



Isle Royale National Park

RECORD OF DECISION

FINAL ENVIRONMENTAL IMPACT STATEMENT TO ADDRESS THE PRESENCE OF WOLVES AT ISLE ROYALE NATIONAL PARK

The Department of the Interior, National Park Service (NPS), has prepared this Record of Decision (ROD) on the final *Environmental Impact Statement to Address the Presence of Wolves at Isle Royale* (plan/EIS). This ROD has been prepared in accordance with the requirements of the National Environmental Policy Act of 1969, as amended (NEPA), its implementing regulations (40 CFR 1500–1508), the Department of the Interior’s NEPA regulations (43 CFR 46), and NPS Director’s Order 12: *Conservation Planning, Environmental Impact Analysis and Decision-making* and accompanying handbook. This ROD includes a summary of the purpose and need for action, synopses of alternatives considered and analyzed in detail, a description of the selected alternative, the basis for the decision, and a description of the environmentally preferable alternative. Citations can be found in the *Reference* section of the final plan/EIS.

BACKGROUND

The origin of the gray wolf (*Canis lupis*) on Isle Royale is not completely understood. It is commonly thought that wolf immigration initially occurred between 1948 and 1950, with individuals crossing an ice bridge approximately 24 kilometers (15 miles) long from the United States or Canadian mainland to Isle Royale (Vucetich, Nelson, and Peterson 2012a). Differing scientific opinions on the genetic history of wolf lineage on Isle Royale make the origin of wolves inconclusive, but genetic research suggests a limited number of founding breeders.

Wolf numbers on Isle Royale have fluctuated since the animals first became established (Martin 1995; Wilmers et al. 2006), with the long-term average reported to be 22 animals (Vucetich and Peterson 2016). The wolf population reached its peak on the island in 1980, when 50 animals were present (Peterson and Page 1988). By 2017, observations suggest there were only two wolves remaining (Peterson and Vucetich 2017). The most recent observations from the winter of 2017-2018 suggest there may be no more than two wolves remaining on the island.

Wolves play a critical role as apex predators on the island in managing the abundance and spatial distribution of moose (*Alces alces*) and, by extension, the distribution, type, and abundance of island vegetation. Since the initial wolf immigration in the late 1940s, the relationships among wolf, moose, and vegetation trophic levels have been well studied. This has included fluctuating population numbers, moose browse effects, wolf inbreeding depression, disease, vegetation dynamics, and ongoing climate change trends. Absent other large predators, such as bear, coyote, and mountain lion—and without human influences such as hunting, roads, and large-scale human habitation—wolves represent the only predators of moose on Isle Royale. Moose are the primary prey species for wolves on the island, and each species affects the distribution and abundance of the other species on the island (Peterson, Vucetich et al. 2003). However, wolves will prey on beavers (*Castor canadensis*) and other small mammals when they are available on the island. The wolf-moose predator-prey relationship on Isle Royale has provided researchers with a rare

opportunity to conduct extensive long-term (almost 60 years) two-level (wolf-moose) and three-level (wolf-moose-vegetation) scientific studies (UNESCO 2016; Wilmers et al. 2006).

Factors influencing the moose population have changed over time. Currently, the moose population is influenced more heavily by vegetation, climatic conditions, disease, and parasites, than by wolves. The combined effects of climate, balsam fir growth, and moose abundance have led to a shift from a top-down driven ecosystem, where wolves had a greater influence, to a bottom-up driven ecosystem, where climate and vegetation are the primary factors regulating moose population growth rate (Vucetich and Peterson 2004; Wilmers et al. 2006). It is likely that the moose population on the island will continue to increase until a lack of available forage, disease, weather, or other population control measures cause a decline. The growth rate of moose on Isle Royale does not mimic the patterns on the mainland in Minnesota and Michigan where moose populations are either static or decreasing due to various factors.

PURPOSE AND NEED FOR ACTION

The purpose of this plan/EIS is to determine whether and how to bring wolves to Isle Royale to function as the apex predator in the near term within a changing and dynamic island ecosystem. A decision is needed because the expected extirpation of wolves and the decreasing potential for immigration raises concerns about possible effects to the current Isle Royale ecosystem, including effects to both the moose population and forest/vegetation communities. Over the past five years the wolf population has declined steeply, intensifying the need to determine these effects. Although wolves have not always been part of Isle Royale, they have been present for more than 65 years, and have played a key role in the ecosystem, affecting the moose population and other species during that time. At this time, due to the low number remaining, genetic inbreeding, and the remoteness of Isle Royale, natural recovery of the population is unlikely due to the tenuous nature of ice bridge formation.

ALTERNATIVES CONSIDERED

Alternatives analyzed in this plan/EIS were developed based on the results of internal and public scoping, agency input, and past and ongoing planning efforts. The action alternatives, Alternatives B, C, and D, include the capture and relocation of wolves from the Great Lakes Region to Isle Royale National Park. NPS would target wolves for relocation that are known to feed on moose as one of their prey sources, are in good health with no apparent injuries, and have the appropriate genetic diversity to sustain a viable population on the island. Capture and relocation efforts would take place between late fall and late winter. All of the action alternatives include monitoring which could include radio or GPS collar tracking from ground and air, scat sample collection, visual observations, and other methodology as funding is available. A detailed description of the alternatives carried forward, including elements common to all alternatives and all action alternatives, is provided in chapter 2 of the plan/EIS. Alternatives analyzed in the plan/EIS included the following:

- **Alternative A.** Alternative A, the no-action alternative, is a continuation of existing management practices and assumes no new management actions would be implemented beyond those currently available. NPS current management of wolves at Isle Royale does not include supplementation of the existing wolf population or introduction of new

wolves to the island. Therefore, under Alternative A, wolves would not be released onto Isle Royale; however, wolves would not be prevented from immigrating to or emigrating from the island on their own.

- **Alternative B (Selected Alternative).** Under Alternative B, between 20 and 30 wolves with a wide genetic diversity would be introduced to the island. Wolves would be supplemented as needed up to the third year after initial introduction. After the third year, should an unforeseen event occur that impacts the wolf population, such as a mass die-off or introduction of disease, and the goals of the alternative are not being met due to this event, wolves may be supplemented for an additional two years. No additional wolves would be brought to the island after five years from date of initial introduction.
- **Alternative C.** Alternative C would involve the initial introduction of between 6 and 15 wolves. The NPS would bring wolves to the island as often as needed in order to maintain a population of wolves on the island for at least the next 20 years. Under this alternative, additional wolves may be brought based on one or more resource indicators that could include genetic health of the wolves, ecological health, and prey species population trends.
- **Alternative D.** Under Alternative D, the NPS would not take immediate action and would continue current management, allowing natural processes to continue. This alternative will involve continued the study of island ecosystem changes without an apex predator and only take action should the weight of evidence suggest an apex predator is necessary to ecosystem function. Resource indicators, such as population size and growth rate of moose would be used to determine if and when wolf introduction actions should be taken. If the weight of evidence indicates wolf introduction actions should be taken, NPS would follow procedures outlined within Alternative C.

SELECTED ALTERNATIVE

The NPS has selected alternative B (hereinafter referred to as the selected alternative), as described in the plan/EIS, for implementation. The selected alternative will implement a time-limited wolf introduction at Isle Royale. This alternative will provide an immediate introduction of a large enough number of wolves to fulfill the function of the apex predator throughout the 20-year planning period and allow the wolves to hunt, establish pair bonds, and ultimately establish packs. The selected alternative will introduce the historical average number of wolves on Isle Royale in an effort to have immediate effects on the island moose population, while minimizing impacts to the untrammeled quality of wilderness over the course of the planning period.

The individual elements required to implement the selected alternative are described below:

Capture Tools- In compliance with state and federal requirements, wolves selected for introduction will be captured using available tools ranging from helicopter net-gunning, modified padded foot-traps, darting from a helicopter, or modified snares with appropriate stops. Human and wolf interactions will be minimized.

Capture Location and Logistics- Wolves will be captured primarily from the Great Lakes region, from areas with a similar vegetative make-up to Isle Royale and where wolves display

behavioral traits representative of those needed to survive on Isle Royale (e.g., hunting large prey such as moose). Research suggests that introduced wolves will do best if from an area with similar prey base and habitat; therefore, selecting wolves from an area with moose that is not too geographically distant will be beneficial to population survival and growth. Areas of the Great Lakes region where wolves will be captured could include, but are not limited to, Minnesota, Wisconsin, Michigan, or Ontario, Canada. The National Park Service will seek wolves that exhibit good health with no apparent injuries based on examination by a qualified wildlife veterinarian and possess one or more of the following desirable traits: (1) are known to feed on moose as one of their prey sources; (2) are not habituated to humans or their food and are not nuisance animals; and (3) possess appropriate genetic diversity and mixture of age and sex. The National Park Service will aim to capture family groups that are separated by at least 40 miles to maximize genetic variation. Capture will include the use of chemical immobilization during capture and introduction efforts. Animals will be held for the minimum time necessary prior to introduction to Isle Royale.

The NPS will assess whether wolves inadvertently caught by trappers in the Great Lakes states could be used for introduction on Isle Royale and whether this option will allow the National Park Service to efficiently and humanely relocate these wolves to ensure wolf welfare and overall plan success. The NPS will consider wolves that have preyed on cattle provided adequate safety concerns can be mitigated (i.e., an individual wolf is only known to have preyed upon cattle, and not domestic pets, given the National Park Service allows service animals to visit the park with disabled owners). The NPS has engaged the U.S. Department of Agriculture's Animal and Plant Health Inspection Service-Wildlife Services personnel to discuss the feasibility of acquiring wolves that have been involved in depredation events on cattle and will retain this option moving forward, provided safety concerns can be mitigated.

Time of Capture and Introduction. The capture and release periods to bring wolves to Isle Royale will occur primarily between late fall and late winter. Closure of portions of the island, or the whole island, may be necessary to conduct introduction operations and ensure health and safety of staff, visitors, and animals. The exact timing of the closure will be determined during implementation and will not be a permanent closure, lasting less than one month.

Vaccinations / Health Evaluations. Captured wolves will be evaluated by a certified wildlife veterinarian, which could include collection of samples for health and genetic testing. Any injuries sustained during capture will be addressed prior to introduction and individual animals may be vaccinated, as deemed appropriate. Wolves will be sedated during examination.

Transportation. Once captured, wolves will be transported via boat, fixed-wing aircraft, or helicopter to the island. For example, wolves could be net-gun captured with a helicopter and flown to a site for evaluation by a certified wildlife veterinarian using a fixed-wing aircraft. Once fully evaluated, wolves could then be transported to Isle Royale with fixed-wing aircraft, helicopter, or the park's landing craft vessel. The National Park Service will remain as flexible as necessary to achieve transportation logistics safely and efficiently as determined by the management alternative employed. In order to avoid undue stress and the risk of habituation to humans, wolves will be held for the minimum amount of time necessary for examination and transport to Isle Royale. The wolves will remain sedated during transportation to a site for evaluation and, subsequently, during transport to the island.

Release. Wolf introduction will occur by hard release. This entails release of individuals or groups of wolves onto the island with no time to acclimate in holding pens prior to release and without intensive support provided following release. An example of hard release would include dropping wolves off on a suitable land area (e.g., beach, dock, or frozen lake) and allowing them to disperse freely. This type of release has been shown to work effectively and reduces the risk of wolf injury or habituation in holding pens. The location of the release may occur anywhere on the island and could involve multiple locations of simultaneous release.

Carcass Provisioning. During initial release, carcass provisioning of natural prey may be implemented to ensure the success of initial establishment. Moose carcasses will be harvested on Isle Royale and not from off island to prevent the exchange of disease, parasites, or other foreign materials from the mainland to the island. The provision of carcasses may serve as a means of encouraging recently introduced wolves to stay in certain areas of the island. Additionally, carcass provisioning may be used as a strategy to contain pair-bonded individuals to one area of the island while the release of another animal or group of wolves occurs elsewhere.

Monitoring. As funding is available, existing ongoing monitoring will proceed as detailed in plan/EIS in Chapter 2. Current monitoring of vegetation, wolves, and moose aims to assess landscape level health, population trends, and immigration to the island. Monitoring results will be taken into account and the National Park Service will adjust actions within the parameters of the selected alternative, as necessary. Short-term and long-term monitoring of vegetation may include the use of permanently established plots, satellite imagery, and the assessment of forest structure and composition. The collection of a variety of moose population data will be carried out through aerial surveys or remote sensing, and systematic searches.

Wolf monitoring efforts will continue to include the use of telemetry (global positioning system [GPS] or radio), non-invasive fecal DNA-based approaches, direct monitoring via photo documentation, and/or observation. Introduced wolves may be telemetered along with a subset of wild born Isle Royale wolves. The park, under the selected alternative, will collar more individuals during initial introduction and will likely collar fewer wolves over time with subsequent introductions. The use of telemetry collars may be employed as a monitoring tool for population dynamics and to allow for the National Park Service to monitor for mortality and to aid in the location of den sites, where less invasive monitoring techniques could be conducted. Data captured through the use telemetry (VHF for GPS) collars will assist in providing information on the success of the reintroduction program. By employing wildlife telemetry, the NPS will enhance its understanding of the ecosystem by providing further insight into both the demographic characteristics (e.g., sex, age) and health of the wolf population, its impacts on the Isle Royale ecosystem, and ultimately the health of the ecosystem itself. Wolf predation is one dominant natural limiting factor and evolutionary driver for the moose population in Isle Royale National Park. Using telemetry to document wolves and their ecosystem impacts will help the NPS better understand influences on wolf demography, ecological processes (e.g., predation, trophic cascades), factors influencing population health for both predator and prey, and characteristics that determine a successful reintroduction effort to restore predation. The exact number of collars will be evaluated and determined as part of the minimum requirements analysis for Wilderness. The park will use the minimum necessary to accomplish monitoring goals. The NPS will not implement telemetry actions until a minimum requirements analysis has been completed.

In general, monitoring of introduced wolves will serve two purposes. First it will allow program success to be assessed using metrics of relevance to wolf population restoration goals, including the demographic characteristics and genetic health of the population. Second, it will allow enhanced understanding of the role of the introduced wolves in restoring Isle Royale ecosystem function. Monitoring approaches used will reflect the need to understand wolf movements, demography, social dynamics, and predator-prey dynamics.

Number of Founding Wolves. The selected alternative will introduce 20–30 wolves to the island within the first 3 years. During the 3-year introduction process, multiple and separate introductions will take place. Wolves will be selected to maximize age, sex, and genetic diversity. Under the selected alternative, there is a greater need to ensure adequate genetic diversity in the initial wolf population; therefore, the exact number of individuals (between 20 and 30) will be determined going forward based on available genetic data and assessment by subject matter experts.

Supplementation of the Wolf Population. The selected alternative will supplement additional wolves, up to 30 total, as needed until the third year as part of the initial introduction. After the third year, should an unforeseen event occur, such as disease or mass mortality, that decreases the wolf population to fewer than 12 individuals and less than 3 breeding age females, and the objectives of the alternative are not met, wolves may be supplemented for an additional 2 years. However, no additional wolves will be brought to the island after 5 years from date of initial introduction. Should introduction efforts prove to be unsuccessful after 5 years, ecosystem monitoring will continue and wolves will not be prevented from immigrating to or emigrating from the island on their own.

Location of Release on the Island. Under the selected alternative, complete groups of wolves, such as packs or pairs with pups, may be released simultaneously as a group with multiple groups distributed across the island, while unrelated wolves will be released in spatially disparate areas of to minimize conflict.

CONSULTATION

Tribal Consultation. A copy of the plan/EIS was sent to the Tribes listed in the FEIS with a request for review and comment. In February 2017, the park met with members of the following Tribes and commissions: Red Cliff, Keweenaw Bay, Great Lakes Indian Fish & Wildlife Commission, Lac Vieux Desert, St. Croix, Bad River, Mille Lacs, Bois Forte, and Bay Mills. These meetings were government-to-government consultations to discuss the draft plan/EIS. In April 2017, park staff held a call with biologists from the Keweenaw Bay Indian Community and the Grand Portage Band of Lake Superior Chippewa to discuss comments submitted on the draft plan/EIS and seek further clarification on their requests. In May 2017, park staff held a call with the Fond Du Lac Band of Lake Superior Chippewa to discuss, in more detail, the Anishinabe teachings and traditional ecological knowledge referenced in the Tribe's letter to the park. A letter was sent to the Keweenaw Bay Indian Community and the Grand Portage Band of Lake Superior Chippewa responding to their letter submitted on the draft plan/EIS. The park also met with the Grand Portage Band of Lake Superior Chippewa in November 2017 to discuss their comments on the DEIS.

On December 14, 2017, the National Park Service sent a letter to the Tribal Historic Preservation Officer's for Keweenaw Bay, Fond du Lac, St. Croix, Mille Lacs, Bois Forte, Red Cliff, Lac Vieux Desert, Sokaogon Mole Lake, and the Grand Portage Band of Lake Superior Chippewa containing the no adverse effect determination sent to the Michigan State Historic Preservation Officer in addition to the assessment of effect and the 'Tribal Perspectives' section of the FEIS.

National Historic Preservation Act. On November 22, 2017, the National Park Service sent a letter to the Michigan State Historic Preservation Officer requesting concurrence with a no adverse effect determination under Section 106 of the National Historic Preservation Act. On February 5, 2018, the Michigan State Historic Preservation Officer concurred with the National Park Service's determination of no adverse effect.

Endangered Species Act/CITES. The National Park Service completed consultation with the U.S. Fish and Wildlife Service (USFWS) on the introduction of wolves to Isle Royale from Minnesota, Wisconsin, and Michigan. The USFWS concurred with the NPS determination that the project is '*not likely to adversely affect*' the gray wolf. The USFWS concurred with this determination for the following reasons: temporary disturbances to the captured wolves' daily activities are expected; although there is a potential for intraspecific conflict among wolves, once released, competition and interaction are natural processes and are not expected to develop beyond historic levels on the island; Isle Royale provides abundant foraging and sheltering areas for gray wolves in addition to a large prey base; and potential human/wolf conflict on Isle Royale is very low and/or non-existent given the wilderness character of the island.

The capturing and handling of wolves associated with the selected action will be conducted in cooperation with the States of Michigan, Minnesota, and Wisconsin. Capture and handling will be undertaken directly by a qualified employee or agent of the State conservation agency (Michigan or Minnesota) in accordance with the provisions of Section 6 of the Endangered Species Act (the Act) or authorized by an enhancement of survival permit under Section 10(a)(1)(A) of the Act issued to the NPS for translocation of wolves from Wisconsin.

Should the National Park Service decide to obtain wolves from Ontario, Canada, the National Park Service would be required to obtain a Convention on International Trade In Endangered Species (CITES) export permit from Canada. In addition, the National Park Service would be required to declare all wildlife to the USFWS and to use designated ports or other ports through authorized exceptions. The National Park Service will not implement actions associated with introducing wolves from Ontario, Canada until these permits and measures are satisfied.

BASIS FOR DECISION

Alternative B has been selected for implementation. In identifying its preferred alternative, the National Park Service considered factors such as the extent to which alternatives meet the purpose of and need for action, environmental consequences including impacts to wilderness character, and implementation feasibility. Alternative B provides an immediate introduction of an apex predator to the island, thus restoring the predator-prey dynamic found on the island. Alternative B provides a large enough number of wolves to be genetically sustainable over the life of the plan. The selected alternative protects wilderness character by taking immediate action

to restore the natural quality while prohibiting supplementations after five years from date of implementation, limiting long-term trammeling in the wilderness.

The introduction of 20-30 wolves may increase the health of the moose population over time as the wolves cull older, weaker, and diseased individuals. This introduction would also decrease the rate of herbivory on the island and slow the rate of change in forest structure and composition. This will be a significant beneficial change from the current condition by restoring the ecological process of predation. The selected action could retain forest components that would otherwise be reduced in the presence of increased herbivory, allowing for forest succession to return to a historical trajectory last seen when predation had more influence in community dynamics. Overall, the introduction of wolves under the selected alternative will increase the likelihood of reestablishing a functioning top-down, predator influenced system. This will reduce existing stresses on the island ecosystem and many elements of the island ecosystem may be improved. It is expected that in the presence of wolves under the selected alternative, herbivory and its associated impacts will be less likely to impact the Isle Royale ecosystem over the long term. For these reasons, Alternative B was selected for implementation.

The NPS did not select Alternative C because management actions could continue over the life of the plan (at least the next 20 years), resulting in increased impacts, financial cost, and logistical support, and repeated intervention actions in the ecological environment. Alternative C would introduce a smaller number of wolves initially, potentially resulting in subsequent introductions, further impacting wilderness character during each subsequent event. Natural processes should be allowed to evolve with minimal influence from human actions, so limiting the number and frequency of introduction events (as in the selected action) is preferable. The selected action provides a sufficient number of wolves initially, making subsequent introductions unnecessary over the course of the plan.

The NPS did not select Alternative D because changes currently occurring on the island lead the NPS to believe action is needed now. Predation on the island has been minimal over the last five years due to the decreasing number of wolves on the island. The NPS has observed changes in the ecosystem as a result of increased herbivory from the growing moose population. Alternative D sets a higher threshold for action, requiring metrics to be met that show wolves are necessary to ecosystem function before NPS would take action. Changes in the ecosystem that are already occurring lead the NPS to believe that introducing wolves immediately would re-establish a top-down, predator influenced system, thus decreasing herbivory and allowing forest succession to return to a historical trajectory.

The selected action is grounded in best available science and represents a balanced approach to natural resource management and policy while providing for the preservation of wilderness character and continued visitor enjoyment. For these reasons, Alternative B was selected for implementation.

ENVIRONMENTALLY PREFERABLE ALTERNATIVE

The NPS is required to identify the environmentally preferable alternative in the ROD for public review and comment. The NPS, in accordance with the NEPA regulations, defines the environmentally preferable alternative (or alternatives) as the alternative that causes the least damage to the biological and physical environment and best protects, preserves, and enhances historical, cultural, and natural resources (43 CFR 46.30)

After completing the environmental analysis, NPS identified Alternative B as the environmentally preferable alternative. Alternative B would provide for immediate introduction of wolves and would restore the predator-prey system and associated functions to the island without waiting and allowing for further impacts of herbivory to the resources. Once introduction is complete, Alternative B would allow natural processes to continue into the future without requiring additional supplementations that would result in increased impacts to wilderness character and potential impacts to established pack dynamics on the island.

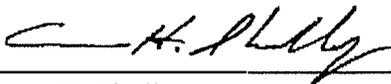
CONCLUSION

Overall, among the four alternatives considered, the selected alternative (Alternative B) best meets the purpose and need of the plan/EIS, is expected to quickly restore the predator-prey dynamic on the island, and fulfills the NPS's statutory mission and responsibilities, giving consideration to economic, environmental, technical, and other factors. The selected alternative incorporates all practical means to avoid or minimize environmental harm and will not result in the impairment of park resources or values or violate the NPS Organic Act.

The required "no-action period" before approval of the ROD was initiated on March 16, 2018 with the US Environmental Protection Agency's *Federal Register* notification of the filing of the final plan/EIS (Vol. 83 No. 52 Federal Register 11746).

The official responsible for implementing the selected alternative is the Isle Royale National Park Superintendent.

APPROVED BY:



Cameron H. Sholly

Regional Director, Midwest Region

June 7, 2018

Date

ATTACHMENT A—NON-IMPAIRMENT DETERMINATION

This non-impairment determination has been prepared for the selected alternative, as described in the Record of Decision for the final Environmental Impact Statement to Address the Presence of Wolves at Isle Royale National Park (plan/EIS).

By enacting the NPS Organic Act of 1916 (Organic Act), Congress directed the U.S. Department of the Interior and the NPS to manage units “to conserve the scenery, natural and historic objects, and wild life in the System units and to provide for the enjoyment of the scenery, natural and historic objects, and wild life in such manner and by such means as will leave them unimpaired for the enjoyment of future generations” (54 USC 100101).

NPS *Management Policies 2006*, section 1.4.4, explains the prohibition on impairment of park resources and values:

While Congress has given the Service the management discretion to allow impacts within parks, that discretion is limited by the statutory requirement (generally enforceable by the federal courts) that the Park Service must leave park resources and values unimpaired unless a particular law directly and specifically provides otherwise. This, the cornerstone of the Organic Act, establishes the primary responsibility of the National Park Service. It ensures that park resources and values will continue to exist in a condition that will allow the American people to have present and future opportunities for enjoyment of them.

As stated in section 1.4.5 of the NPS *Management Policies 2006*, an action constitutes impairment when its impacts “harm the integrity of park resources or values, including the opportunities that otherwise will be present for the enjoyment of those resources or values.” To determine impairment, the NPS must evaluate the “particular resources and values that will be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts.”

National park system units vary based on their enabling legislation, natural and cultural resources present, and mission. Likewise, the activities appropriate for each unit and for areas in each unit also vary. For example, an action appropriate in one unit could impair resources in another unit.

As stated in section 1.4.5 of the NPS *Management Policies 2006*, an impact on any park resource or value may constitute an impairment, but an impact would be more likely to constitute an impairment to the extent that it affects a resource or value whose conservation is

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park; or
- key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or

- identified in the park's general management plan or other relevant NPS planning documents as being of significance.

The significance and importance of each resource analyzed, based on the Isle Royale National Park enabling legislation, is discussed in the following sections.

For the selected alternative, a determination of non-impairment is made for each of the impact topics carried forward for detailed analysis in the plan/EIS. A non-impairment determination is not made for wilderness because this impact topic is not generally considered to be a separate park resource and value subject to the non-impairment standard established by the Organic Act and clarified further in Section 1.4.6 of *NPS Management Policies 2006*. A description of the current state of each resource topic evaluated for impairment can be found in chapter 3 of the plan/EIS. Each resource or value for which non-impairment is assessed and the reasons why impairment will not occur are described below.

ISLAND ECOSYSTEM

Isle Royale represents a unique island ecosystem that is driven by a series of complex interactive physical and biotic processes. The interrelationships of predator and prey interactions (wolf and moose) and their effects to the island ecosystem as a whole, including potential changes to vegetation, habitat, and other wildlife ecology were discussed in detail in the plan/EIS. The presence of wolves could directly and indirectly affect the community dynamics of the island and contribute to effects on other resources. Overall, the introduction of wolves under the selected alternative will increase the likelihood of a top-down, predator influenced system. The presence of wolves may create an environment with an apex predator affecting the key elements of the ecosystem. Under the selected action, the introduction of wolves will restore predation on the island. This will be a significant beneficial change from the current condition by restoring the ecological process of predation. The selected action will retain forest components that would otherwise be reduced in the presence of increased herbivory, allowing for forest succession to return to a historical trajectory last seen when predation had more influence in community dynamics. It is expected that with an increase in predation and a decrease in herbivory, the rate of ecosystem shifts (e.g., boreal to northern hardwood forest or savannas) will be slowed.

Successional vegetation changes on the island, as discussed above, will still progress but the rate of change will likely depend on climatic conditions and the frequency of disturbance events. A top-down predator-influenced system should assist in releasing some stresses on the island ecosystem and result in an overall improvement. As a result, the selected action will not result in impairment of the island ecosystem or its associated components, as are described below.

Aquatic Vegetation and Wetlands

Changes in the level of wolf predation affect moose population abundance and distribution, with indirect effects on vegetation abundance and distribution from changes in the rate and intensity of moose herbivory. Since aquatic plants can range from 14% to 37% of a moose's summer diet (Bump et al. 2009), the abundance and distribution of aquatic plants is highly dependent on the abundance of moose. Predation is important in that it exerts pressure on the moose population and in turn reduces herbivory. Increasing moose population numbers could result in trampling of vegetation near water bodies, such as sedge mats around the edges of lakes. Moose are

disturbance agents and their aquatic foraging activities can have lake-level consequences, especially for nutrient-poor systems. This natural process is known as bioturbation. Resultant nutrient releases can affect community and nutrient dynamics in these aquatic systems by altering nutrient uptake and plant and microbe productivity (Bump et al. 2016). Isle Royale also contains numerous wetlands (including marshes, bogs, and vegetated lake and pond shores) which support considerable biodiversity. Wetlands can be impacted either directly through effects such as trampling from moose, or indirectly from erosion. This plan would allow riparian and wetland vegetation (particularly shrubs, herbs, and grasses) to become dense and benefit those avian species dependent on densely vegetated habitat. The plan provides the NPS the ability to reduce the moose population resulting in reduced herbivory and trampling of aquatic vegetation in addition to reduced bioturbation, thus benefiting the ecosystem. As a result, the selected action will not result in impairment of aquatic vegetation or wetlands at Isle Royale.

Terrestrial Vegetation

Moose prefer to browse saplings of a variety of common island species as described in the plan/EIS. Since the tree species moose prefer can grow beyond moose browsing height, moose tend to browse on young growth and deplete these targeted species. These losses can result in changes to forest structure and composition over time. Absent wolves, possible changes associated with the current levels of moose herbivory include the decline of balsam fir on the west end of Isle Royale, and the potential to succeed towards a more savannah-like spruce-dominated forest type. Spruce in savannah-like settings with an exotic bluegrass understory (Cotter and Robertus 2015) would likely expand over the 20-year window (although dependent on climatic conditions as well). Without intervention, some species, such as balsam fir, yew, and mountain ash will benefit from the introduction of an apex predator by reducing herbivory of these key browse species and could promote regeneration as new shoots will be less heavily browsed. These changes will improve ecosystem resiliency. The selected action will slow the rate of change of forest composition on the island; however, other factors such as alteration of climate and succession may impact terrestrial vegetation regardless of the presence of wolves on the island. As a result, the selected action will not result in impairment of terrestrial vegetation at Isle Royale.

Soil Processes and Erosion

Soil chemistry is affected through browsing-induced changes to litter composition and reduced litter quantity. Soil carbon, nitrogen, cation exchange capacity, field nitrogen availability, potential mineralizing of nitrogen, and respiration rates are reduced in heavily browsed areas compared to areas where there is little to no browsing. These soil microbial processes determine the amount of nitrogen available to plants (Pastor et al. 1988). The selected action will likely result in a decrease in browsing, which could increase the available nitrogen for plants within communities on the island. Browse-induced changes in the availability of nitrogen for plants and consequent ecosystem changes may not be discernible in the 20-year plan horizon. Currently, over-browsing impacts on vegetation are not resulting in vegetation changes that are causing observable increases in soil erosion. Although other natural processes on the island, such as fire, can result in localized increases in erosion, moose browsing on terrestrial vegetation does not. As a result, the selected action will not result in impairment of soil processes and erosion at Isle Royale.

Other Wildlife – Notable Scavenger, Avian, and Prey Species

The dynamic relationship between moose and wolves on Isle Royale has impacts on other wildlife species and to some degree most species on Isle Royale. The common raven (*Corvus corvax*) (Egan, Gostomski, and Ferrington, Jr. 2015) and red fox (*Vulpes vulpes*) (Peterson and Vucetich 2016) are two important scavenger species documented at Isle Royale. The selected action will increase wolf predation of moose and beavers and could provide increased foraging opportunities for the common raven and red fox (Beyer et al. 2006; Krefling 1974). The introduction of wolves could result in interspecific mortality of foxes where foxes access moose carcasses. This occurs primarily in winter. While there is expected mortality, this mortality is not likely to result in impairment of the fox population because this event is relatively infrequent.

Representative bird species encompass a wide diversity of passerines and waterbirds, including a few warblers, waterfowl, shorebirds, corvids, flycatchers, woodpeckers, sparrows, and other birds common to the northern forests (NPS 2008a). The selected action will cause wolf population numbers to rise and the resultant moose population numbers could drop because of increased predation, which could allow riparian and wetland vegetation (particularly shrubs, herbs, and grasses) to become dense, resulting in benefits to those avian species dependent on densely vegetated habitats (as noted under “*Aquatic Vegetation and Wetlands*”).

Although wolves feed primarily on moose at Isle Royale (Peterson 1977; Peterson and Page 1988; Jordan, McLaren, Sell 2000), beavers are secondarily taken by wolves during the summer season and their population dynamics have been documented during studies of wolf ecology and prey relations at Isle Royale (Peterson 1977). The main impact of beavers on vegetation is from tree-cutting and dam-building activities (Krefling 1963). Under the selected action, beaver populations may decrease due to predation in the short term (i.e., 1 to 5 years). In the long term (i.e., more than 5 years) it is expected that predation of moose would benefit beavers because there would be a reduction in the competition for shared resources. With an introduction of an apex predator under the selected action, competition between these herbivores for key resources such as aquatic vegetation and aspen would be reduced. Wolves have been known to also kill American marten. It is not expected that the introduction of wolves would impact beaver or American marten species at the population level on Isle Royale. As a result, current and future generations of visitors will have similar opportunities to view other wildlife on Isle Royale. Therefore, the selected action will not result in impairment to other wildlife species at Isle Royale.

Water Quality

Isle Royale contains various water resources, including inland lakes, streams, and inlets from the surrounding Lake Superior waters. Changes in nutrient cycling could occur with increased moose foraging in aquatic environments in the absence of wolves. Large herbivores have a significant influence on internal phosphorus cycling (Bump et al. 2009). Nearly 50 years of data has shown that moose transfer significant amounts of aquatic-derived nitrogen to terrestrial systems from clustered foraging patterns such as feeding on aquatic plants and excreting in terrestrial habitats (Bump et al. 2009). Because the selected action could better regulate moose population growth, the selected action could cause a decrease in nitrogen and other nutrients transferred from the aquatic environment to terrestrial environments. Because water quality is

also impacted by increased turbidity caused by foraging moose, a decreased moose population as a result of the selected action will cause a lesser degree of turbidity with positive effects on water quality.

Direct contributions to water quality impacts from the selected action, such as the transportation of wolves to the island and ongoing monitoring activities to support the introduction of a viable population of wolves at Isle Royale, will be at levels similar to current park management activities and scientific studies on the island. Such impacts will not result in measurable changes to existing conditions. As a result, the selected action will not result in impairment to water quality at Isle Royale.

MOOSE

Moose population trends noted in 2016–2017 annual report (Peterson and Vucetich 2017) indicate the population has been growing at a mean rate of 21.6% per year for four consecutive years. The Isle Royale wolf population depends primarily on moose for prey, with moose comprising more than 90% of wolf diets (Vucetich, Nelson, and Peterson 2012a), forming virtually 100% of the wolf prey base from December to April and more than 80% prey biomass during the summer (Peterson and Page 1988). The introduction of wolves to Isle Royale under the selected action will directly impact individual moose and the overall moose population and indirectly impact the vegetation communities and overall island ecology.

Under the selected action, there will be direct adverse impacts to individual moose through carcass provisioning. Carcass provisioning will be expected to require no more than 24 moose during the first 5 years of the release. If all 24 moose were harvested from the island, impacts would be limited to the individual animals, and no population effects would occur. This assessment is based on the current moose population estimate of 1,300 animals, with 24 animals representing 2% of the total population (Peterson and Vucetich 2016).

Mech (1966) recorded a moose predation rate of a large wolf pack (15–16 individuals) on Isle Royale that averaged one moose per three days during the winter survey periods. Once established, a population of 30 wolves could result in a predation of approximately 210 moose per year, affecting a range of age classes. At the population estimate of 1,300 moose on Isle Royale for 2016, (likely underestimated per Vucetich and Peterson 2016), 210 moose kills per year will approach approximately 16% of the estimated current population. This estimated predation level will be below the moose population mean growth rate of 22% between 2012 and 2015 (Vucetich and Peterson 2015). If the current moose population on the island is greater than the estimated 1,300 animals recorded in 2016 (90% confidence interval ranging upwards to 1,690), the percentage kill rate would be even lower at approximately 12%.

The reduction of moose from increased wolf predation will have a beneficial indirect impact on moose habitat. Mech (1966) calculated approximately 5,823,300 pounds of browse are required annually to support approximately 89,425 pounds of moose or approximately 99 moose, assuming an average moose weight of 900 pounds. Further estimates calculate a single moose could consume on average 58,912 pounds of browse annually. Therefore, the release of 20–30 wolves and a reduction of 210 moose per year will result in approximately 12,371,545 pounds of

browse not removed by moose annually through herbivory. The reduction in this browsing pressure would reduce pressure on plant communities, assuming favorable climatic conditions.

If winter tick parasitism of moose is density-dependent or associated with predation pressures, the increased predation pressure from wolves also may reduce the severity or incidence of tick infestation. Thus, the selected action may potentially provide a benefit to the moose population through reduction of winter tick infestations, as population numbers began to decline.

Assuming the wolf population will grow after release in response to the abundance of food, it is possible that after five years of increased wolf predation, moose numbers might begin to decline, resulting in an increase in population health and reduced herbivory that will allow plant communities a greater potential to recover. After five years, it is likely that wolf predation can regulate the Isle Royale moose population at a density where competition for forage produces no detrimental effect. Thereby, plant communities could grow to provide adequate browse and thermal protection for moose on the island. Ultimately, the recovery of the plant communities would have a beneficial indirect impact on moose.

The selected alternative is expected to improve conditions for the moose at the population level, even though individual moose will experience adverse effects. The moose population at Isle Royale will continue in a condition better than its current state once the selected action is implemented. Therefore, implementation of the selected action will not impair moose at Isle Royale.

WOLVES

For purposes of this determination, the NPS analyzed impairment for wolves as a whole, including impacts to the two remaining wolves on the island and impacts that introduced wolves may experience once they arrive on the island.

Under the selected action, it is unknown whether the two remaining wolves on Isle Royale would contribute further to the gene pool or survive an introduction of unrelated, introduced individuals from the mainland. The resident pair may breed together or breed with introduced individuals. Impacts to the current Isle Royale wolf population under the selected action include the potential for social competition and increased intraspecific conflict, because a greater number of individuals would be establishing territories, pair bonds, and packs on the island. Impacts from intraspecific conflict (e.g., territory defense, prey) could result in mortality of resident and introduced wolves. Peterson and Page (1988) documented wolf mortality from interspecific conflicts on Isle Royale, and the potential for interspecific or interpack conflicts could result in mortality to the current resident wolves. However, if food is abundant and some relatedness exists, even in a growing population, intraspecific competition generally is reduced (Mech and Boitani 2003).

Potential impacts to introduced wolves could include mortality of introduced individuals attempting to return to the mainland via ice bridges from the island, if the season is not cold enough to ensure solid bridge formation. Given that on average ice bridge formation occurs in one out of 10 years and when formed, typically is short lived (approximately 10 days) (Licht et al. 2015), the potential emigration of introduced wolves back to the mainland will be low.

Disruption of the breeding season around mid-February could result in a limited period to form pair bonds, thereby affecting annual reproduction for that year. If pack establishment is delayed, the initial growth rate for the introduced population could be reduced in the short term. Overall, it is assumed that up to 10% of introduced wolves may not contribute to population goals due to mortality (e.g., natural death, intraspecific conflict) and emigration from the island.

The selected action would radio-collar up to all introduced wolves. The addition of radio telemetry collars to introduced wolves would have a potentially low increase in risk, since the National Park Service would carefully fit the radio collars to the animal to minimize the potential for external injuries (e.g., chafing). The subset of wild-born Isle Royale wolves subsequently collared could experience some potential adverse effects associated with being captured. Potential effects from aerial telemetry surveys as part of the monitoring program could adversely affect individuals or packs, if monitoring were to occur during deep snow and energy expenditures and stress levels were to increase, accordingly. However, the NPS biologists and research biologists have been conducting aerial monitoring of the Isle Royale wolves for decades. These teams have developed specific winter survey protocols to minimize adverse effects to wolves if environmental conditions warrant.

Overall, the introduction of wolves under the selected action would be beneficial. A founding population near observed long-term averages of Isle Royale and with an age structure demographically similar to non-harvested populations would likely maximize genetic variation and delay any potential future inbreeding problems. While there is a potential for the two remaining wolves on the island to experience adverse effects, the introduction of wolves to the island would ensure that current and future generations of visitors will have similar opportunities to experience the presence of wolves. Therefore, the selected action will not result in impairment of the Isle Royale wolf population.

SUMMARY

In the best professional judgment of the NPS decision-maker, based upon the impact analysis in the plan/EIS; relevant scientific studies; advice or insights offered by subject matter experts and others who have relevant knowledge or experience; and the results of civic engagement and public involvement activities, no impairment of Isle Royale resources or values will result from implementation of the selected alternative.