



Double Whammy!

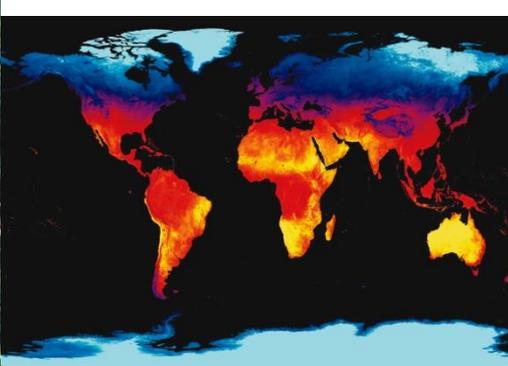
Climate Change and Invasive Species K-12 Curriculum for the Great Lakes

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How will climate changes impact aquatic invasive species?



©Shedd Aquarium

What changes can we expect?

- Increasing temperatures
- Changing precipitation regimes
- Increased storms and flooding
- Can all impact species distribution, spread, and establishment



Becomes even more important not to release!

- Most are tropical or subtropical species, that currently may not be able to withstand PA's colder climate.
- As temperatures warm, suitable habitat could increase.
- Never release aquatic plants or animals into waterways!



Evaluating the risk of non-native species establishment

- Risk Screening
 - Identifying risky AIS proactively without unnecessarily regulating beneficial or low risk non-native species
- Grise, S. N, Light, T.S. 2011
 - Assessed potential risk of southern species not native to PA
 - Used CLIMATCH to predict climate suitability for Pennsylvania
 - Australian based
 - Not many U.S. climate points
 - Lacked predictive capacity

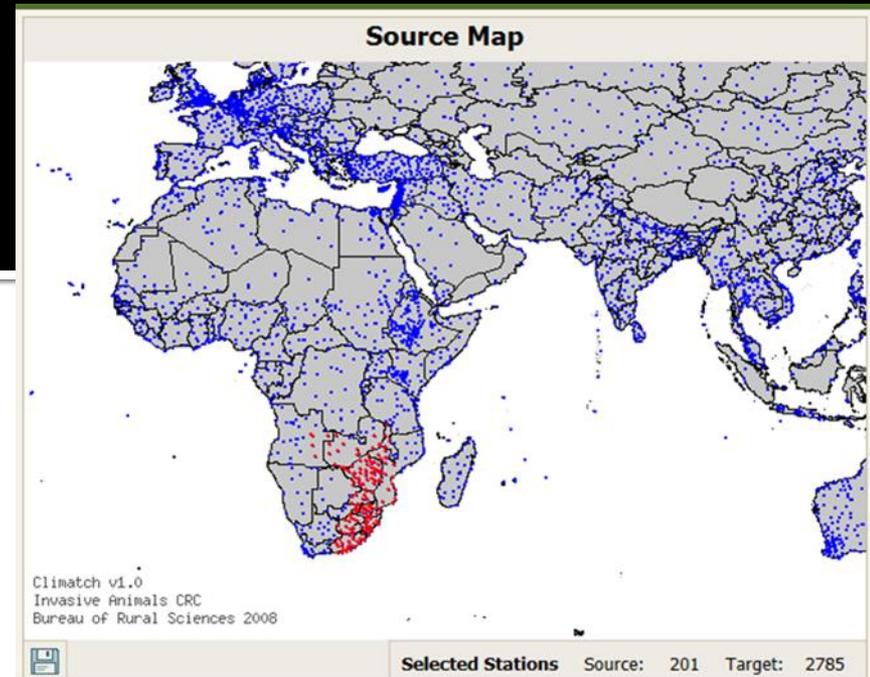


CLIMATCH

Source region

Ex: Mozambique Tilapia

Target regions



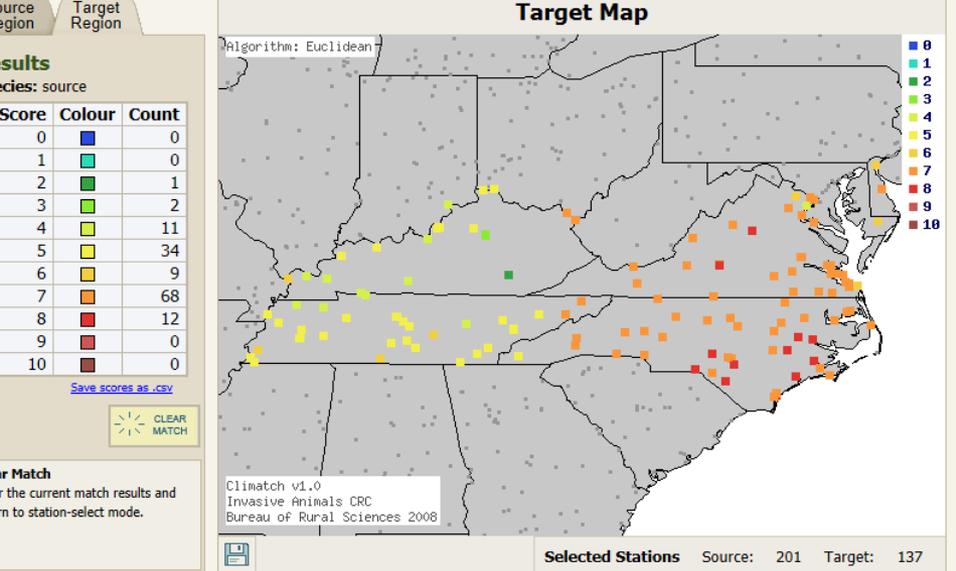
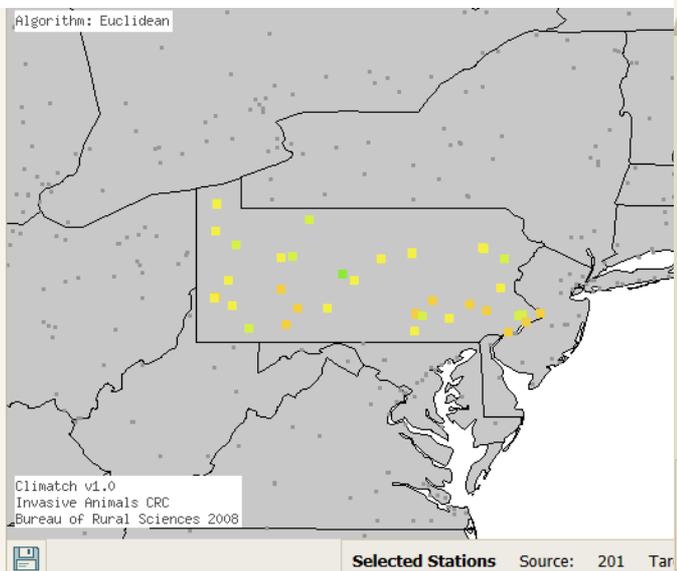
Results
Species: source

Score	Colour	Count
0	Blue	0
1	Light Green	0
2	Green	0
3	Light Yellow	1
4	Yellow	9
5	Light Orange	18
6	Orange	12
7	Red-Orange	0
8	Red	0
9	Dark Red	0
10	Black	0

[Save scores as .csv](#)

CLEAR MATCH

Tool tips:
This box displays a description of the active tool.



- Current PA climate:
 - 0% suitable climate (0/40 stations greater than 7)

- Future PA climate:
 - 58.4% suitability between all five states (80/137 stations greater than 7)

CASE STUDY- Red piranha

Name: Red piranha

Scientific Name: *Pygocentrus nattereri*

Fisk Score: 19

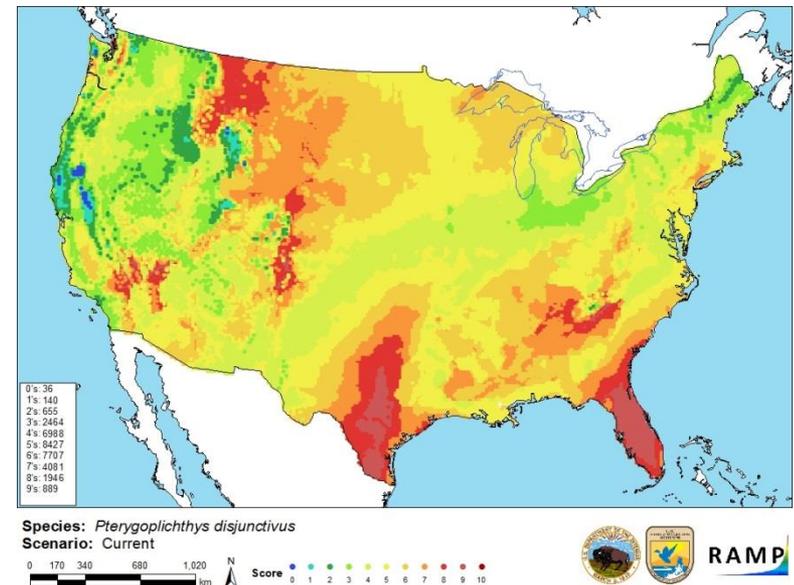
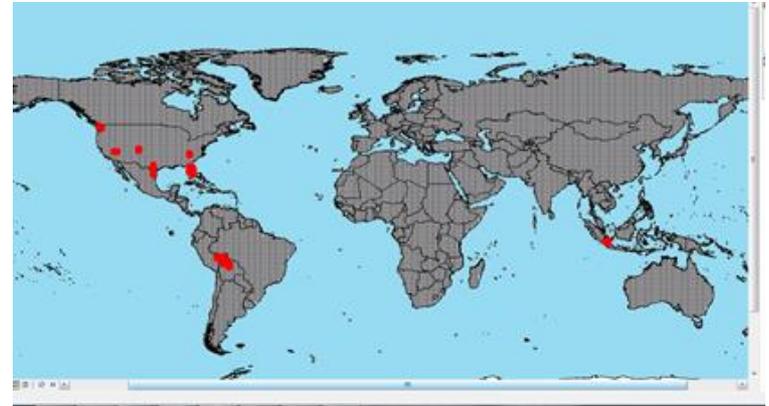
- Highly used in the aquarium trade
- Large size (>10 cm)
- Voracious predator
 - Threatens food webs
 - Threat to recreational activities
 - Threatens Pennsylvania's fishery (estimated at \$3 billion annually)
- CLIMATCH baseline result of zero- too cold now!
- CLIMATCH A2 2099 result – increase of 54.7% climate suitability



Characteristic	Red piranha						Comments
Adaptability	Yes		No	X	Maybe		Doesn't tolerate pollution and breeding is restricted by flowing waters
Rapid Reproduction	Yes		No	X	Maybe		Success it tied to moving waters, and also to the wet season. Only 500-600 eggs
Opportunistic Feeder	Yes	x	No		Maybe		Feeds on a wide variety of food items
Lack of predator pressure	Yes		No		Maybe	x	Probably wouldn't have any predators in PA

New and Emerging tools...

- RAMP (Risk assessment mapping) TOOL
 - Developed by U.S. Fish and Wildlife Service
 - U.S –based
 - Increase from 1,960 U.S points to 42,638 U.S. points
 - Climate prediction capabilities



AIS and Climate Change Curriculum

- Funded by Great Lakes Restoration Initiative (Part 2) Funding
- Great Lakes Sea Grant Network Region-wide project
- Pennsylvania and New York
- 10 existing lessons, modified to include concepts of climate change and aquatic invasive species

Newspapers in Education (NIE)

Tuesday, March 6, 2012 11:04 AM (from News 7 Online.com) 1/1

Reconnect with your environment
Learn about environmental issues. Use what you already know about your community.



Your service project could win environmental award

By ANNA MCCARTNEY
Contributing writer

In your service-learning project, you might be asked to help clean up a beach, reduce household water usage, or plant native plants. The Great Lakes Sea Grant Network is a program that provides grants to support service-learning projects that focus on environmental education.

Double trouble
Climate change might hasten spread of invasive species

By ANNA MCCARTNEY
Contributing writer

When Great Lakes water levels are low, the risk of invasive species is high. Invasive species are plants and animals that are not native to an area and whose introduction causes or is expected to cause economic or environmental harm or harm to human health.

COMING UP

When Great Lakes water levels are low, the risk of invasive species is high. Invasive species are plants and animals that are not native to an area and whose introduction causes or is expected to cause economic or environmental harm or harm to human health.

Students learn how PPCPs affect our water quality

By ANNA MCCARTNEY
Contributing writer

More than 100 students from 10 high schools across Pennsylvania participated in a program that focused on water quality and the effects of pharmaceuticals and personal care products on water quality and health.

Sea Grant
Check out our website to learn more.

Coastal Resources Management Program

Check out our website to learn more.

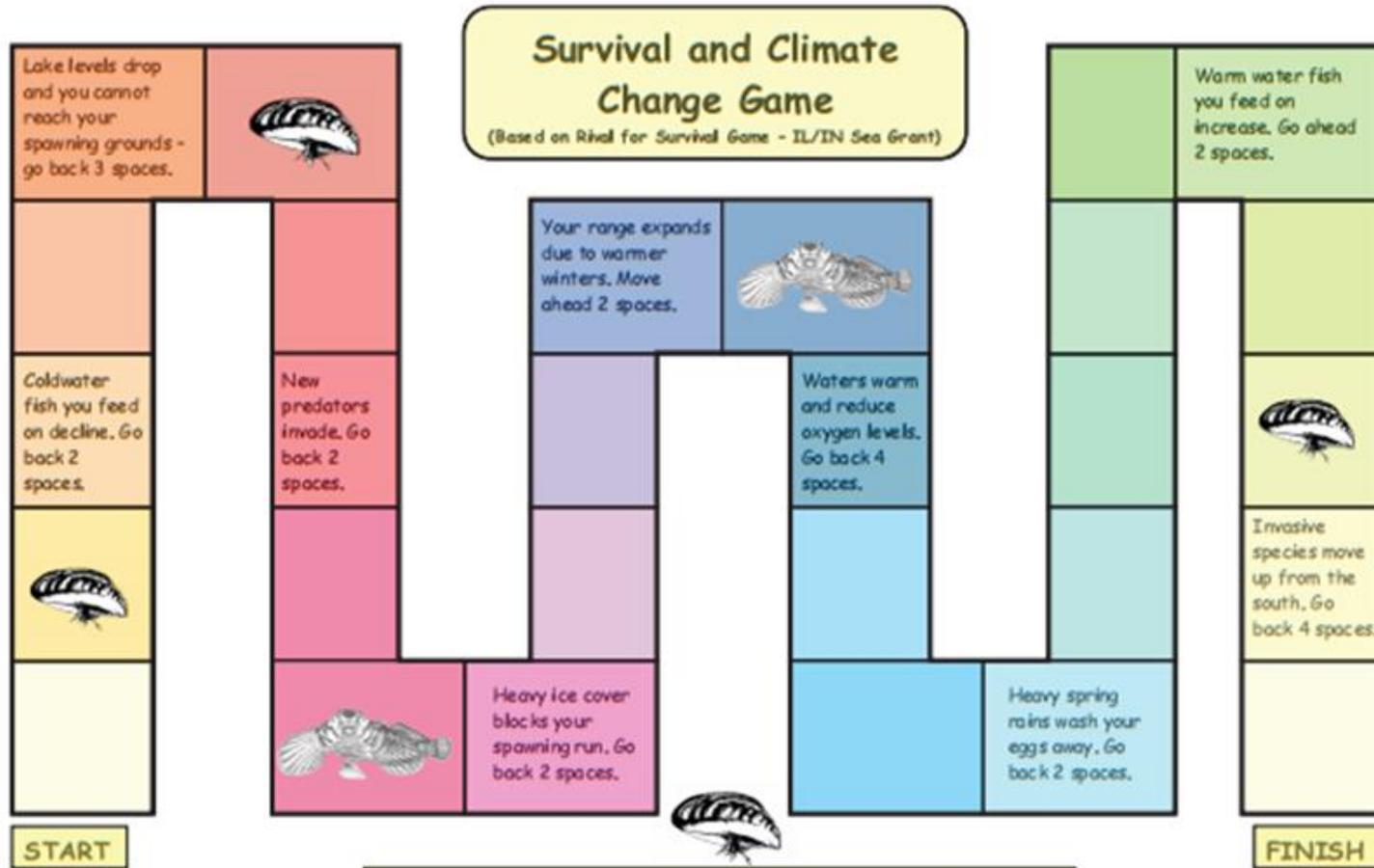
- Anna McCartney, PA Sea Grant
- Series of AIS and Climate related pages
- Reached over 6,000 students
- 120,000 potential readers

Lessons



1. Biodiversity: Nonindigenous Species
2. Climate Change and Invasive Species: Double Whammy in a Bag
3. COSEE: Climate change and ecosystems
4. Double Trouble: Five lessons for taking action against AIS and climate change threats to the Great Lakes Ecosystem.
5. Exotic Species and Climate Change Activity
6. Get the Lingo-AIS and Climate Change BINGO
7. Making Connections, Climate Change and AIS
8. Visualizing Changes in the Earth System: Climate Change and Invasive Species- More or Less?
9. Rival for Survival Climate Change Game
10. What Makes a Good Invader?

Lessons



Source: - *Rival for Survival Game* http://www.ilseagrant.org/education/rival_gamebod_etc.pdf

Let's play a game!

**What
Makes a
Good
Invader?**



Invasive Species in the Great Lakes: What makes a good invader?

Overview

Students will learn about invasive species in the Great Lakes, characteristics that make species good invaders, factors that can influence invasive communities, and the role that climate change may play in causing and proliferating invasions.

Objectives

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

- Provide examples of invasions causing harm in the Great Lakes
- Identify characteristics (traits) that are common among many invasive species
- Present information on the role that climate change can play in the establishment and spread of invasive species
- Recognize some common native and invasive species in the Great Lakes
- Talk about populations, communities, and the niche

Length of Lesson

This lesson can be completed in 1 hour if the activity is played once. Ideally it should be played multiple times so students can observe different outcomes depending on what events were spun on the wheel and to redistribute the species cards so each student can be a new species with different traits than their first. Ideally, a 1.5-hour session would be best.

- 10 minutes- Introduction: Do you know of any invasive species?
- 10 minutes- Examples of invasive species in the Great Lakes
- 5 minutes- Summary of introduction: students should now be able to describe characteristics that make a good invader
- 5 minutes- describe the rules of the activity
- 45 minutes- play 2-3 rounds of the activity
- 15 minutes- Summary: have students describe what got them “into the community”. Do the characteristics that made them a good invader match the ones we discussed in the introduction?

Invasive



**Purple
loosestrife**

Native



**Showy
goldenrod**

PURPLE LOOSESTRIFE

Move forward:



Move backward:



GOLDENROD

Move forward:



Move backward:



KEY



Growth: On a scale of 1-5, with more icons meaning the species has a high growth rate.



Reproduction: On a scale of 1-5 with more icons meaning the species has a high reproductive rate.



Spread: On a scale of 1-5, with more icons meaning the species easily spreads and establishes in new locations



Climate Change: This icon can appear in both the move forward and move backwards sections because species can benefit from climate change in some ways, and also be stressed by other climate changes.



Adaptability: On a scale of 1-5, with more icons meaning less ability to adapt to new and stressful environments.



Temperature: On a scale of 1-5 with more icons meaning the species is more sensitive to changes in temperature.



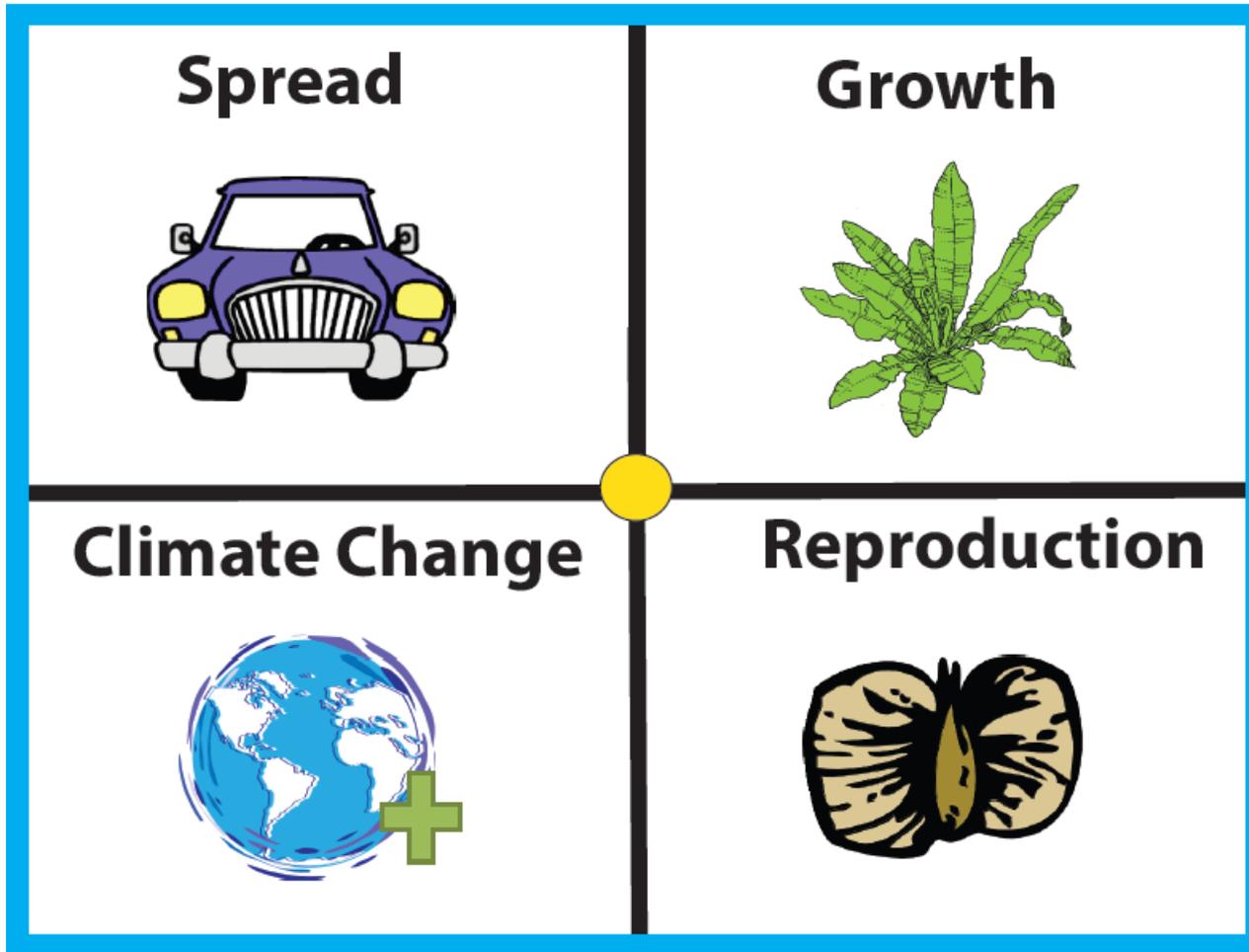
Flood: On a scale of 1-5 with more icons meaning the species is less resistant to flooding.



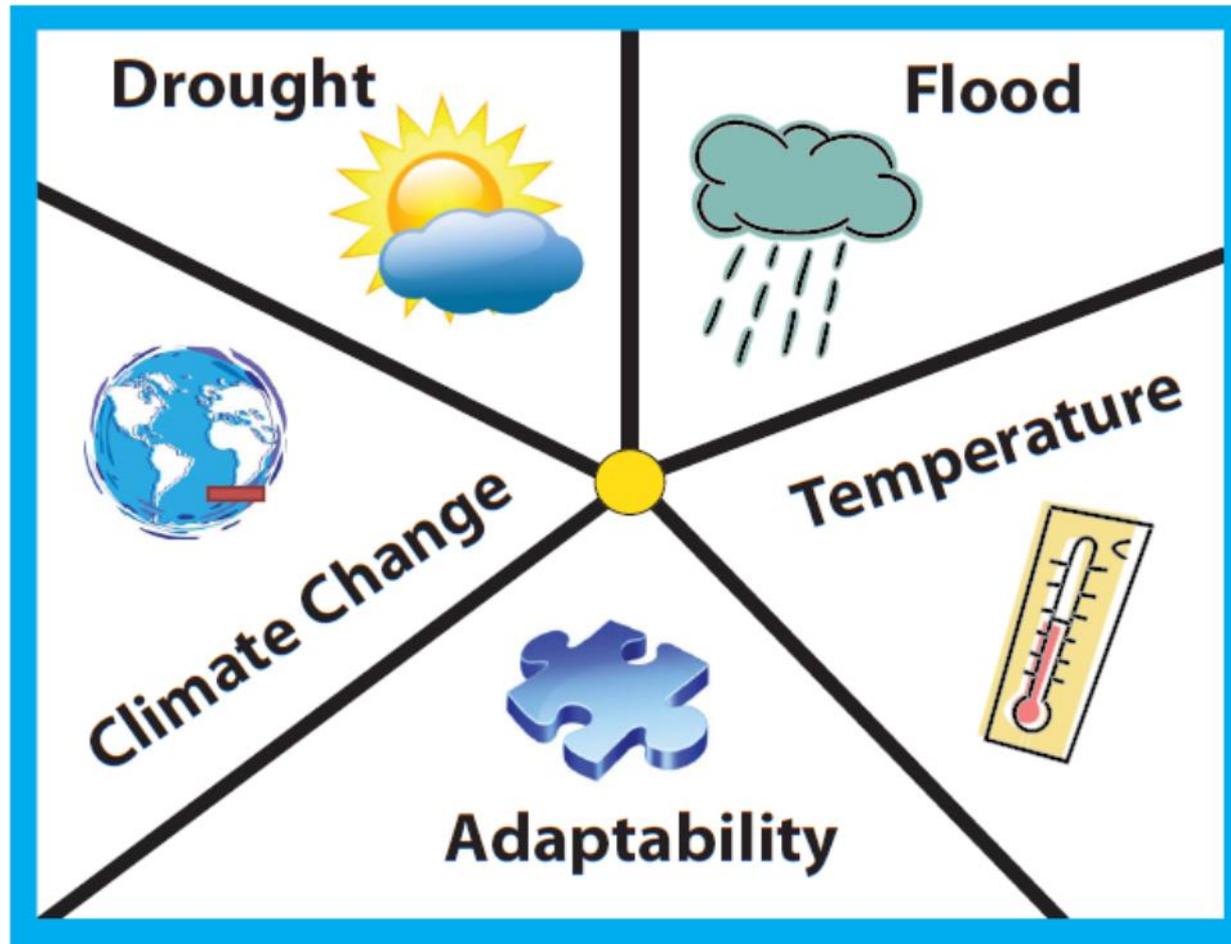
Drought: On a scale of 1-5 with more icons meaning the species less drought tolerant.



- All species can grow, reproduce, and spread
- Abilities differ between species
- Climate change will impact species in different ways



- Some characteristics will help facilitate invasion for species



- Some changes will harm a species ability to establish and thrive.



Lessons

Lessons can be downloaded from the PA Sea Grant website:

www.paseagrant.org

under 'Education' and 'Curriculum'

Or for a flash drive, contact me!



Questions???



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