What Do Scientists Know About Invader Species of the Great Lakes?

Grade Level: 5-12
Subject Area: Life Science
Duration: 50 minutes (2 or 3 class periods for full activity)
Setting: classroom
Skills: gathering information, organizing information, and analyzing information
Vocabulary: ecosystem, exotic species, ballast, brackish, imported.

Related State Content Benchmark Objectives
- **Describe common ecological relationships among species.**
- **Describe general factors regulating population size in ecosystems.**
- **Predict the effects of changes in one population in a food web on other populations.**

Objectives
Students will be able to:
- name and visually recognize some invader (non-indigenous) species of the Great Lakes;
- locate on a world map the origins of the Great Lakes invaders species;
- explain the ways in which invader species are introduced into the Great Lakes; and ,
- analyze the impacts of invader species on the Great Lakes ecosystem.

Materials
For each group of 3-4 students:
- copies of the included information cards; each of the three card categories (introduction, ecosystem impact, and invader pictures) should be copied onto a different color card stock paper-24 cards per group); and ,
- answer sheets.

Background
Since the early 1800's, over 170 species of aquatic plants, algae, fish, worms, mollusks, and other organisms have invaded the Great Lakes. Some North American species such as the green sunfish (*Lepomis cyanellus Rafinesque*) have migrated eastward and have become pests in Europe. Biologists worry about these intrusions, because each new species in the Great Lakes alters the region's ecosystems. Ecosystems have a fixed amount of energy that must be divided among all of the species present. When a foreign (exotic) species invades an ecosystem, it often has no enemies. This allows an invader to rapidly multiply and to displace native organisms. The introduction of invader species has led to a loss of biological diversity in this region.

It is estimated that about 15 percent of the 175 species of fish in the Great Lakes are nonnative species that were introduced accidentally or intentionally. Eighty-six invader species are plants, although plants have received less attention as invaders. How these invaders get into the region is variable, but many have been shipped in unintentionally.

When ships are not loaded with cargo, they take on ballast to balance and stabilize them as they travel. The use of water as a ballast material has replace the use of sand and stones. Ballast tanks are filled with water from the harbor where ships are loaded; this water is dumped along with any aquatic organisms present, when ships reach their destination. It is estimated that in the history of the Great Lakes, 34 percent of the invader species entered in solid ballast and 56 percent through ballast water. As shipping times between continents become shorter, the threat of introducing live exotics becomes greater.

The United States and Canada have requested that all ships entering the Great Lakes discharge their water ballast while still in the ocean, replacing it with salt water to reduce the introduction on new exotic species. About 90 percent of the ships currently comply with this request.

The Activity

1. Work in groups of three to four people each, with a complete set of 24 shuffled cards. (If there are eight groups, each group will be able to take a separate invader to report on at the conclusion of the activity).
2. Beginning with the picture of the invader, match the cards to determine which introduction and ecosystem impact card goes with each invader. For each picture, there should be one matching introduction card and ecosystem impact card.
3. When group members agree that they have matched the cards to the best of their ability, they may check their answers on the answer sheet.
4. Each group selects an invader to present to the class; construct a poster on the invader, develop a fact sheet, or create a skit to introduce your invader. The impact of the invader on human affairs should be discussed.
5. Consult the Internet for current information. Begin with sites for the Great Lakes Panel on Aquatic Nuisance Species, for example http://www.glc.org/projects/ans/anspanel.html, and the following:

    - http://www.great-lakes.net/envt/exotic/exotic.html - Exotic Species in the Great Lakes region

    - http://www.nfrcg.gov/nas/nas.htm - National Biological Service's Nonindigenous Aquatic Species (NAS) Information Resource

    - http://patton.nfrcg.gov:80/zebra.mussel - zebra mussel information resources

Additional Resources

To order *Earth Systems – Education Activities for Great Lakes Schools* (ES-EAGLS) contact Ohio Sea Grant Publications, The Ohio State University, 1314 Kinnear Rd., Columbus, OH 43212-1194. For questions about ordering this material, phone: 614-292-8949. The ES-EAGLS is a set of booklets:

Land & Water Interactions in the Great Lakes; Great Lakes Climate & Water Movement; Great Lakes Shipping; Life in the Great Lakes; and *Great Lakes Environmental Issues*. They are listed at $8.00/booklet. The activity: "What Do Scientists Know About Invader Species of the Great Lakes?" is modified from the *Life in the Great Lakes* booklet.

Michigan Sea Grant. Spiny Tailed *Bythotrephes*. "Its Life History and Effect on the Great Lakes" (booklet). *Upwellings* Vol.11 (3), Summer 1990 Vol. 14(1), Winter 1992.

Michigan DNR. *Zebra Mussels in Lake Michigan: What recreational boaters and anglers should know* (brochure). Office of the Great Lakes, P.O. Box 30028, Lansing, MI 48909.

Ohio Sea Grant. *The Spiny Waterflea, Bythotrephes. A newcomer to the Great Lakes*. Dave Berg. 2pp. FS-049.

Wisconsin Sea Grant. *The Sea Lamprey: Invaders of the Great Lakes*. Warren Downs. 8pp. WIS-SG-82-138. 1982.

Minnesota Sea Grant. *Seiche*, Spring 1992 – "Eurasian milfoil: Can it be controlled?"

Introduction

Originally, it came from the Caspian Sea region of Poland, Bulgaria, and Russia. Canals built during the 1800s allowed it to spread throughout Europe. By 1830 it had invaded Britain. First introduction into the Great Lakes was about 1985, when one or more transoceanic ships discharged ballast water into Lake St. Clair. Freshwater ballast from a European port likely contained larvae and possible yearlings. This temperate , freshwater species found a suitable habitat in plankton-rich Lake St. Clair

Introduction

Originally, it came from the Atlantic Ocean, the St. Lawrence and Hudson Rivers (possibly Lake Ontario) and up their tributaries to spawn. It swam from Lake Ontario into Lake Erie through the Erie and Welland Canals, gaining entry into the upper Great Lakes by attaching to the hulls of boats.

Introduction

A native of Northern Europe , it made its way into Lake Huron in 1984 and was found in all of the Great Lakes by 1987. It is believed to have been brought over in fresh water or mud in ballast water of European freighters from eastern Baltic sports. Studies show that the Great Lakes' species closely resemble those living in the ports of Finland and St. Petersburg (the former Leningrad).

Introduction

Arriving from the freshwater and brackish water in northern Europe, this invader was discovered in Lake Superior in 1986. It probably "hitchhiked" in ballast waters from Europe and Asia. In five years, its population reached 1.8 million adults, making it the most abundant fish in the Duluth harbor. This bottom feeder can reproduce in its first year and females may lay 13,000 to 200,000 eggs per season.

Introduction

This species was intentionally imported from northern Europe over 100 years ago, because its hardiness and beautiful flowers were popular with landscapers, florists, and gardeners.

Introduction

Coming from the salty Atlantic Coast, this invader migrated through water routes, including canals in New York State and up the St. Lawrence River. It swam into the upper Great Lakes through the Welland Canal, or the Erie barge canal, or both before 1931.

Introduction

It came from Europe, Asia, and North Africa and was introduced into North America as an aquarium plant. It has since spread to 37 states and 3 Canadian provinces.

Introduction

From saltwater areas of the Atlantic Coast, this invader moved up the Hudson River and via various canal systems into Lake Ontario and Lake Erie.

Ecosystem Impact

This is a large plankton form that eats smaller zooplankton, thereby competing with small fish for food and affecting fish survival and growth rates. Its spiny tail prevents young fish from swallowing it, thus removing it from the food chain. It is an invader species so new that it may take years to determine its ecological impact.

Ecosystem Impact

Only about 8 inches long, this perch-like fish has no value as a sport or food fish. It is less temperature-dependent than perch and tolerates more polluted areas. It also can find hidden prey in soft sediments more efficiently than its competitors. The fish is not preferred by predators because of its spiny fins. It displaces sport and food fish, especially yellow perch and walleye, yet it is not readily consumed in the food web. This invader made up 90 percent of the fish population in the Scottish Lake, Loch Lommond, only 9 years after it was introduced.

Ecosystem Impact

It is called “the beautiful killer” because its’ dense roots choke waterways as it competes with other vegetation. It spreads quickly, crowding out valuable plants that provide food for migrating waterfowl, and destroys habitats for almost all other forms of wetland life.

Ecosystem Impact

Forms thick mats that choke out native aquatic vegetation. It disrupts all forms of water recreation: boating, swimming, and fishing.

Ecosystem Impact

It destroys valuable fish, especially lake trout, by attaching with its sucker-like mouth to suck blood and other bodily fluids. It upsets the ecological balance by removing top predators, allowing for explosion of the populations of smaller fish such as alewives. It had great economic impact on the commercial fishing industry.

Ecosystem Impact

It filters plankton from water, binding what it doesn't use into pellets that cannot be used by other plankton-feeding organisms. It accumulates on objects such as boat hulls and underwater pipes and clogs valves of both industrial and municipal water intake pipes.

Ecosystem Impact

Suspected to be partially responsible for the decline of Lake Erie's yellow perch population because of competition.

Ecosystem Impact

Large numbers die off in spring and summer because of an electrolyte imbalance from living in fresh water. These die-offs clog municipal and industrial intake pipes and foul beaches. In 1967, bulldozers had to remove 50,000 tons of the rotting fish. The sea lamprey enabled this invader to thrive by killing lake trout and other fish at the top of the aquatic food chain. After the sea lamprey arrived, this invader proliferated. Between 1960 and 1966, for example, they went from representing 8 percent to 80 percent of Lake Michigan's fish by weight. Presently, this invader is food for larger game fish.

Ecosystem Impact

This is a large plankton form that eats smaller zooplankton, thereby competing with small fish for food and affecting fish survival and growth rates. Its spiny tail prevents young fish from swallowing it, thus removing it from the food chain. It is an invader species so new that it may take years to determine its ecological impact.

INVADER # 2

Sea Lamprey (Petromyzon marinus)
Adult size: 3 feet (91 cm)

Ecosystem Impact

It is called "the beautiful killer" because its' dense roots choke waterways as it competes with other vegetation. It spreads quickly, crowding out valuable plants that provide food for migrating waterfowl, and destroys habitats for almost all other forms of wetland life.

Ecosystem Impact

Forms thick mats that choke out native aquatic vegetation. It disrupts all forms of water recreation: boating, swimming, and fishing.

INVADER # 1

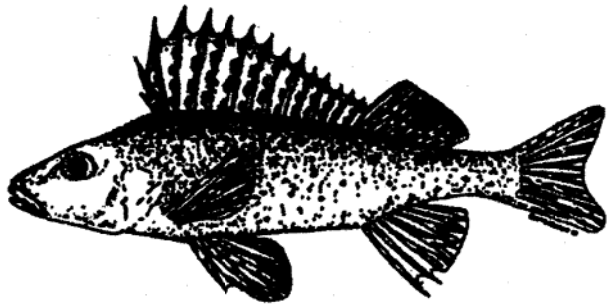
Zebra Mussel (dreissena polymorpha)
Adult size: 1-4 cm long

INVADER # 2

Sea Lamprey (Petromyzon marinus)
Adult size: 3 feet (91cm)

INVADER # 4

River Ruffe (Gymnocephalus cernus)
Adult size: usually less than 15 cm long

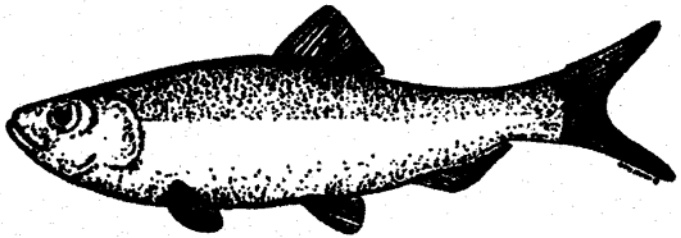


INVADER # 3

Spiny Water Flea (Bythotrephes cederstroemi)
Adult size: 1 cm

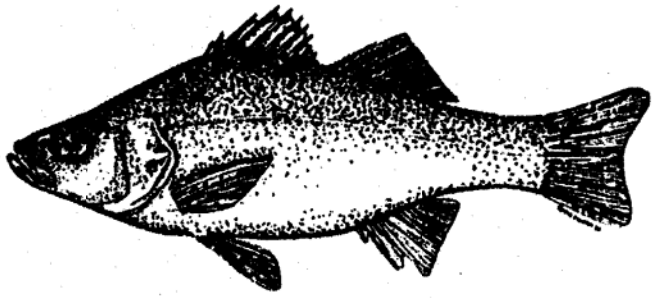
INVADER # 5

Alewife (Alosa pseudoharengus)
Adult size: 3 cm



INVADER # 6

White Perch (Morone americana)
Adult size: 30 cm K20 cm is more common)



INVADER # 7

Purple Loosestrife (Lythrum salicaria)
Adult height: .5 to 2 meters tall

INVADER # 8

Eurasian Watermilfoil (Myriophyllum spicatum)
Leaflet is actual size.

Answers to Cards

Invader 1: Zebra mussel (*Driessena polymorpha)*

Introduction
Originally it came from the Caspian Sea region of Poland, Bulgaria, and Russia. Canals, built during the 1800's allowed it to spread throughout Europe. By 1830 it had invaded Britain. First introduction into the Great Lakes was about 1985, when one or more transoceanic ships discharged ballast water into Lake St. Clair. Freshwater ballast from a European port likely contained larvae and possible yearlings. This temperate, freshwater species found a suitable habitat in plankton-rich Lake St. Clair.

Ecosystem Impact
It filters plankton from the water, binding what it doesn't use into pellets that cannot be used by other plankton-feeding organisms. It accumulates on objects such as boat hulls and underwater pipes, and clogs valves of both industrial and municipal water intake pipes.

Invader 2: Sea Lamprey (*Petromyzon marinus*)

Introduction
Originally, it came from the Atlantic Ocean, the St. Lawrence and Hudson Rivers, (possibly Lake Ontario) and up their tributaries to spawn. It swam from Lake Ontario into Lake Erie through the Erie and Welland Canals, gaining entry into the upper Great Lakes by attaching to hulls of boats.

Ecosystem Impact
It destroys valuable fish, especially lake trout, by attaching with its sucker-like mouth to suck blood and other bodily fluids. It upsets the ecological balance by removing top predators, allowing for explosion of the populations of smaller fish such as alewives. It had great economic impact on the commercial fishing industry.

Invader 3: Spiny Water Flea (*Bythotrephes longimanus)*

Introduction
A native of northern Europe, it made its way into Lake Huron in 1984 and was found in all of the Great Lakes by 1987. It is believed to have been brought over in fresh water or mud in the ballast water of European freighters from eastern Baltic ports. Studies show that the Great Lakes species closely resembles those found in the ports of Finland and St. Petersburg (the former Leningrad).

Ecosystem Impact
This is a large plankton form that eats smaller plankton, thereby competing with small fish for food and affecting fish survival and growth rates. Its spiny tail prevents young fish from swallowing it, thus removing it from the food web. It is an invader species so new that it may take years to determine its ecological impact.

Invader 4: River Ruffe (*Gymnocephalus cernus)*

Introduction
Arriving from the freshwater and brackish water in northern Europe, this invader was discovered in Lake Superior in 1986. It probably "hitchhiked" in ballast waters from Europe and Asia. In five years, its population reached 1.8 million adults, making it the most abundant fish in the Duluth harbor. This bottom feeder can reproduce in its first year and the females may lay 13,000 to 200,000 eggs per season.

Ecosystem Impact

Only about 8 inches long, this perch-like fish has no value as a sport or food fish. It is less temperature-dependent than perch and tolerates more polluted areas. It also can find hidden prey in soft sediments more efficiently than its competitors. This fish is not preferred by predators because of its spiny fins. It displaces sport and food fish, especially yellow perch and walleye, yet is not readily consumed in the food web. This invader made up 90 percent of the fish population in the Scottish Lake, Loch Lommond, only 9 years after it was introduced.

Invader 5: Alewife (*Alosa pseudoharengus)*

Introduction
Coming from the salty Atlantic Ocean, this invader migrated through water routes, including canals in New York State and up the St. Lawrence River. It swam into the upper Great Lakes through the Welland Canal, or the Erie barge canal, or both before 1931.

Ecosystem Impact
Large numbers die off in spring and summer because of an electrolyte imbalance from living in fresh water. These die-offs clog municipal and industrial intake pipes and foul beaches. In 1967, bulldozers had to remove 50,000 tons of the rotting fish. The sea lamprey enable this invader to thrive by killing lake trout and other fish at the top of the aquatic food chain. After the sea lamprey arrived, this invader proliferated. Between 1960 and 1966, this invader went from representing 8 percent to 80 percent of Lake Michigan's fish by weight. This invader is now food for larger game fish.

Invader 6: White Perch (*Morone americana)*

Introduction
From saltwater areas of the Atlantic Coast, this invader moved up the Hudson River and via various canal systems into Lake Ontario and Lake Erie.

Ecosystem Impact
Suspected to be partially responsible for the decline of Lake Erie's yellow perch because of competition.

Invader 7: Purple Loosestrife (*Lythrum salicaria)*

Introduction
This species was intentionally imported from northern Europe over 100 years ago, because its hardiness and beautiful flowers were popular with landscapers, florists, and gardeners.

Ecosystem Impact
It is called "the beautiful killer" because the dense roots choke waterways as it competes with other vegetation. It spreads quickly, crowding out valuable plants that provide food for migrating waterfowl, and destroys habitat for almost all other forms of wetland life.

Invader 8: Eurasian Watermilfoil (*Myriophyllum spicatum)*

Introduction
It came from Europe, Asia, and North Africa and was introduced into North America as an aquarium plant. It has since spread to 37 states and 3 Canadian provinces.

Ecosystem Impact
Form thick mats that choke out native aquatic vegetation. It disrupts all forms of water recreation – boating, swimming, and fishing.