

Environmental Threats

Sleeping Bear Dunes
National Lakeshore
Michigan



A Publication of
Friends of Sleeping Bear Dunes

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This booklet was compiled by Kerry Kelly,
Friends of Sleeping Bear Dunes.

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Sleeping Bear Dunes National Lakeshore, a unit of the National Park System, preserves the natural beauty and biodiversity of Northwestern Michigan in an area of approximately 71,000 acres that includes North and South Manitou Islands. The National Lakeshore encompasses a wide variety of ecological areas including Lake Michigan, shorelines and beaches, coastal dunes, perched dunes, inland lakes and streams, forests, and meadows. One of the responsibilities of the National Park System is to preserve and protect these natural areas for generations to come.

The intent of this booklet is to provide a short history of the development of the ecosystems in Sleeping Bear Dunes National Lakeshore and to describe some of the impacts that people have had on them. You will learn about some of the unintended consequences of our development as a nation, and some of the specific environmental threats to the ecosystems in the National Lakeshore today. As you read, think about how your actions affect this beautiful place.

History – Great Lakes Region

During the most recent ice age, continental glaciers spread southward from Canada and repeatedly covered this area under massive sheets of ice up to a mile thick. The glaciers carved out the Great Lakes and smaller inland lakes. They also deposited gravel and sand forming the hilly terrain you see today. The last glacier retreated about 10,000 years ago and since that time, other natural processes such as erosion and deposition carved the land, and the native plant and animal populations evolved together developing into balanced ecosystems.

About 3,000 years ago, Native Americans lived here, but due to their small population and low-impact lifestyle, they did not alter the balanced natural environment. Very little development occurred until Europeans started coming in greater numbers in the mid-1800s.

When the Erie Canal opened in 1825, the Great Lakes became one of the primary transportation corridors from the east coast to Chicago enabling the industrial revolution to push into the midsection of the United States. As the cities of the Midwest began to grow and prosper, the Great Lakes shipping industry expanded rapidly. Demand for lumber to build the cities resulted in the massive expansion of the logging industry in Michigan and Wisconsin.



SS Puritan at the Glen Haven Dock

This commercial exploitation of the forests dramatically changed the natural ecosystem for the first time since the glaciers. While the cutting of trees had obvious negative effects, there were also unintended consequences such as soil erosion that degraded the soil and washed silt and nutrients into the streams and lakes. This deforestation period lasted until most of the trees were gone.

The first settlement in what is now Sleeping Bear Dunes National Lakeshore was established on South Manitou Island in the mid-1830s. The purpose of the settlement was to provide cordwood to fuel the steamships that traveled between the Erie Canal and the Chicago area. In about 10 years, most of the trees around the dock were gone, but the demand for cordwood continued to grow. By the 1870s most of the trees on the islands were removed – clear cut – leaving nothing but brush and stumps. The logging companies moved to the mainland in the 1850s. By 1910 most of the forests were cut throughout Michigan. Huge, majestic trees hundreds of years old were sawn into boards and taken by ship or rail to build our cities leaving a ravaged landscape behind.



Logging Sled and Crew



Clear-cut Forest

The widespread logging of the forests resulted in little remaining ground cover to prevent soil erosion. This depleted the soils of their nutrients and caused a buildup of nutrients in Lake Michigan and the inland lakes. The increased nutrient content of the lakes resulted in more algae causing lower oxygen levels in the lakes, and reduced populations of aquatic species. As the logging ended, the lake began to become cleaner because the forests were recovering resulting in less soil erosion.

Of course some of the cleared land could now be used for farming. As the farms were established, the farmers quickly realized that they could boost productivity by adding manure and (eventually fertilizer). Some of the fertilizer eventually found its way into the streams and rivers and finally into inland lakes and Lake Michigan, again adding to the nutrient content in the lake.

As agricultural practices developed, other environmental problems arose. By the 1950's pesticides had been developed to be sprayed on fields and orchards to

control weeds and insects. These chemicals also found their way into the water and the food chain. DDT, PCBs, heavy metals, and other toxic materials were eventually banned or regulated and the ecosystem slowly recovered again.

As more people moved into this area in the early 1900's they brought with them animals and crops from other parts of the world. A wide variety of non-native plants, insects, and animals were introduced – some intentionally as crops or garden plants and some accidentally as impurities or hitchhiking on animals or in building materials. Many of these introduced species have no predator in this ecosystem because they did not co-evolve with native species. As a result, they may take over, displacing native species.

As the population of the Midwestern United States grew, there was increasing demand to move cargo from the east coast and Europe into the Midwest. Canals were developed in the mid-1800s to allow ships to navigate the St. Lawrence River into the Great Lakes. Non-native aquatic species (fish, mussels, lampreys, etc.) began to show up in the Great Lakes. Often these species had no predators in the Great Lakes, so they flourished – often to the detriment of the native species. A good example of this is the Sea Lamprey, which nearly decimated the commercial fishing industry in the Great Lakes. With the opening of the St. Lawrence Seaway in 1959 this problem grew exponentially. Today, most of these invasive species enter the Great Lakes in the ballast water of the ocean-going cargo ships. Zebra Mussels, Quagga Mussels, Round Gobi's, Spiny Water Fleas are just a few examples of invasive species that have entered the Great Lakes this way and have taken over their new habitat.

By the early 1900's, growth of the cities near the Great Lakes had other impacts on the environment. Phosphate detergents worked well for cleaning clothes and as industrial cleansers, but phosphate is also a fertilizer and when the water from a washing machine discharged, the phosphate found its way through sewers and septic systems into the groundwater, dramatically increasing the nutrient level in the rivers, inland lakes and Great Lakes causing an increase in algae and decrease in oxygen content required for aquatic species to “breathe”. By the mid-1900's industrial chemicals found their way into the rivers and lakes too because of poor industrial controls. Water pollution became so bad that fish and other aquatic life were being poisoned, prompting congress and state legislatures to pass laws limiting the amount of industrial pollutants and phosphates that could be discharged into the water. The Clean Water Act of 1972 set goals for water quality and established the standards managed by the Environmental Protection Agency (EPA) and implemented by the states. This began a process that would result in dramatically improved water quality. The Clean Water Act has been amended several times to respond to new threats to our nations waters.

We will now look at the environmental threats in several of the ecosystems within the boundaries of Sleeping Bear Dunes National Lakeshore.

Lake Michigan

The boundary of Sleeping Bear Dunes National Lakeshore extends ¼ mile into Lake Michigan, so the environmental threats to the lake are also included here. The balance of aquatic life in Lake Michigan was established during the 10,000 years since the last glacier (Wisconsin Glacier) receded.

Overfishing

When European settlers came to the Great Lakes, they quickly established a commercial fishing industry due to the abundance of high quality fish. The catch increased about 20% every year between 1820 and 1880. By the end of that period, the fish population was becoming depleted in the Great Lakes due to overfishing and destruction of spawning grounds. New fishing technologies increased efficiency from 1910 through 1950s, but annual catches have declined since then due to overfishing. The larger, high-value fish have been replaced by smaller, low-value fish.

By 1960 the commercial fishery in the Great Lakes was near collapse. The once common lake sturgeon is rare today due to overfishing. Declining stocks of lake trout and other native species were the result of overfishing and a non-native predator – the sea lamprey. The lake trout was the primary top predator in the food chain, so as its population declined, the population of alewife (another non-native fish discussed later) increased dramatically. During the 1960s through the 1980s, miles of Lake Michigan shoreline were often littered with rotting, stinking alewife carcasses.

To counter the alewife problem, Michigan intentionally introduced two non-native species into Lake Michigan: Coho (1966) and Chinook (1967) salmon. These have now become an economically important recreational fishery and the alewife population has been reduced. Part of this reduction is also due to the unintentional introduction of the round goby (see below). As you can see, non-native species do not always enter an ecosystem accidentally. Sometimes they are introduced intentionally as a solution to other problems. The consequences of introducing a non-native species are complex and not completely understood for years after the introduction.

Invasion by Non-Native Species

History has taught us that once introduced into the Great Lakes ecosystem, non-native invasive species are very difficult (often impossible) to eradicate and very expensive to manage. By 2008, the number of non-native aquatic species known to have been introduced into the Great Lakes reached 186. The number is probably much higher because of microscopic or inconspicuous species that have likely gone undetected. Non-native species find their way into the Great Lakes through a number of means, but the most prolific pathway has been through ballast water of ocean-going cargo ships that enter the Great Lakes

through the St. Lawrence Seaway and empty their ballast water into the lakes. If the ballast water is not treated, the organisms that were picked up with the water will be released into the Great Lakes. Regulations are in place now to require monitoring and treatment of ballast water.

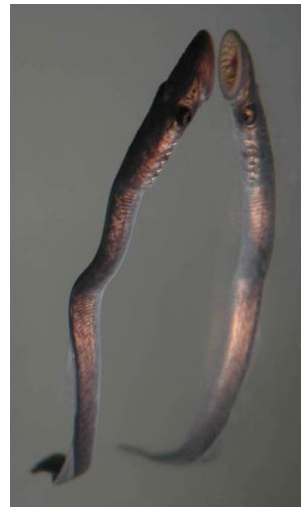
Some of these non-native species become hazardous to the ecosystem. Generally, a natural balance between a species and its predators and prey develops over many years of co-evolving together. When a species is moved from its balanced native ecosystem and introduced to a new ecosystem it may find that the new environment suits it very well especially if it has no predators, disease organisms, and plenty of food in the new system. In this case, its population can grow rapidly and cause an imbalance in the new ecosystem, resulting in dramatically reduced populations – even extinctions – of the native species. When this happens, we call the introduced species an **exotic (or non-native) invasive species**.

Of course, this works in both directions. Some of our native species when introduced into ecosystems in other parts of the world will become an invasive species there. So controlling the transport of species from one ecosystem to another is very important. This is true whether we are talking about aquatic or land-based ecosystems.

Sea Lamprey (*Petromyzon marinus*)

As already mentioned, sea lamprey is a predator that kills or scars large, commercially important fish. The lamprey uses its suction cup-like mouth to attach itself to the skin of a fish and rasps away tissue with its sharp probing tongue and teeth. Secretions in the lamprey's mouth prevent the victim's blood from clotting, and victims typically die from excessive blood loss or infection. Each lamprey can kill over 40 pounds of fish throughout its life.

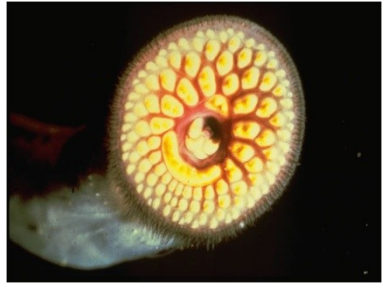
Sea lamprey first came into the Lake Ontario from the Atlantic coast through the Erie Canal. When the Welland Canal was built for commercial shipping to navigate around Niagara Falls, the natural barrier to lamprey migration was removed and the lamprey moved into the Great Lakes. The first sea lamprey was detected in the Great Lakes around 1920 and their population has dramatically expanded since resulting in a large reduction in whitefish and lake trout populations.



Sea Lamprey and mirror



Two lamprey attached to fish



Lamprey mouth

Today an extensive management program is run by the U.S. Fish and Wildlife Service and the Great Lakes Fish Commission. They survey lamprey populations, trap adult lamprey and larvae, and treat streams where the lamprey spawn with lampricides, which are designed to kill only the lamprey and not affect other species in the ecosystem. Continued vigilance is required to control the lamprey population. The program has been very successful, reducing the lamprey population by 90% since the program began.

Alewife (*Alosa pseudoharengus*)

The alewife is a species of herring native to the Atlantic Ocean. Like the sea lamprey, it came into Lakes Huron and Michigan through the Welland canal. After sea lampreys eliminated most of Lake Michigan's large predator fish, the alewife population exploded throughout Lake Michigan. These small silvery fish average about 6 inches in length and weigh about 4 ounces. During the early summer, these small fish spawn in harbors and near-shore waters, disappearing by late fall to feed off the bottom in the central depths of the lake. They migrate shoreward again in mid-March and April, completing the yearly cycle.

Alewives swim in dense schools and have been the major prey of the Lake Michigan's trout and salmon. At the same time alewives have exerted overwhelming pressures on lake herring, whitefish, chubs, and perch:

species that compete with alewives for the plankton and other small aquatic organisms that make up the diet of these fish. The unintentional introduction of the round goby has provided a competitor for their food and resulted in a significant decrease in the alewife population.



Zebra Mussel (*Dreissena polymorpha*)
Quagga Mussel (*Dreissena rostriformis*)

These small bivalve mollusks are related and both come from the Black, Caspian, and Azov Seas. They were first introduced in 1990 and within 10 years had invaded all the Great Lakes. Once in the Great Lakes, they moved to inland lakes by attaching to the hulls or motors of boats or larvae floating in water in the bottom of boats or kayaks. They may also be in bait containers that moved from lake to lake without proper cleaning. The mussels go through a life cycle that includes a microscopic larva stage – small enough to be invisible to the naked eye. It is in this stage that it spreads by being moved by currents, boats or containers to other locations. There doesn't seem to be any good way to control the expansion of these mussels once they make their way into an ecosystem. The best control mechanism to keep them out of inland lakes is to follow DNRE regulations which require boats, bait containers, live wells and equipment to be washed with hot water (over 130 F) or dried for at least 3 days before moving the boat or equipment from one lake or stream to another.



Zebra mussel shells on the beach near Lane Rd in the Port Oneida Rural Historic District

Both species of mussel are extremely prolific. Each individual mussel can filter up to a gallon of water per day removing even very small (micron size) particles of food for native species. The mussels live in colonies. The zebra mussels attach to solid surfaces (rocks, metal, etc.) but the quagga mussels can colonize soft surfaces (wood, sand, etc.). These colonies can grow up to 3 feet thick. Divers have photographed coatings of mussels on almost every shipwreck and historic artifact in Lake Michigan. The mussels also coat boats, engines, and other equipment and even plug industrial water inlet pipes. Be careful when you walk on the beach because the sharp shell of the mussel can slice your feet.

The effect of the mussels is obvious today. Lake Michigan is very clear compared to historic conditions. This seems like it would be a good thing, but it means that the mussels are removing the tiny particles that provide food for the small organisms in the aquatic food chain.

The water clarity allows more light to penetrate deeper into the lake, providing a larger productive habitat for native algae such as *Cladophora*. The mussels fertilize the *Cladophora* with their waste products (pseudofeces) leading to a

shift in the phosphorus balance in Lake Michigan – causing a near-shore increase and off-shore deficit. There are now huge beds of the algae in various parts of Lake Michigan. Examples of these areas in Sleeping Bear Dunes include an area west of the outlet of the Platte River and an area southwest of South Manitou Island.

The algae do not pose a risk to human health, but bacteria may develop in the algae bloom and cause a risk to humans and aquatic life. The algae blooms attract gulls which deposit fecal matter adding nutrients, supporting even more algae growth. Storms churn up the algae and bring it up to the surface. Once on the surface, wind direction determines where the algae will wash up on the beach.



Cladophora algae washing up on the beach

A thick soup of algae will be present in the water along the beach and the wave action will deposit thick mats of it onto the shore. It can become buried by sand and stepping on the apparently clean sand results in your foot sinking into the foul-smelling rotting algae mat.

Botulism Type E Toxin – Waterfowl Deaths

The large algae beds are also implicated in an altered food cycle that may be responsible for the death of thousands of waterfowl each year. In 2006 and 2007, Sleeping Bear Dunes National Lakeshore experienced several thousand waterfowl dying and washing up on our Lake Michigan beaches. Several agencies and organizations have been studying the problem.

The current hypothesis is that the filtering ability of the large number of zebra and quagga mussels in Lake Michigan has resulted in clearer water making it possible for large algae beds to grow. The algae break off due to underwater currents and are deposited in low areas of the lake bed, where it decays and becomes anaerobic providing the perfect habitat for naturally occurring botulism bacteria to flourish.

The botulism type E toxin is absorbed by the zebra and quagga mussels. The toxin doesn't affect the mussels but accumulates in them and when they are eaten by small fish like the round goby (see below), the fish flounder and die. Waterfowl find the floundering fish to be easy prey, so they eat the fish and accumulate the toxin in their bodies. The toxin affects their nervous system and they find it hard to fly, swim, walk, and eventually they either drown or suffocate. Many of the birds eventually end up on the beach. Species affected include piping plover, loons, eagles, grebes, gulls, cormorants, and a variety of ducks. Volunteers monitor beaches within Sleeping Bear Dunes National Lakeshore in the summer and fall to document the dead birds, bury them, and

collect samples for analysis to confirm the cause of death as botulism type E toxin. The study to identify potential causes and potential treatments is ongoing.

Round Goby (*Neogobius melanstomus*)

The round goby is a small (4-10" long) bottom-dwelling fish. It entered the Great Lakes around 1990 in the ballast water of ocean-going ships from the Black and Caspian Seas. Because they are so aggressive, eat so much, and spawn prolifically, they are becoming the dominant small fish species in the Great Lakes, resulting in reduced populations of alewives and other small fish. They also eat the eggs of other fish species, which will have an effect on those fish populations.

On the positive side, the gobies have become food for some of the larger fish in the lake including perch and walleye. They also eat Zebra and Quagga mussels. They seem to be part of the food cycle that results in waterfowl die-off due to botulism poisoning. After summer storms, dead gobies can often be seen washed up on the beaches.



Round Goby

Ruffe (*Gymnocephalus cernuus*)

The Eurasian ruffe came to Lake Superior in the ballast water of an ocean-going freighter in 1985. It has since spread to Lakes Michigan and Huron. It is a small (4-6" long) aggressive fish, which lacks natural predators in the Great Lakes. It feeds on a variety of food including whitefish eggs. The spiny dorsal fins of the ruffe discourage predation by other fish. It is a relative of perch and spends its days in deep water and feeds in the shallows at night. Rapid population growth makes it a competitor with native fish. In Lake Superior, its main competitor, yellow perch, experienced a 75% population decline because of the ruffe.



Eurasian Ruffe Side View



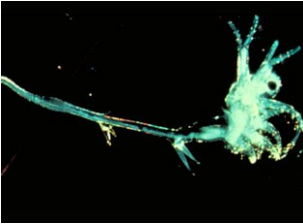
Ruffe in the Hand

Spiny Water Flea (*Bythotrephes cederstroemi*)

These tiny planktonic crustaceans entered the Great Lakes in ballast water in 1982. They are native to Britain and the Bering Sea. While they are very small, they eat large volumes of zooplankton and reproduce rapidly (less than 2 weeks in summer) and compete with small fish for food. Since the zooplankton is the base of the aquatic food web, this competition is a serious problem. They can be eaten by small fish, but the spiny tail makes them undesirable and difficult for small fish to swallow.



Clump of spiny water fleas



Enlarged photo of a spiny water flea

Another behavior they use to avoid predators is a vertical daily migration. The females dive deeper in the water during daylight hours where there is less visibility for the predators to see the fleas. During the evening, they return to the surface where the water is warmer and there is more food. The spiny water flea currently inhabits Platte Lake.

Asian Carp

There are seven species of non-native carp grouped under the category of Asian Carp: bighead, black, grass, silver common, goldfish, and crucian carp. The biggest threats to the Great Lakes are the bighead and silver carp which are now in the Des Plaines River in Illinois and may find their way into Lake Michigan.



Bighead Carp – US Fish & Wildlife Service Photo

The **bighead carp** (*Hypophthalmichthys nobilis*) is a deep bodied fish that grows up to 100 pounds and five feet long. They feed mostly on zooplankton using gill rakers that strain plankton from the water, but they also eat some algae and insects. They have no true stomach so they must feed continuously, consuming about 20% of their body weight per day. Bighead carp were first introduced into the U.S. in the early 1970s to clean holding ponds in aquaculture production. After escaping the ponds due to flooding, they have now been found in the water of 23 states. Major watersheds in which they are prevalent include the Mississippi, Missouri, Ohio, and Tennessee rivers. Of particular concern are the Chicago Waterway and Calumet River systems in Illinois and Indiana that are directly connected to Lake Michigan and may provide a pathway for the carp to become established in Lake Michigan and associated river systems.

Silver carp (*Hypophthalmichthys molitrix*) is a deep bodied fish similar to the bighead carp – but smaller. They grow up to lengths of 3 feet and can weigh up to 60 pounds. Silver carp are very efficient filter feeders, as they possess specialized gill rakers that are fused into sponge-like porous plates. They feed primarily on phytoplankton, but will also consume zooplankton, invertebrates, detritus, and bacteria. Silver carp like the bighead carp lack a true stomach, requiring them to feed continuously. Silver carp are a very active, schooling species are known for their habit of leaping out of the water when disturbed.



Silver Carp jumping behind a speed boat



These large fish can injure boaters.

Silver carp were introduced into the U.S. in the early 1970s in aquaculture production. They are now found in at least 11 states. Like the Bighead carp, they are found in the Chicago Waterway and Calumet River systems.

If any of the Asian carp species were to establish breeding populations in Lake Michigan, they have the potential to disrupt the base of the food web in the lake and associated rivers and streams by removing a significant portion of the plankton, algae, mussels, etc. The most likely source of introduction would be through the Chicago Ship Canal and Calumet River. Silver carp DNA has been detected near the mouth of the Calumet River beyond the electric barriers constructed to keep the carp out of Lake Michigan.

The Army Corps of Engineers is moving aggressively to prevent Asian carp from establishing a sustainable population in the Great Lakes. They are leading a congressionally authorized study called the Great Lakes and Mississippi River Interbasin Study (GLMRIS) which is a collaboration of federal, state, and local partners. The study covers the entire basin of 1,500 miles of hydrologically complex topography and deals with dozens of different kinds of aquatic invasive species. A series of three highly effective electric barrier systems have been put in place along with a 13-mile barrier that prevents fish bypass during flooding. This study will not be completed for several years.

Wetlands – Inter-dune Wetland, Marshes, Streams, Lakes

Phragmites (*Phragmites australis*)

This tall perennial wetland grass is an invasive non-native species from Europe that crowds out native grasses and can create a fire danger. *Phragmites* obscures views for landowners and can make beaches unusable. It was brought to the U.S. as an ornamental landscaping grass and escaped into the wild. The grasses are very large, growing up to 19 feet tall. They create colonies through seeds and clones from rhizomes. The colonies are very difficult to remove. Several approaches have been used to control them ranging from “bloody glove” or hand swiping the plants with herbicide-coated gloves to bundling stems like corn shocks and spraying the bundle with herbicide. One of the most effective methods is to cut the stem and fill the hollow center with herbicide. This method is tedious but is highly effective and causes very little collateral damage to native plants.

Purple Loosestrife (*Lythrum salicaria*)

This wildflower with the showy purple flower cluster was first introduced into the U.S. in the 1800s as an ornamental flower. It flourishes in wet areas near streams, marshes, ponds, and lakeshores. It has no natural predators and grows in thick clusters crowding out native plants like cattails and bulrush. One plant can produce two million seeds per year.



Purple Loosestrife flowers

The National Lakeshore has a program to eliminate purple loosestrife colonies by pulling the plants out by the roots. When the colonies are very large they control by using an aquatic approved glyphosate herbicide. The seed head is cut and the herbicide is applied with a “bloody glove” to wipe the chemical up the stem. By not spraying, adjacent native plants are not affected. Bio-control methods using two types of insects have also been used with good results.

Zebra and Quagga Mussels

Zebra mussels are currently found in several of the inland lakes in Sleeping Bear Dunes National Lakeshore including Bass (Benzie co.), Otter, Loon, Big and Little Glen and North Bar. As mentioned earlier, these mussels are not native to this region and when introduced into one of our inland lakes or streams, they will flourish. Boaters and kayakers may not realize that they can inadvertently transport Zebra or Quagga mussel larvae in water sloshing in the bottom of their boats when the boat is moved from an infested body of water like Lake Michigan to an unexposed inland lake. The larvae are very small and undetected by the human eye. It is often difficult to remove all the water from inside a kayak, and if that water is transported to an uninfected lake it could be the

source of introduction! Also, equipment that has not thoroughly cleaned and dried can transport the larvae. Anything (including clothing) that is in contact with an infected body of water can provide a means of transportation.

Recreational Impacts

One of the responsibilities of the National Park Service is to preserve our natural environment so we (and future generations) can experience the beauty and integrity of the ecosystem in special areas like Sleeping Bear Dunes National Lakeshore. By making the natural environment accessible to more people, there is a risk that the increased use will result in a negative environmental impact. This is true especially on our rivers. The Platte and Crystal Rivers provide a beautiful, relaxing and fun experience in nature for the thousands of visitors who canoe, kayak, or tube these rivers.

The increased river traffic is causing erosion of the river bed, especially where tubes are being used. People riding tubes have a tendency to use their feet to propel themselves around the river. This can cause a disruption of the spawning habitat for some fish and other aquatic species. River activity can also cause river bank erosion and trash accumulation.



Thousands of people enjoy floating the Platte R.

The Friends of Sleeping Bear Dunes has an Adopt-A-River program where volunteers kayak or canoe the river picking up trash along our rivers.

Mute Swans

These large white birds with orange beaks and graceful necks are not native to North America, but were brought here from Europe. Their population has been growing rapidly in Michigan from about 5,400 in 2000 to 15,000 in 2010.

Mute swans are fierce competitors to native waterfowl and have supplanted many species on breeding habitat throughout the state. They are also voracious feeders, which results in disturbance and destruction of submerged aquatic vegetation – a valuable food source for native waterfowl and other wetland species. The native species that have been negatively affected include common loon, native trumpeter swans, several duck species, and Canada geese.

As mute swan populations grow, the number of reported conflicts with humans (attacks on humans in boats or on shore) has also increased. Michigan has implemented management efforts to reduce mute swan populations over time to reduce the impact of this invasive species. These efforts include reducing reproductive capacity through nest and egg destruction as well as directly removing birds where they pose a threat to resources or humans.

Dunes

There are several types of dunes in Sleeping Bear Dunes National Lakeshore. The dunes that develop just behind the beaches are called “fore-dunes” and often have interdunal swales or wetlands that develop between dunes. The dunes that develop high on top of the moraine bluffs are called “perched dunes” because the sand is “perched” on top of the sand and gravel of the moraines left by the melting glaciers.

Baby’s Breath (*Gypsophila paniculata*)

You may recognize Baby’s Breath as the tiny white flower in many floral arrangements. Many seed distribution companies will send complimentary packets of Baby’s Breath seeds to their customers. This invasive plant escaped from ornamental plantings and has taken over areas of fore-dunes and perched dunes. It is starting to take over roadsides and open fields within the Park too. The plant has a deep tap root which can be over 6 feet deep. It over-stabilizes the dunes and impacts native plants like dune grass and the federally threatened Pitcher’s thistle that rely on moving sand dunes. Large areas of baby’s breath have developed on Sleeping Bear plateau, near the Dune Climb, on the Cottonwood Trail, and on the coastal dunes in southern areas of the park.



Baby’s Breath stabilizes dunes



Baby’s Breath eradication team at work

Sleeping Bear Dunes National Lakeshore has initiated a joint project with The Nature Conservancy to remove this invasive plant and restore the native dune ecosystem. A total of 1375 acres of dunes at Sleeping Bear Dunes are infested with baby’s breath. This program began in 2007. By 2010, over 500 acres had been treated. The removal is conducted by digging down below ground level and cutting the plant at the tap root just below the caudex (underground base of the stem). The areas that have been treated will be studied in the coming years to determine effectiveness of the treatment. Re-treatments will be necessary to keep this species at a manageable level.

Lyme Grass (*Leymus arenarius*)

This perennial grass grows 2-4 feet high and is blue-green in color. The flowers are dense blue-green spikes in early summer and turn beige in late summer and fall. Lyme grass is native to Europe and Asia. It spreads through rhizomes but also reproduces by seeds. It prefers well-drained sandy soil in full sun, and it can quickly become invasive on dunes replacing our native dune grass and causing stabilization to our naturally shifting sand dunes. Because it spreads from rhizomes, mechanical removal is not effective. Grass-selective herbicides are required for control.

Spotted Knapweed (*Centaurea maculosa*)

Spotted knapweed was introduced from Eastern Europe into North America in the early 1900s as a contaminant in crop seed. The plant grows well in poor, sandy soils and dunes. It can grow to 2-4 feet tall and has a purple flower. In August, when the plants flower, fields look like they have a pink or purple haze. Seeds are viable in the soil for several years. The plants are allelopathic– they exude a toxin into the soil which is toxic to other plants. Knapweed crowds out native plants in dunes like dune grass and pitcher’s thistle. In meadows, it crowds out native grasses and wildflowers.

Control mechanisms are limited. Frequent mowing or cutting can keep the plants from going to seed, but when the plants are cut, they often produce flowers close to the ground. Prescribed burns have been used to control the knapweed and the heat of the fire destroys some of the seeds on the ground. Pulling the plants is not very effective and gloves should be worn to keep the toxin from the skin.



Spotted Knapweed Flower

One control method in farm areas is to pasture sheep and goats in fields infested with knapweed. They eat the knapweed plants and flowers, which provides moderately good forage for the animals. Grazing prevents the plants from producing seeds.

Meadows and Fields

Many of our farm fields haven’t been worked for years and have poor, sandy soil. Invasive species like spotted knapweed can take over, crowding out the native grasses and plants. These fields turn a pink or purple hazy color in August when the knapweed is in bloom. Open fields and meadows offer habitat for many meadow birds, but fields where knapweed has taken over do not provide good nesting habitat for these birds. We would like to return these areas to a mix of native meadow plants that would provide better habitat for the birds.

Leafy Spurge (*Euphorbia esula*)

This invasive plant was introduced into the U.S. in the early 1800s as a seed contaminant from Eurasia. It grows in colonies and reproduces by seeds that have a high germination rate. Seeds are viable in the ground for at least 7 years. It also spreads from the root which is extensive. Plants are typically 2-3 feet tall and are topped with pale yellow-green bracts.



Leafy Spurge yellow-green flower

Leafy Spurge is found along roadsides and in fields. The plant contains a milky white toxin which is poisonous to cattle. It also produces chemicals which interfere with the growth of other plants in the area. It can take over whole fields and many chemical applications of herbicide return poor results. Once established this plants is extremely difficult to get rid of.

Autumn Olive (*Elaeagnus umbellata*)

This fast growing thorny shrub or small tree was imported from Asia around 1830 for ornamental uses, erosion control, and to provide bird habitat and food. It has beautiful, abundant, fragrant white flowers in spring and red berries in August. The birds love the nutrient-poor berries and spread the seeds efficiently so that fields are rapidly covered with a thicket of thorny bushes. The shrub fixes nitrogen in the soil and can flourish in poor, sandy soil. Even though this shrub has some perceived positive attributes, it is considered an aggressive, invasive plant. This thorny shrub will rapidly take over meadow land and make it unsuitable for grasses and meadow birds. Birds that nest in the trees often have poor reproductive success because of the nutrient-poor berries and the fact that Autumn Olive doesn't support needed insect life. It is found in fallow farm fields throughout the National Lakeshore. The National Park Service and volunteers are controlling these by pulling the trees and mowing fields on a regular basis in the Port Oneida Rural Historic District.

Tree of Heaven (*Ailanthus altissima*)

These trees were introduced from China as ornamental trees and as a host for the Cynthia moth, used in silk production. By 1840 they were commonly available in nurseries. Known as Chinese Sumac, they can grow to 80 feet tall and spread rapidly by colonization through root sprouts. It grows best in open areas like abandoned fields or fence rows. While these trees have some positive attributes, they can take over large areas of meadow and alter the ecosystem. Once established they are very difficult eradicate, even with the use of herbicides.

Forests

Forests in Sleeping Bear Dunes National Lakeshore are predominantly maple-beech forests with many other species mixed in such as ash, oak, hemlock, and black cherry. The Lakeshore also has coastal forests consisting of jack, white and red pines, white oak and ash in the lowland areas near the shorelines. There are also many conifer plantations dispersed throughout the park. The threats to our forests include invasive insects, diseases, and plants. One of the biggest vectors for the threats to our forests is through campers bringing firewood from other parts of the state. At Sleeping Bear Dunes National Lakeshore, campers are asked not to bring firewood to the campgrounds because of this problem. Local sources of campfire wood are available at the campgrounds. This firewood ban will become mandatory in 2012.

Beech Bark Disease

This disease was first identified in Europe around 1849. It was brought to North America in Nova Scotia in 1920 and spread from there to the U.S. in 1929. Now it has spread as far west as Wisconsin and south to North Carolina. The disease was first noticed in Michigan in 2000. It was probably brought here in infested firewood. The beech scale insect attacks the bark and creates a wound. The wound is then infected by a fungus creating a canker. In subsequent years, more cankers form ultimately killing the tree. The main vector in its spread seems to be wildlife and wind transport.

The first symptom of infestation is a white waxy coating that the beech scale insect secretes. The fungus creates a reddish spot that makes it look as if the tree is bleeding. A reddish brown fluid will ooze from the wound. Then reddish fruit bodies containing the spores form around the wound. The foliage becomes sparse and yellow and then they die or break off at the wound. The process takes 5-8 years from infection to death of the tree, and there is roughly an 80% death rate. The potential loss of beech trees can be devastating because the beech and oak in our forests provide food for wildlife.

Emerald Ash Borer

Over 5.7 billion ash trees are threatened by the Emerald Ash Borer (EAB). This is a much larger threat than even Dutch Elm Disease, which killed about 200 million trees. Estimates are that 95% of the ash trees will be killed by the disease. It was accidentally introduced in 2002 in Canton, MI by wooden shipping containers infected with the EAB. It was detected in Indiana in 2004 and Kentucky in 2009. Quarantine zones have been established to stop the spread of the EAB. Do not transport unprocessed wood – like campfire wood or logs. If you are camping at Sleeping Bear Dunes National Lakeshore, you must buy your wood at the campground.

After trees are infected, it takes a year before symptoms show up. Surveys are being conducted throughout the state of Michigan to look for evidence of EAB infestation. Some instances have been found in Northern Michigan. In September, 2011 an infestation has been discovered within Sleeping Bear Dunes National Lakeshore. Most of the ash trees on the mainland part of the Lakeshore may be infected with the greatest infestation near the Good Harbor area.

The adult insect is about 10-14 mm long and emerald in color. Larvae are 1 mm in diameter and about 30 mm long and are creamy white in color. The adults lay yellow-brown eggs in crevasses in the bark. When the eggs hatch the larvae bore through the bark and eat cambium and phloem, effectively girdling the tree and killing it within 2 years. The larvae pupate in the bark and adults emerge in June through July leaving a D-shaped hole in the bark.



Emerald Ash Borer Larvae



Emerald Ash Borer Adult

Asian Longhorned Beetle (*Anoplophora glabripennis*)

This beetle attacks many kinds of trees including: maple, elm, poplar, ash, birch, horse chestnut, and willow. The beetle came to the U.S. in 1996 in infested wooden packing crates from China, Japan, and Korea. By 2004 the beetle was known to be in NY, NJ, Chicago, and Toronto. The adult beetles are easy to detect when present in large numbers, but as larvae, they are hidden in the wood and difficult to detect. Adult beetles are 1-1.5 inches long and may have antennae 4 inches long. They are glossy black with about 20 white dots.



Asian Longhorned Beetle Adult

During the summer, the adult female digs 35-90 depressions in the tree bark and lays an egg in each one. After 10-15 days, the egg hatches and a white larva burrows into the phloem and cambium of the tree bark and eventually the burrow into the heartwood of the tree and remain there during the winter. They mature into pupae during the winter and the adults emerge in the spring or summer through a ½ inch circular hole

leaving sawdust and oozing sap. Eradication can be achieved by identifying infected trees and cutting down infected and healthy trees near the infestation and chipping and burning the trees.

While adult beetles are capable of flying several hundred meters in a single flight, the most common way for the beetle to move into a new area is in infested firewood. So as with the Emerald Ash Borer, the best way to help keep these pests away is to realize that moving firewood also moves pests. Do not bring firewood from home if you are camping – or for beach fires.

Hemlock Woolly Adelgid (*Adelges tsugae* Annand)

The hemlock woolly adelgid is a small aphid-like insect that feeds on several species of hemlock. They are native to Asia but have been in North America since 1924. About 50% of the native range of hemlock in the eastern U.S. has been infested. In Virginia, New Jersey, Connecticut, and portions of Pennsylvania extensive tree mortality is common.

It is easily recognized by the presence of dry, white woolly substances on young twigs. The wool is most obvious in the spring. Egg masses look like the tip of a cotton swab – only smaller – and usually on the underside of the young twigs.



Hemlock Woolly Adelgid egg masses

The adelgid injures the hemlocks by sucking plant juices and injecting toxic saliva into the plant during feeding. Branches and needles of infested branches turn grayish-green and fall off. Buds are also killed, resulting in little new growth on infested branches. Major limbs can die within two years of infestation and the infestation progresses from the bottom of the tree. Early detection is critical to stopping infestation, so if you see it, report it to a Park Ranger.

Oak Wilt

Oak wilt is a fungal disease that attacks the water-conducting system of oak trees. The tree responds by producing gums and resins that plug these systems and the tree wilts and dies. In recent years new areas of oak wilt have been identified in Michigan. Red oaks die within a few weeks of infestation. White oaks are more resistant. The disease spreads primarily from a diseased tree to healthy ones by root grafts. It can also spread from one area to another by picnic beetles and by people moving infected firewood into uninfested areas.

If there is no infestation in an area, the picnic beetle will attack trees in the spring, but because they cannot chew through the bark, they enter through fresh wounds on the tree. Any wound made by pruning or injury in the spring creates a point of entry for the infection. In areas where there is an infection, root grafts must be broken by cutting the roots between infected trees and healthy ones.

Garlic Mustard (*Alliaria petiolata*)

Garlic mustard was brought into the U.S. in the 1800s and cultivated for food and medicinal purposes. It is a biennial with a distinct garlic odor that grows in cool forests. The first year it grows low to the ground and forms a rosette of green leaves. In the second year, plants grow to 1-4 feet tall with small white flowers on top in May to June. Seeds can be viable in the soil for at least 7 years. Within 5-7 years of its introduction this plant can completely dominate the forest floor crowding out wildflowers such as trillium and jack-in-the-pulpit and inhibiting forest regeneration.



Garlic mustard plant and flower

The best way to eliminate garlic mustard is by hand pulling or using herbicide applications on large patches where native plants no longer exist. Natural Resources personnel and volunteers remove garlic mustard from the National Lakeshore forests each year. Garlic mustard can be found in various wooded areas of the mainland and on both North and South Manitou Islands.

Black Locust

These trees are native to southern Appalachia and the Ozarks. They reproduce primarily through rhizomes. The trees were planted in Sleeping Bear Dunes National Lakeshore by early settlers who used them as windbreaks, erosion control, firewood, fence posts, and wagon tongues. They spread rapidly from the roots and created large groves of locust trees that took over the edge of forests and open fields. The National Park Service is aggressively managing the infestations with a tree-cutting program. When trees are cut, the stumps are treated with herbicide to kill the root system. Annual monitoring and treatment is needed in subsequent years to ensure re-sprouting does not allow these trees to become re-established.

Wildlife Impacts

An imbalance in wildlife populations can be caused by a number of things such as the introduction of non-native species or human impacts that favor one species over the natural balance. When this happens, it can cause destruction of the habitat. For example, when deer were introduced on North Manitou Island in 1926 to provide game for hunters, the deer quickly impacted the island ecosystem by eating many of the plants that make up the understory in the forest. The deer also eat the low leaves of trees creating a browse line. A browse line can be seen most easily on the edge of a lake or river.

On North Manitou Island, the deer population grew so large that many deer were starving and some vegetation was severely impacted. The National Park Service conducts a special deer hunt on NMI to control the deer population. The impact of deer on the understory vegetation is being studied by building fenced-in test plots that are protected from the deer and comparing the vegetation inside the fence with that in the adjacent areas of the forest.

Climate Change

One of the most significant environmental threats to the world, and therefore to this region is the effect of climate change due to global warming. There is scientific consensus that the atmospheric composition is changing and that global temperatures are increasing. Normal fluctuations in local weather are sometimes confused with global climate change. An unusually cool summer in Michigan does not negate global climate change.

Climate scientists predict that warming will cause more intense storms. The warming temperatures mean that we may see longer growing seasons and possible influx of pests from southern climates. Birds may migrate north earlier and stay longer before heading south for the winter. We have already seen significant changes to ice cover on Lake Michigan. The ice used to freeze in the Manitou Passage, so you could walk or take a team of horses across to the Manitou Islands – but no more. The exact impact of global warming here in Northern Michigan is unknown, but it has the potential to be very significant.

Doing Our Part

Over the years, industrial development has created unintended consequences, which often exact a hefty price on the natural environment. While all negative results of our actions can never be fully anticipated, we should realize that our capabilities have grown to the point that we can have a significant effect on the world around us. We should insist that business and governmental leaders evaluate potential harmful effects of proposed new development and technology before it is implemented.

The National Park Service, in their roll of preserving and protecting the natural environment, is attempting to restore balance to the ecosystems they manage with the goal of protecting the native plants and animals in their natural habitats. We can each play a positive role in this effort too by being aware that we may be the source of introducing non-native species into the park.

Sleeping Bear Dunes National Lakeshore is a beautiful place and together we can keep it safe for future generations to enjoy as we do.

