**General Directions for all:**

1. Create a food web to depict the ecological relationships in the given scenario by placing each organisms’ name (or picture) in the food web and connecting the organisms by arrows that illustrate appropriate feeding relationships.
2. Identify the specific types of autotrophs and heterotrophs in the ecosystem. This should include the following:
	1. Producers/autotrophs
	2. Herbivores
	3. Omnivores
	4. Carnivores
	5. Scavengers
	6. Decomposers
3. Identify the primary consumers, secondary consumers, and tertiary consumers in the food web.
4. Identify the trophic level(s) for each organism in the food web.
5. Find out the key role of your main organism in the ecosystem by exploring them in eol.org. Follow the instructions associated with your investigation case.

**Analysis/Discussion:**

1. a) What went wrong with this ecosystem?

 b) Why and how is the lack of your main organism affecting the rest of the ecosystem?

2. a) Why are the plants important in this ecosystem?

 b) Fill out the diagram to show where they get their energy from and what they produce.

 Photosynthesis diagram

3. Propose a solution to this problem.

 a) How can the ecosystem return to normal?

 b) What evidence supports your decision?

4. Read the article about your ecosystem to find out what actually went wrong with your ecosystem.

 a) Read the highlighted parts of the article.

 b) Compare what you read to what you thought the problem was with the ecosystem.

 c) Do you think the solution you proposed the previous day would still work? If not, what is

the revised suggestion for the solution?

**Let’s save the bees, small insects with a huge impact in our lives!**

You and your family walk into a field near a farm during early summer and you see less cherries

and strawberries than in previous years. You also observe less alfalfas, a type of plant in which

cows feed on. You notice something else missing as well. There are no bees around. They are not moving from flower to flower like they usually would at this time of the year. No bees means no honey for you! Oh no! Why are there less alfalfas?! What are the cows going to feed on now?! Does this mean these cows will produce less milk?! Honey and milk are used to make cheese, yogurt, ice-cream and many other products that you love to eat. What caused all of this? Could it be the lack of bees? Let’s investigate.

**Key terms that will help you in your investigation:**

* Alfalfas- type of flowering plant cows feed on.
* Insecticides- type of chemical used for killing insects that feed on plants.
* Bee-eater- a type of bird that feeds on bees.
* Eagle- a large bird that feeds on other birds.

**Directions:**

a. Visit [www.eol.org](http://www.eol.org) . Write “bee” in the search bar and select “Go”.

b. Select the “Detail” tab on the top of the page.

c. In the “Detail” page, select “Associations” from the Table of Contents on the left

d. Read about the role of bees in the ecosystem.

e. Answer the question: What role do bees play in the ecosystem?

**The whales need your help!**

You and your classmates are going on a fieldtrip to Cape Cod. Everyone gets on a boat to watch

the whales. While on the boat, you see not only the endangered right whales, but also many

different species including tuna, sharks, and seabirds. Your teacher explains that the whales feed on zooplankton and krill. She also says there are less whales coming back each year. Therefore, there might be no whales coming back the following year. Oh, no! Why?! You really like whales and you wonder if you can do something to make them return. You and your fellow explorers decide to investigate.

**Key terms that will help you in your investigation:**

Endangered- animals in danger of not existing anymore.

Right whale- a species of whale.

Phytoplankton- plant like plankton that live in the uppermost sunlit layer of the ocean called the photic zone.

Zooplankton- animal like plankton that drift in oceans and seas around the world. They vary in

size from single cell organisms to much larger multicellular organisms. Zooplankton’s diet

consists of phytoplankton and smaller zooplankton.

Krill- small crustaceans who live in all of the world’s oceans. They feed mainly on

Phytoplankton.

**Directions:**

a. Visit [www.eol.org](http://www.eol.org) . Write “right whale” in the search bar and select Go.

b. Select the “Detail” tab on the top of the page.

c. In the “Detail” page, select “Associations” from the Table of Contents on the left.

d. Read about the whales.

e. Answer the question: What do right whales feed on?

f. Then, select “Habitat”

g. Look through the graphs and see how much oxygen these whales need. Where could the

oxygen come from?

**Only three grey wolves left in the Isle Royale National Park!**

Have you ever seen a wolf? You might have seen one in documentaries or movies on the TV.

Wolves are fascinating animals, which unfortunately are seen less and less in some of their

habitats in the United States. One of the last places to find them in is the Isle Royale National

Park, which only has three wolves left. Wolves are a keystone of this park’s ecosystem, and their loss could cause the whole ecosystem to destabilize. You want to find a way to keep them

around. You and your fellow explorers decide to investigate.

**Key terms that will help you in your investigation:**

Endangered- animals in danger of not existing anymore.

Grey wolf- a type of wolf that feeds on animals such as moose and rabbit. The grey wolf is an

endangered animal.

Moose- the largest species of the deer family. Moose diet mainly consists of plants like Aspen

and grass.

Snowshoe Hare- type of rabbit that gets its name from its large hind feet. Snowshoe hare feed on small plants and flowers such as grass.

Aspen- the common name of the tree species section populous. It grows in Northern and Western North America.

**Directions:**

a. Visit [www.eol.org](http://www.eol.org) . Write “Grey Wolf” in the search bar and select Go.

b. Select the “Detail” tab on the top of the page.

c. In the “Detail” page, select “Associations” from the Table of Contents on the left.

d. Then look at “Ecology” and “Conservation.”

e. Answer the question: What role do Grey Wolves have in the ecosystem?

**No whales means no fish either?!**

Have you ever seen a whale? You might have seen one on a whale watching trip or on TV.

Unfortunately whale sightings have become rarer as they are being severely hunted. In the past, scientists believed that if the whale population decreased, the krill population, their food source, would increase. They further expected that the oceans would have more fish since there would be more food available to them. Strangely enough however, as the whale population has declined so has the population of krill and other fish. It has become clear that whale and krill populations are linked. You and your fellow explorers want to find out why the presence of whales benefits the whole ocean. If you find this information, you can advocate against whale hunting.

**Key terms that will help you in your investigation:**

Endangered- animals in danger of not existing anymore

Blue whale- the largest living animal and the heaviest known to have ever existed. Blue whales eat mainly krill. Blue whales are endangered species.

Phytoplankton- plantlike plankton that live in the uppermost sunlit layer of the ocean called the photic zone.

Zooplankton- animal like plankton that drift in oceans and seas around the world. Zooplankton’s diet consists of Phytoplankton and smaller zooplankton.

Krill-small crustaceans who live in all of the world’s oceans. They feed mainly on

Phytoplankton.

Squid- found in all oceans. They feed mainly on Zooplankton.

**Directions:**

a. Visit [www.eol.org](http://www.eol.org) . Write “Blue Whale” in the search bar and select Go.

b. Select “Detail” tab on the top of the page

c. In the “Detail” page, select “Associations” from the Table of Contents on the left

d. Then look at “Ecology” and “Conservation”

e. Answer the question: What role do blue whales have in the ecosystem?

**Sea otters, friends or enemies with the seagrass meadow?**

Have you ever wondered what keeps the ocean clean? Seagrass meadows are one of the main

plants along the ocean coasts that can filter the water. They are the foundation of an ecosystem that encompasses a host of sea life such as sea slugs, crabs, and sea otters. Unfortunately, seagrass is dying, destroying the ecosystem they support. Knowing the importance of the sea grass, you want them to flourish and you wonder what ocean animal could help you with that. You and your fellow explorers decide to investigate.

**Key terms that will help you in your investigation:**

Seagrass- aquatic plant that grows along most coasts although it favors warmer climates.

Seagrass often grows in large meadows.

Sea Otters- animals whose diet is composed of a variety of organisms including crabs and

starfish. Sea otters are endangered.

Rock crabs- sea crabs that eat small fish and sea slugs.

Sea Slug- type of snail that live in water temperatures ranging from frigid to tropical. Sea slugs

eat mainly algae.

Algae- a word for a large group of aquatic plants including seaweed. Algae grows in oceans all

over the world.

**Directions:**

a. Visit [www.eol.org](http://www.eol.org) . Write “Sea Otter” in the search bar and hit Go

b. Select “Enhydra lutris”

c. Then select the “Detail” tab on the top of the page

d. In the “Detail” page, select “Associations” from the Table of Contents on the left

e. Then look at “Ecology” and “Conservation”

f. Answer the question: What role do Sea Otters have in the ecosystem?

THE HIDDEN POWER OF WHALE POOP

THE LARGEST ANIMALS ever to have lived on Earth, blue whales are colossal in every

respect — including, it must be said, the scatological. When a blue whale goes, it goes

big. This remarkable phenomenon was recently captured on camera by Eddie Kisfaludy, a

marine biologist and oceanographic consultant. While conducting an aerial survey off the

coast of southern California, he flew over a pod of 40 blue whales. The waters were rich in krill, the tiny crustaceans on which blue whales feed, and their orange hue was brightly visible in a fecal plume he photographed. It’s hard to judge absolute distances from the photo, but in scale the deposit is nearly as long as a fullgrown blue whale.

It may well be the world’s largest documented poop. It’s also an exclamation point to a

line of research pursued in recent years by marine biologists who say whales are the

ocean’s unappreciated gardeners, playing enormous roles in nutrient and carbon cycles.

In short — or perhaps in long — their poop helps make the aquatic world go round.

“Whales and marine mammals can fertilize their surface waters,” said Joe Roman, a

conservation biologist at the University of Vermont, when shown Kisfaludy’s picture.

“This can result in more plankton, more fish, and more whales.” How could that be true?

It now turns out that whales maintain the populations of their prey.

They often feed at depth, but they seldom defecate there, because when they dive the

stress this exerts on the body requires the shutdown of some of its functions. So they

perform their ablutions when they come up to breathe. What they are doing, in other

words, is transporting nutrients from the depths, including waters too dark for

photosynthesis to occur, into the photic zone, where plants can live.

In 2010, after sampling the scat of humpback whales in the Gulf of Maine, Roman and

Harvard zoologist James McCarthy proposed what they called the “whale pump”: A

mechanism describing how whales feeding at depth carry nitrogen to warm, energy-rich

surface waters, discharging it in “flocculent fecal plumes.”

Flocculent is a lovely word for a loose aggregation of particles, fluffy or woolly in nature.

It’s also why whale poop floats. Most previous research on oceanic carbon and nitrogen

flows fixated on their downward drift, but the whale pump represented a flow in the

opposite direction, a way for surface waters to continually be recharged, stimulating the

growth of plankton and everything that eats them.

Before commercial whaling, calculated Roman and McCarthy, the whale pump

distributed three times more nitrogen across the Gulf of Maine than entered it from

atmospheric sources. Even today, with whale populations at a fraction of historical

levels, they added more nitrogen than all rivers and streams running into the Gulf

combined.

Perhaps that’s why sea life in the Gulf of Maine was once so abundant, and the benefits

wouldn’t have ended there. As aquatic plants and animals grow, and in particular as plankton grows, they absorb carbon, then bury it on the seafloor when they die. That’s the rationale behind iron fertilization, a geoengineering technique that some researchers think could counteract global warming.

From this perspective, whales aren’t just gardeners, but geoengineers as well. Marine

biologist Trish Lavery of Australia’s Flinders University estimated that defecation by the

Southern Ocean’s sperm whales ultimately sequesters some 400,000 tons of carbon

dioxide every year. Prior to their commercial whaling decline, that population alone

would have accounted for about roughly the amount emitted by one decent-sized coalfired

power plant.

An open and important question is how whale abundance alters ecosystems, Pershing

said. Their effects could be enormous, especially when conceived in historical terms:

Once there were more than 200,000 blue whales in the Antarctic Ocean alone, whereas

today there are perhaps 8,000 in the whole world. Whatever they once provided has

largely been lost, and restoring their populations might bring it back.

“Although other air-breathing vertebrates, such as seabirds and seals, can also pump

nutrients to the surface, none are as large, or as abundant, as baleen whales were before

the age of commercial whaling,” said Roman. Blue whales’ feces “must have a large

impact on their ecosystems.”

Asked what he thought when seeing Kisfaludy’s photograph, Roman said, “I wish we

had a net on hand to gather the poop.”

Said Pershing, “I’m glad I don’t have to pick that up.”

**Declining Bee Population Pose A Threat to Global Agriculture**

One of every three bites of food eaten worldwide depends on pollinators, especially bees, for a successful harvest. And in the past several months, a scramble in California’s almond groves has given the world a taste of what may lie in store for food production if the widespread — and still puzzling — decimation of bee colonies continues.

For much of the past 10 years, beekeepers, primarily in the United States and Europe, have been reporting annual hive losses of 30 percent or higher, substantially more than is considered normal or sustainable. But this winter, many U.S. beekeepers experienced losses of 40 to 50 percent or more, just as commercial bee operations prepared to transport their hives for the country’s largest pollinator event: the fertilizing of California’s almond trees.

Spread across 800,000 acres, California’s almond orchards typically require 1.6 million domesticated bee colonies to pollinate the flowering trees and produce what has become the state’s largest overseas agricultural export. But given the widespread bee losses to so-called “colony collapse disorder” this winter, California’s almond growers were able to pollinate their crop only through an intense, nationwide push to cobble together the necessary number of healthy bee colonies.

“Other crops don’t need as many bees as the California almond orchards do, so shortages are not yet apparent, but if trends continue, there will be,” said Tim Tucker, vice-president of the American Beekeeping Federation and owner of Tuckerbees Honey in Kansas, which lost 50 percent of its hives this past winter. “Current [bee] losses are not sustainable. The trend is down, as is the quality of bees. In the long run, if we don’t find some answers, and the vigor continues to decline, we could lose a lot of bees.”

The gravity of the situation was underscored on Monday, when the European Commission (EC) said [it intended to impose a two-year ban](http://www.nytimes.com/2013/04/30/business/global/30iht-eubees30.html) on a class of pesticides known as neonicotinoids, now the world’s most widely used type of insecticide. Neonicotinoids are one of the leading suspected causes of colony collapse disorder, and the European Commission announced its controversial decision three months after the European Food Safety Agency concluded that the pesticides represented a “high acute risk” to honeybees and other pollinators.

**Protecting New England’s Marine Ecosystem: Habitat at Risk**

All animals need safe places to grow, reproduce, and ﬁnd food. Marine animals are no different. In the ocean, their habitats can be the sandy bottom, a seamount rising from the ocean ﬂoor, or a deep canyon carved into the continental shelf. These places are affected by pollution and other human activities such as oil and gas drilling and commercial ﬁshing, which research shows can have negative consequences. The National Oceanic and Atmospheric Administration is tasked with regulating ocean ﬁshing and protecting our nation's ocean resources.

Some areas of New England's waters have been closed to various types of ﬁshing gear for decades in order to encourage the return of healthy populations of important groundﬁsh (such as cod, haddock, and ﬂounder), but the region does not have a plan for habitat management, as required by federal law. A plan for protecting essential ﬁsh habitat has been under development for 10 years.

A variety of alternatives will be presented to the public later this year, many of which propose a reduction in the size of the area currently protected. Some of these proposals ignore established science and place the short-term interests of the commercial ﬁshing industry above the need to protect habitat for the long-term beneﬁt of the ecosystem, its ﬁsh populations, and the coastal communities they support.

#### Healthy fish

Biologically productive habitat of ample size is essential to maintain healthy ﬁsh populations. For example, recent work by the Gulf of Maine Research Institute found that older cod—critical to the reproductive success of the species—are far more abundant inside protected areas, making these places crucial to the recovery of depleted cod populations.1 Closed areas also contributed to the recovery of New England's scallop ﬁshery.2

#### Healthy ecosystems

Habitat protection may be more important now than ever before, because these areas can provide resilience for marine species and ecosystems against the effects of climate change. New England waters are warming, disrupting ﬁsh populations and undermining the marine food web.3 A climate change adaptation strategy produced in 2012 by NOAA and other federal agencies made habitat protection a top priority for helping ﬁsh adapt to warming oceans.4



#### A new way to manage fish

Protecting habitat is part of a new way of managing ﬁsh, and it can lead to better ecosystem health in the future. Instead of looking at each ﬁsh species in isolation, this ecosystem-based ﬁsheries management approach takes into account the ways that marine species interact with one another and with their environment. Leading scientists have advocated for such a management model for many years. It's time to take action. Fisheries managers should:

* Protect habitat.
* Leave enough small ﬁsh in the water to feed the entire food web.
* Minimize the incidental take (bycatch) of nontarget ﬁsh, birds, and mammals.
* Establish ﬁshery ecosystem plans that take a broader view of interactions among species.

# **Sea otters promote recovery of seagrass beds**

*Recolonization of Elkhorn Slough by sea otters led to recovery and expansion of seagrass beds due to cascading effects on the food web, study finds*

August 26, 2013

By Tim Stephens

Scientists studying the decline and recovery of seagrass beds in one of California's largest estuaries have found that recolonization of the estuary by sea otters was a crucial factor in the seagrass comeback. Led by researchers at the University of California, Santa Cruz, the study will be published in the Proceedings of the National Academy of Sciences the week of August 26.

Seagrass meadows, which provide coastal protection and important habitat for fish, are declining worldwide, partly because of excessive nutrients entering coastal waters in runoff from farms and urban areas. The nutrients spur the growth of algae on seagrass leaves, which then don't get enough sunlight. In Elkhorn Slough, a major estuary on California's central coast, algal blooms caused by high nutrient levels are a recurring problem. Yet the seagrass beds there have been expanding in recent years.

"When we see seagrass beds recovering, especially in a degraded environment like Elkhorn Slough, people want to know why," said Brent Hughes, a Ph.D. candidate in ecology and evolutionary biology at UC Santa Cruz and first author of the PNAS study. His coauthors include Tim Tinker, a wildlife biologist with the [U.S. Geological Survey](http://www.werc.usgs.gov/tinker), and Kerstin Wasson, research coordinator for the [Elkhorn Slough National Estuarine Research Reserve](http://www.elkhornslough.org/esnerr/), who are both adjunct professors of ecology and evolutionary biology at UCSC.

Hughes and his colleagues documented a remarkable chain reaction that began when sea otters started moving back into Elkhorn Slough in 1984. The sea otters don't directly affect the seagrass, but they do eat enormous amounts of crabs, dramatically reducing the number and size of crabs in the slough. With fewer crabs to prey on them, grazing invertebrates like sea slugs become more abundant and larger. Sea slugs feed on the algae growing on the seagrass leaves, keeping the leaves clean and healthy.

"The seagrass is really green and thriving where there are lots of sea otters, even compared to seagrass in more pristine systems without excess nutrients," Hughes said.

In addition to the sea slugs, small crustaceans known as Idotea are also important grazers on the algae, and they too increase in number when sea otters control the crab population.

This kind of chain reaction in a food web is known to ecologists as a "trophic cascade." Scientists have long known that sea otters have a big impact on coastal ecosystems. Their importance in maintaining kelp forests by preying on animals that graze on kelp is especially well documented. The new study shows sea otters play a slightly different but equally important role in estuarine ecosystems like Elkhorn Slough, according to Tinker.

"This provides us with another example of how the strong interactions exerted by sea otters on their invertebrate prey can have cascading effects, leading to unexpected but profound changes at the base of the food web," he said. "It's also a great reminder that the apex predators that have largely disappeared from so many ecosystems may play vitally important functions."

The sea otter population in Elkhorn Slough has had its ups and downs, reflecting trends in the ongoing recovery of California's sea otters. The slough's initial recolonizing population of about 15 declined in the late 1980s, then grew to nearly 100 in the 1990s before declining again, followed by a recovery over the past decade. These fluctuations in the otter population were matched by corresponding fluctuations in the seagrass beds, Hughes said. Even within the slough, he said, sea otter density varies among the different seagrass beds, and those with more otters have fewer and smaller crabs and healthier seagrass.

The researchers used a combination of field experiments and data from long-term monitoring of Elkhorn Slough to study these interactions. "We used multiple approaches, and they all came up with the same answer," Hughes said.

Eelgrass (Zostera marina) is the dominant seagrass in Elkhorn Slough and elsewhere in the northern hemisphere. Seagrasses in general provide important nursery habitat for juvenile fish, and eelgrass beds along the west coast are especially important for species such as Pacific herring, halibut, and salmon. In addition, seagrass beds protect shorelines from storms and waves, and they soak up carbon dioxide from seawater and from the atmosphere.

"These are important coastal ecosystems that we're losing, and mostly that's been associated with bottom-up effects like nutrient loading. This study shows that these ecosystems are also being hit by top-down forces due to the loss of top predators," Hughes said.

The findings in Elkhorn Slough suggest that expansion of the sea otter population in California and recolonization of other estuaries will likely be good for seagrass habitat throughout the state, he added.

According to Wasson, the study has important management implications, suggesting that to restore valued coastal habitats, it may be necessary to restore entire food webs. "That is a new perspective for us," she said. "Most estuarine managers focus on the bottom-up approach, bringing back marshes and eelgrass and hoping the rest comes along with it. But in this case, it's clear you need to focus on the top and bottom of the food web at the same time."

In addition to Hughes, Tinker, and Wasson, the coauthors of the study include Ron Eby and Eric Van Dyke at the Elkhorn Slough National Estuarine Research Reserve; Corina Marks at California State University Monterey Bay; and Kenneth Johnson at the Monterey Bay Aquarium Research Institute. This work was supported by the National Estuarine Research Reserve System, the California Department of Fish and Wildlife, and the U.S. Geological Survey's Western Ecological Research Center.

Only 3 Wolves Left at Isle Royale National Park

Sixty years ago, Michigan's Isle Royale was one of the only places you could find gray wolves in the contiguous United States.

Today, the wolf population at the remote national park is in trouble. Now there are just three individuals — a mated pair and their pup — left on the island in Lake Superior, according to a [new report](http://isleroyalewolf.org/sites/default/files/annual-report-pdf/Annual%20Report%202015-for%20web.pdf). Inbreeding is to blame, ecologists say, but climate change may be an indirect culprit in the decline.

It might be too late for the population to recover on its own, and wildlife managers are considering bringing more [wolves](https://www.livescience.com/27909-wolves.html) to the island to keep the growing moose population in check and restore the health of the ecosystem. [[Gallery: Photos of Brand-New Baby Wolves](https://www.livescience.com/18218-gallery-baby-maned-wolves.html)]

A “sky glow” named ‘Steve’, an ant making a break for it with a diamond , and new signs of life in a field riddled with hundreds of dead headless reindeer.

"Isle Royale is the last place on the planet where you have a forested ecosystem, a wolf population and moose population where none of them are exploited by humans," said John Vucetich, a wildlife ecologist at Michigan Technological University, who worked on the new report.

Because it is somewhat isolated from human influence, Isle Royale is an ideal place to study [predator-prey dynamics](https://www.livescience.com/49191-bears-wolves-carnivores-thriving-europe.html). And since the late 1950s, scientists have been conducting yearly surveys to figure out how and why the populations of wolves (predators) and moose (prey) on this island shift over time.

Moose arrived on Isle Royale by 1900. Without any predators, the moose population was kept in check only by starvation, and the animals were stripping the island of its native plants and trees, such as balsam firs. Conservationists in the early 20th century, including Aldo Leopold, entertained the idea of introducing [gray wolves](https://www.livescience.com/43213-unsettled-science-gray-wolf-peer-review.html) on Isle Royale to take care of the moose problem, Vucetich said. But then wolves came to the island on their own via an ice bridge in the late 1940s. The wolf population increased to as many as 50 individuals over time, but has averaged at about 25.

The last time the wolf population dropped significantly was around the year 1980, when there was an outbreak of [canine parvovirus](https://www.livescience.com/23048-yellowstone-wolves-hit-by-disease.html), which was introduced to the island by pet dogs, Vucetich said. The population stayed low for another 10 or 15 years and then started to increase again in the 1990s. But in the last six years, biologists have witnessed another crash in wolf abundance.

In January 2014, nine wolves were counted in the survey. The three wolves counted in January 2015 mark a new low. Over the same one-year period, the moose population grew 19 percent, from 1,050 to 1,250, according to the report.

With such a small population, the wolves are susceptible to inbreeding, which can lead to serious health and reproductive problems. Bone deformities that occur at a rate of 1 in 100 in the general wolf population have been occurring recently at a rate of 1 in 3 in the wolves on Isle Royale, Vucetich said. And the small family of wolves left on the island doesn't seem to be faring so well. The two adults, which have been a mated pair for four years, had three pups two years ago, none of which survived beyond their second birthdays, Vucetich said. The pup that's currently with them appears to have a hunched posture and a deformed tail. [[In Photos: The Fight Over Gray Wolves' Endangered Status](https://www.livescience.com/40137-photos-gray-wolves-endangered-status.html)]

A comeback is unlikely without new genetic material. But climate change might make it more difficult for roving wolves from the mainland to get to Isle Royale on their own, as warming temperatures in [Lake Superior](https://www.livescience.com/31952-lake-superior.html) already make it less likely for an ice bridge to form in the winter, Vucetich said.

"If you think the purpose of a national park is to protect ecosystem health, you need to do something," Vucetich said. "The National Park Service has known about this problem for some time now, and they are delaying making a decision. That's disappointing."

But a [wolf reintroduction program](https://www.livescience.com/17263-yellowstone-wolf-environment-change.html) would likely take a few years to get off the ground. The National Park Service is currently weighing if and how they should intervene. Phyllis Green, superintendent of Isle Royale National Park, said an environmental impact analysis about how to manage wolves and moose on the island should be up for public comment in the next couple of months. But it's complicated because her agency has to manage for an entire ecosystem, not just wolves, in the face of a warming world.

"What are we going to do about climate change with species other than wolves?" Green said. "That's the larger question. That's why we have to decide where we put the park service's energy."

People focus on wolves because they're charismatic animals, Green said. But in her eyes, the true face of climate change on the island might be a type of cisco fish that was only found in the park's lakes and streams, but is now extinct.

"They're gone forever because their genetic strain is gone," Green said. "With wolves, we are fortunate because we have options to explore through this planning process. We have healthy wolf populations with healthy genes all around this island."