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Do Invasive Hogs Alter Species Relationships in Salt Marshes?

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Grade Level
7th Grade

Subject Area
Life Science

VA SEA is a collaborative project between the Chesapeake Bay National Estuarine Research Reserve, the Virginia Institute of Marine Science's Marine Advisory Program, and Virginia Sea Grant. The VA SEA project is made possible through funding from the National Estuarine Research Reserve System Science Collaborative, which supports collaborative research that addresses coastal management problems important to the reserves. The Science Collaborative is funded by the National Oceanic and Atmospheric Administration and managed by the University of Michigan Water Center.

Title: Do Invasive Hogs Alter Species Relationships in Salt Marshes?

Focus Build a salt marsh relationship web and determine the impacts of invasive hogs

Grade Level 7th Grade Life Science, could be a review for 8th grade

FL Science Standards

SC.7.L.17.1: Explain and illustrate the roles of and relationships among producers, consumers, and decomposers in the process of energy transfer in a food web.

SC.7.L.17.2: Compare and contrast the relationships among organisms such as mutualism, predation, parasitism, competition, and commensalism.

SC.7.L.17.3: Describe and investigate various limiting factors in the local ecosystem and their impact on native populations, including food, shelter, water, space, disease, parasitism, predation, and nesting sites.

Learning Objectives

- ✓ Students will build a salt marsh food and relationship web
- ✓ Students will identify relationships (mutualism, commensalism, etc.) within an ecosystem
- ✓ Students will assess how changes in resources cascade throughout a food web and impact multiple species because of their interconnected relationships
- ✓ Students will evaluate if the relationship web supports or disproves the starting hypothesis

Total length of time required for the lesson

15 minutes of prep, 15 minutes of explanation, 20 minutes of worksheet, 5 minutes of discussion. (40 minutes total class time)

- Teacher explanation: 10 minutes for initial presentation, 5 minutes in the middle of the lesson
- Activity: 8 minutes for building food web, 5 minutes for worksheet Part 1, 7 minutes for worksheet Part 2
- Discussion: 5 minutes at the end of class, but could be longer

Key words, vocabulary:

-Commensalism: an association where one organism benefits without harming the other

-Competition: the interaction between two or more organisms that utilize the same resource

-Invasive species: an organism that is not indigenous, or native, to a particular area

-Mutualism: a beneficial association between two organisms

-Parasitism: an association where one organism lives in or on another and causes harm

-Predation: killing and consuming of one living organism by another

Note: This lesson focuses on relationships between organisms and does not cover food web terminology. Terms like primary producer, tertiary consumer, etc. could easily be added to the food web portion.

Background information

Invasive hogs are a known nuisance species in Florida. Hogs are known to damage forests and farmland because they dig for roots and wallow in wet soils. Additionally, hogs have no natural predators and have large litter sizes, so their population can rapidly increase and cause problems for farmers and forest conservation.

Lesser known are the impacts of hogs to salt marshes. Salt marshes are coastal ecosystems that occur in wave-sheltered environments. They are commonly seen in Florida on the back side of barrier islands (along the Intracoastal Waterway, for example) or in areas with very little wave activity (such as on the Nature Coast). They are temperate ecosystems that occur mainly in the northern half of the State. Students in the southern portion of the State may be more familiar with mangroves, which occur in a similar location in areas that do not experience freezes. Salt marshes (and mangroves also, but those are not the focus of this lesson) act as barriers against flooding and fish nursery habitat.

Hogs often live in forests on the edge of salt marshes. During the winter, when food in the forest is limited, hogs can travel onto the salt marsh in search of food. In this activity, students will evaluate how hogs disrupt salt marsh communities by eating mussels, an action that cascades throughout the entire ecosystem because of the connectedness of species in the ecosystem.

Materials & Supplies

Each student will need a copy of the blank food web or a blank piece of paper (see 'Teacher Prep' below).

Each pair or small group will need the organism overview sheet. This can be cut into strips ahead of class or left as a full sheet (see 'Teacher Prep' below).

Each student will need the activity worksheet printed. This can be printed double sided.

Students will also need a red, blue, green, and purple writing implement. If this is not possible, the worksheet can be updated to use solid, dashed, dotted, and curly arrows.

Teacher Preparation

A blank food web is provided. This is optional but is intended to help students fit everything on one page and assist in grading because all webs will match the answer key. If using, print one copy per student ahead of class (black and white will also work fine, color will be more fun). Alternatively, students can use a blank piece of paper and write the organisms as they draw the web.

Arrange desks so students can work in pairs or small groups.

Print one organism overview sheet per pair/group. This sheet is designed to be cut into slips to increase student engagement and make the activity more interactive, but giving students the full (uncut) sheet

will not change the activity. Cut the sheet into strips with one organism per strip (optional). The organism overview sheet (cut or not) can be reused for multiple classes.

Procedure

1. Print the blank food web (optional), the organism overview sheets, and the worksheets. Cut the organism overview sheet into strips (optional).
2. Begin class by presenting slides 1-7 of the PowerPoint. This will overview five key relationships between organisms, and an example of each.
    a. If this is a review for the students, this part can be shortened. Or, it can be lengthened if this is the first time the students are seeing the material
    b. Specific talking points are in the slide notes.
        i. On slide 2: Ask students to name some ways organisms can be connected. They will likely say predation, but may come up with some other relationships, Students may indicate a relationship without explicitly saying so ("they live together") and you can probe to identify if the student is thinking of a positive or negative relationship (i.e., mutualisms or resource competition).
        ii. On slides 3-7, discuss how changes in the abundance of one organism can impact the other through this relationship. For example, decreases in prey populations affects predators. Loss of one mutualist hurts the other. Increases in the number of competitors can hurt an organism. This will play into the hog activity, so make sure students understand that organisms are connected by more than just predation.
        iii. When discussing predation, you can mention different diet types (carnivore, omnivore, herbivore, etc.) if this was recently taught.
        iv. You could also add information to this section explaining food chains and consumer positions within a food web, but be cautious in how much new material the students are being provided in one lesson.
3. Present slides 8-16
    a. These slides overview hogs and salt marshes. All information is provided on the slides and you can read directly from the slides to give the students some background information. Depending on the location of your school, students will have more or less exposure to wild hogs and/or salt marshes. If appropriate, ask students what they know about hogs and marshes when these topics are introduced.
        i. Slide 13 is a video of hogs in the marsh.
        ii. Slide 15 is a transition slide to the web activity.
4. Have the students break into groups of 2-3 students and build the food web.
    a. Give each student the printed web (optional, a blank sheet of paper will do)
    b. Give each group the organism overview slips/sheet.
    c. Each student needs red, blue, green, and purple pens
    d. Mention that hogs and trematodes will not be in the web yet, but that they will be added soon.
    e. Have students build the relationship web using the information on the organism overview sheet. Note that the food web has been simplified for ease of this activity. If students ask why a predation link is missing, you can explain that the salt marsh food web is extremely complicated, and it would be very difficult to draw every instance of predation.

f. Optional: You could add questions about primary, secondary, and tertiary consumers if that was recently studied. This is not included in the activity, but would easily fit with the food web exercise. The food web contains a 5th level consumer (dolphins).

5. Once students have built their web, hand out Part 1 of the worksheet. This will prompt students to add other non-predation relationships to the web, turning the food web into a relationship web.
6. After all students have finished Part 1, reconvene. You can review answers if time permits, or move directly into slides 17 & 18.
    a. Ensure that students have added hog predation of mussels to their food web.
    b. At slide 18, explain the hypothesis. Mention that scientists start with a hypothesis and then look for evidence that supports or disproves their hypothesis. Using the relationship web the students just made, they will support or disprove the hypothesis presented here.
7. Have students get back into groups and complete Part 2.
8. After all students have finished the activity, reconvene and review the worksheet.
    a. Discuss if our initial hypothesis was supported or not supported.
        i. Not supported, every species should have been impacted be hogs due to changes in resources.
        ii. If the students missed this, walk through the relationship web together. If mussels are depleted, mud crabs will have less food, so redfish will have less food, so dolphins will have less food. Mussels compete with fiddler crabs for algae, so a loss of mussels will benefit fiddler crabs. Mussels are in a mutualism with cordgrass, so a loss of mussels will hurt the cordgrass and all organisms in the web that depend on cordgrass. Snails are hurt by the loss of cordgrass, which impacts the trematode parasites.
    b. Were there any species that were not impacted by invasive hogs?
        i. No (see explanation above)
        ii. Highlight that even though only one species was eaten, many were negatively affected.
    c. Were the overall effects of hogs positive or negative? Highlight that changes in resource availability benefit some species but hurt others.
        i. Students will likely say negative, but fiddler crabs and snapping shrimp would benefit from the reduced competition, so this is a valid argument.

Assessment

Students will be assessed based on their completion of the relationship web, the provided worksheet, and group discussion at the end of class.

Optional Extensions:

Option 1, 10 minutes: Have students write a paragraph addressing the questions: “Should scientists control the invasive hog population? Why or why not? Do you have any suggestions for how scientists can reduce the impacts of hogs on salt marshes? Try to come up with one mechanism related to reducing the hog population and one mechanism that does not involve reducing the hog population”. If time permits, allow students to share with a partner or the class. I have included an example about lionfish in the Optional Extension portion of the worksheet to get students thinking about potential

management options. If you think this provides too much direction and students will copy the response, feel free to remove it.

- This is an open ended question, but a common argument for controlling the hog population will likely be to preserve the natural relationships present in the marsh ecosystem. Arguments against could be that hogs have been in Florida for 300 years and are part of the ecosystem, or that it is not the responsibility of humans to interfere with the ecosystem. Award full points for any valid argument.
- Mechanisms for reducing the impacts may include hunting of hogs, trapping of hogs, relocation of hogs away from salt marshes, or introduction of a predator to hogs. Mechanisms that do not involve reducing the hog populations include adding mussels to the salt marsh to replace those that have been eaten or adding fences surrounding salt marshes to prevent hog access.

Option 2, a full class or homework assignment: Have students research a local invasive species and discuss how it alters a food/relationship web.

References/Acknowledgements

Giuliano, W. M. 2010. Wild hogs in Florida: Ecology and management. EDIS 2010.

Organism Overview Sheet:

Algae: Algae can be free floating in the ocean or living on the marsh surface. For this activity, we are grouping all algae together as a single resource. Algae photosynthesize.

Cordgrass: Cordgrass is the most common grass species in salt marshes on the east coast of the US. Cordgrass can grow up to 5ft tall along the marsh edge. It photosynthesizes.

Dolphin: The bottlenose dolphin is a top predator in the salt marsh. They can swim at speeds up to 20 miles per hour. Dolphins eat a variety of fish, squid, and other sea creatures. To simplify our marsh food web, we have only included one fish species. So, in this web, dolphins eat redfish.

Fiddler crab: Fiddler crabs are the most common salt marsh crab. Male fiddler crabs have one large claw and one small claw, while females have two smaller claws. Male fiddler crabs wave their large claw to attract a mate, and do not use it for catching prey or eating. Fiddler crabs eat algae.

Mud crab: Mud crabs are carnivorous crabs that eat mussels and periwinkle snails. They build U-shaped burrows in the marsh. There are several species of mud crabs in Florida salt marshes, but they have similar behavior and diets, so we've grouped them together here.

Mussels: Ribbed mussels are common in salt marshes along the entire US east coast. Mussels are filter feeders and are closely related to oysters and clams. They feed on algae. Some species of mussels are eaten by humans, but not the ribbed mussels found in salt marshes.

Periwinkle snail: These small snails are very common in salt marshes, and range in size from the tip of a pencil to the size of your fingernail. Snails feed on the leaves of cordgrass.

Purple crab: This crab lives underground in large burrow networks that are shared by many individuals. They are a bright purple color, have square shells, and are nocturnal. The purple crab is an herbivore, eating the roots and stems of cordgrass. Large populations of purple marsh crabs can cause problems because they consume the cordgrass faster than it can grow, causing the cordgrass to die in a process known as marsh dieback.

Redfish: Redfish, also known as red drum, are a popular sportfish. They can grow up to 5 feet long, with the largest redfish ever caught in Florida weighing 52 pounds. Redfish live in shallow coastal waters and feed on the marsh at high tide. They eat fiddler crabs, mud crabs, purple crabs, and snapping shrimp.

Snapping shrimp: The big-clawed snapping shrimp grows up to 2.5 inches in length. They have two claws, but one is much larger than the other and can be up to half the size of the shrimp's body. The shrimp can close its large claw very quickly, creating a snapping noise and a jet of water that stuns prey. Snapping shrimp eat a variety of small crustaceans, including fiddler crabs.

Worksheet:

Part 1: Relationship web

1. Using the printed organism overview slips, build a salt marsh food web. Draw predation relationships in red. Remember, some species can act as both predators and prey, and a single species may consume or be consumed by multiple species. Hogs and trematodes will not be in the food web at first, but we'll add them later.

   Now that you have a food web showing predation, let's add other relationships to our web.

2. Cordgrass provides a hard surface for mussels to attach to. Mussels produce nitrogen-rich waste products that increase cordgrass growth. This relationship is known as: (circle one)

   Mutualism Parasitism Commensalism Competition

3. Draw the mussel-cordgrass relationship on your food web in **blue**.

4. Snapping shrimp live in the burrows of mud crabs. Mud crabs do not eat snapping shrimp and the snapping shrimp provide no benefit to mud crabs. This relationship is known as: (circle one)

   Mutualism Parasitism Commensalism Competition

5. Draw the snapping shrimp-mud crab relationship on your web in **green**.

6. Trematodes are parasites of snails. Draw this parasitism on your web in **purple**.

   When snails have trematode parasites, they stay alive, but they reduce their feeding on cordgrass. This can benefit other species by reducing competition for resources.

7. Name the species in the food web that competes with snails for resources:

   _____

8. Invasive hogs consume mussels. Add this relationship to the web, and let your teacher know you have finished part 1 of the worksheet

Part 2: Effects of Invasive Hogs

Now that we have built our full web, we can figure out what species benefit and what species are hurt by invasive hogs.

Think about the relationships you've put on your web and the role mussels play in this ecosystem. What would happen if hogs were to consume most of the mussels in a salt marsh ecosystem? Explain if the following species would benefit or be hurt by hogs eating mussels and why. Rember to consider relationships other than just predation!

Algae:

Fiddler Crab:

Cordgrass:

Snail:

Did this activity support or not support the initial hypothesis that hogs will affect less than half of the organisms in a marsh food web? Explain

Are any species **completely** unaffected by hogs eating mussels? This means there is no change in their population size or food availability, either positively or negatively. If so, name the species.

Discuss with your partner if you think hogs are overall positive or negative for salt marshes. There's no right answer here, but be prepared to share with the group.

Optional Extension 1:

Write a paragraph in response to the following questions:

Should scientists control the invasive hog population? Why or why not? Do you have any suggestions for how scientists can reduce the impacts of hogs on salt marshes? Try to come up with one mechanism related to reducing the hog population and one mechanism that does not involve reducing the hog population. Be creative in your answers.

Example: Lionfish are an invasive fish that consume many native fish that live on coral reefs, including herbivorous fish that eat algae on coral reefs. Without the herbivorous fish, algae can overgrow and kill corals, harming the coral reef ecosystem. We should control the lionfish population to prevent the loss of the coral reef ecosystem. Scientists are working to reduce the negative impacts of lionfish in several ways. First, they are encouraging people to fish for and eat lionfish. Scientists have even made a cookbook full of lionfish recipes! Second, scientists are working to protect sharks, one of the few predators of lionfish. Third, scientists are researching ways to reduce algal growth on coral reefs to substitute for the herbivorous fish. Finally, scientists and law makers are protecting the native fish from fishing. If humans are also catching the native herbivorous fish, we are adding to the problem.