose were much less abundant and their browsing effects less prevalent on the forests. The return of a strong apex predator has the potential to cull the moose population, which would in turn retain Isle Royale's current forest makeup that provides habitat to a multitude of other species.

Since environmental factors are uncontrollable and hunting and trapping are not allowed on Isle Royale given its status as a national park, wolves are the only viable method of keeping the moose population in check. Excessive browsing would greatly change the makeup of the forests, as the preferred balsam fir, willow, and aspen would give way to spruce, birch, and maple. Recent reports have indicated certain areas have already been browsed to the point of resembling

grasslands more than woods (As Wolves Die out, Moose Numbers Boom on Michigan's Isle Royale, 2017), which in turn affects the island's other species such as beaver, fox, and numerous types of birds. The circumstances on the island allow for a simplified food web and unique predator-prey interactions, and the monumentally important role of the wolf in sustaining healthy forests and ecosystems on Isle Royale will not be present should they die out (Vucetich et al., 2012). Extinction of wolves on the island would render the Wolf-Moose Project dead as well, thereby closing the door to future opportunities to research predation, genetics, populations, wolf behavior, and numerous other ecological subjects.

For Isle Royale to remain the site of the longest predator-prey study in history, and for continual scientific discovery to spring from it, wolves *must* be reintroduced. An equilibrium may never be attained between the canines and ungulates, but for any sort of balance to occur in the island's ecosystem, wolves *must* be reintroduced. Isle Royale's very wilderness character lies in jeopardy, as wolves are inherently synonymous with its primal and isolated image (Vucetich et al., 2012). The public's view of National Parks is inextricably tied to their natural features: as roaming bison and spouting geysers are to Yellowstone, as giant sequoias and towering granite peaks are to Yosemite, and as mountain goats and vast ice sheets are to Glacier, wolves and moose are essential to the fabric of Isle Royale. The fact that neither species has lived there for millennia does not diminish their importance to public perception or science. Rather, the value of wolves on Isle Royale and their status as *the* apex predator in its ecosystems are too greatly consequential to let the canines simply fade away. The world's sole "bounded, discrete population of wild wolves that is free of threat from humans" may lie close to death, but it is humans who have the power to maintain it and continue to learn from it.

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