



Exotic Species and Climate Change Worksheet



Overview:

When people think about the future they form a mental image of what it may be like. They use their imagination along with the knowledge they have about themselves and others, as well as events they've experienced to build a new scenario of what they can expect.

As we consider the impacts of climate change on the Great Lakes, there are a number of ways to visualize those changes.

Objectives: At the conclusion of the lesson, students will be able to:

- Provide examples of potential impacts caused by climate change
- Discuss various interpretations of the role that climate change can play in the establishment and spread of invasive species in the Great Lakes
- Recognize some common native and invasive species in the Great Lakes

Duration:

This lesson can be completed in one class period if the activity is played once. Ideally it should be played multiple times so students can observe different outcomes depending on students knowledge, the cards used, and their distribution.

Standards:

- Share ideas about science through purposeful conversation.
- Communicate and present findings of observations.
- Identify the impact of climate change on native and invasive species.
- Describe helpful or harmful effects of humans on the environment (Climate change, habitat destruction, land management, renewable, and non-renewable resources).
- Predict how changes in climate might affect species survival and distribution.
- Describe how humans are part of the Earth's system and how human activity can purposefully, or accidentally, alter the balance in ecosystems.

Prerequisite Teacher Knowledge

Aquatic invasive species (AIS) are species that are found outside of their native habitat and cause harm to their new environment. They are highly competitive and persistent. There are over 185 non-native species in the Great Lakes, and the trend has been one new species every 6-8 months. As the climate continues to warm, and the Great Lakes

experience additional stressors, AIS may become an even bigger problem as warming temperatures, changing water quality, and disturbance may allow new AIS to expand their ranges and make their home in the Great Lakes. This illustrates the need to be vigilant and step-up efforts to prevent AIS introductions into the country. Most of those responsible for fighting AIS infestations realize that it is less expensive to prevent their introduction in the first place than to try to control or eradicate them once an infestation has occurred.

To prevent future invasions it would be helpful to know the answers to a few questions: Are there characteristics that are common between different invasive species? How can we tell which habitats are most at risk?

Aquatic invasive species have certain characteristics that tend to make them successful:

- Rapid growth and reproduction: tend to grow quickly and produce a lot of offspring; many reproduce multiple times in one season.
- Asexual reproduction: some species need only one individual to reproduce; especially plants, which may need only a small plant fragment to start a completely new population.
- Adaptability: typically hardy and able to tolerate a wide range of environmental conditions, including degraded and polluted habitats and rapidly changing conditions that native species can't tolerate.
- No predators: Since these species are non-native, they often lack the natural predators that would keep their population numbers in check.

Global climate change may make conditions more suitable for invasive species.

Warming temperatures, increased precipitation, and other climate change impacts predicted by scientists present a whole new challenge to invasive species management. While it is unknown exactly how AIS may respond to a changing climate, it is predicted that many species will benefit from these changes, expand their ranges, and have exacerbated negative impacts. Due to the characteristics that allow AIS to become successful, these species will most likely have the upper hand at trying to adapt to changing conditions, which may allow them to further outcompete existing native species.

Materials Exotic species worksheet

EXOTIC SPECIES WORKSHEET:

(Created by New York Sea Grant)

After carefully reading through the statements below, circle those adaptations or characteristics that would be beneficial for an exotic invader. If an impact of Great Lakes climate change is suggested instead, place the letter "I" next to that statement.

Multiple spawning or nesting periods

Range expansions will occur

Broad diet

Overcome barriers to movement

Aggressive behavior

Low reproductive rate

Limited temperature range

Cold-water fish species may decline

EXOTIC SPECIES & CLIMATE CHANGE

New species may enter the ecosystem

Single parent reproduction

Restricted movement

Has history of invasions

Highly developed sensory systems

Fish diseases or parasites may be introduced

Large number of eggs or offspring

Increased water temperatures could increase predation

EXOTIC SPECIES WORKSHEET: ANSWERS

Circled characteristics or adaptations help invasive species survive.

Multiple spawning or nesting periods

I Range expansions will occur

Broad diet

Overcome barriers to movement

Aggressive behavior

Low reproductive rate

Limited temperature range

I Cold water fish species may decline

EXOTIC SPECIES & CLIMATE CHANGE

I New species may enter the ecosystem

Single parent reproduction

Restricted movement

Has history of invasions

Highly developed sensory systems

I Fish diseases or parasites may be introduced

Large number of eggs or offspring

I Increased water temperatures could increase predation.

Explanations of answers:

Answers in red refer to climate change and invasive species.

Multiple spawning or nesting periods – Invasive fish such as Eurasian ruffe that reproduce several times each year will be able to produce more offspring and their numbers will increase.

Range expansions will occur – Predicted increases in water temperature will allow species from warmer climates outside the Great Lakes to expand their range.

Broad diet – Invasive species that have a broad diet can find food and survive once they are introduced into a new environment.

Overcome barriers to movement – Invasive species like zebra and quagga mussels can attach to boats and trailers, giving them the opportunity to be spread to other areas.

Aggressive behavior – The round goby is an aggressive fish that forces native fish out of their preferred habitat, often exposing the native fish to predation.

Low reproductive rate – This would not be advantageous for invasive species .

Limited temperature range - This would not be advantageous for invasive species, since it would limit the environments they could survive in.

Cold water fish species may decline – Predicted increases in water temperature will make it more difficult for cold water species—and scientists believe climate change will reduce the number of cold water fish species.

New species may enter the ecosystem – Scientists believe that warmer temperatures may allow species from outside the Great Lakes to gain new environments to survive in.

Single parent reproduction – The spiny waterflea and fishhook waterflea have single parent reproduction, where the females produce offspring without a male. This eliminates the need for the females to search for reproductive partners and produces more young.

Restricted movement - This would not be advantageous for invasive species.

Has history of invasions – If a species has successfully invaded a new environment they may be more likely to spread to new areas and increase their spread.

Highly developed sensory systems – If an invasive can sense predators it can avoid being eaten or if it can feed in the dark, it will be able to find food more easily than native species that lack a highly developed sensory system. The round goby has such a highly developed sensory system and they have successfully invaded all of the Great Lakes.

Fish diseases or parasites may be introduced – Invasive species may bring diseases or parasites that would be new to native species. Predicted warmer water temperatures would allow parasites that might ordinarily be controlled by temperature to be successfully introduced.

Large number of eggs or offspring – Female zebra and quagga mussels may produce a million offspring in a season, which gives them a marked advantage in increasing their populations.

Increased water temperatures could increase predation – Warmer temperatures often increase the food consumption level of fish, so invasive fish might increase their predation pressure on native fish and invertebrates, which would impact the ecological balance.

Resources:

- Union of Concern Scientists - http://www.ucsusa.org/global_warming/
- PA Sea Grant/Erie Times-News in Education page: Believe it or not – new tool helps size up climate-change debate.
- PA Sea Grant /Erie Times-News in Education page: Double trouble – Climate change might hasten spread of invasive species.
- PA Sea Grant /Erie Times-News in Education page: No hitchhikers allowed – These tools help to identify aquatic invasive species.
- PA Sea Grant /Erie Times-News in Education page: End H.O.M.E.S. invasion

This lesson is one of 10 lessons that focus on climate change and invasive species prepared by the Pennsylvania and New York Sea Grant programs as part of a larger Great Lakes Sea Grant Network initiative funded by the Great Lakes Restoration Initiative.

