Down Jersey LESSON PLAN

The Horseshoe Crab as a Keystone Species

Theme: **Natural History**

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Subject Areas
Art, Physical Education

Duration
One class period

Setting
Indoors or outdoors

Skills
Simulating, comparing, describing, interpreting

Charting the Course
The horseshoe crab is considered a keystone species. That is, many species' survival depends on the horseshoe crab. This phenomenon is evidenced in the Down Jersey region by the annual migration of shorebirds that feast on the eggs of the horseshoe crab.

Vocabulary
Keystone species, biodiversity

Correlation to NJ Core Curriculum Content Standards

Art
1.2 (1)
1.6 (1, 2, 3)

Physical Education
2.5 (3,5)

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Objectives

1. Examine the relationship among species
2. Explain the term “keystone species” and relate to the horseshoe crab
3. Describe the importance of maintaining biodiversity for the health of the environment
4. Participate in a visual representation of the concept of a keystone species

Materials

Photographs of the horseshoe crab/shorebird phenomenon

Optional: Show the video *The Crabs, the Birds, the Bay*, available from the NJ Audubon Center for Research and Education —(609) 861-0700.

Making Connections

The interrelationship between the horseshoe crab and numerous species of shorebirds is well documented. The region of Southern New Jersey along the Delaware Bayshore is famous for being one of the best places to witness the amazing migration of shorebirds that occurs there each spring. The phenomenon is touched on in the film ***Down Jersey*** and deserves closer investigation and explanation. Looking at the horseshoe crab as a keystone species is one way to understand the intricacies of nature and the environment.

Background

See the other Activities in this guide related to the Horseshoe Crab and Shorebirds.

The Horseshoe Crab as a Keystone Species

By Philip Correll, New Jersey Coastal Heritage Trail

Concept of a Keystone Species

A keystone species is a species on which the survival of a number of other species depends. The term comes from the concept of a keystone used in construction. A keystone is placed at the top of an arch. It supports the other stones or bricks in the arch and prevents the entire arch from collapsing. If the keystone is removed, the arch cannot maintain its shape and will fall to the ground.

The same is true in nature. If a keystone species becomes extinct from an environment or ecosystem, the species supported will disappear as will other species that are dependent. These keystone species can occur at any level in the ecosystem. They can be plants or herbivores (plant eaters), carnivores (meat eaters), or detrivores (waste eaters). Carnivores may be important in keeping the populations of other species under control. Herbivores can shape the environment in which other species live. Some important plants support particular insect species that are prey for the birds and bats that disperse the seeds of plants and other organisms.

The Horseshoe Crab and the Delaware Bay

The horseshoe crab (*Limulus polyphemus*) is not a crab at all, but is more closely related to spiders and scorpions. It has changed little in over 300 million years, and the Delaware Bay is home to the largest population of spawning horseshoe crabs in the world. Each spring the warming waters bring the crabs from the Delaware Bay and Atlantic Ocean to the coastlines of New Jersey and Delaware. In late spring, at the high tides of the full and new moons, female crabs come ashore to lay their eggs, depositing up to 20,000 small eggs in shallow nests in the sand.

What makes this odd prehistoric creature a keystone species? At the same time the horseshoe crabs are laying their eggs, nearly a million shorebirds converge on the Delaware Bay each spring on their northward migration. The Bay is the second largest feeding stopover in the western hemisphere for north-bound shorebirds. Many of these shorebirds travel thousands of miles nonstop from Central and South America. They arrive thin and hungry and rely on the feast of tiny green horseshoe crab eggs to regain their weight and energy reserves for the rest of their trip to summer nesting grounds in Canada and the Arctic.

As many as 30 species of shorebirds cram the shoreline in late May trying to double their body weights. The four most common species are the red knot, sanderling, ruddy turnstone, and semipalmated sandpiper,

and they account for as much as 97 percent of the shorebirds that stop over in the Delaware Bay. It has been estimated that a sanderling bird weighing 50 grams on arrival will eat one horseshoe crab egg every five seconds for 14 hours per day.

Clearly, if the horseshoe crab were not there to provide the eggs that are a major food source for these migrating bird species, there would be a major effect on the number of birds migrating and their ability to survive. Since these birds come from such great distances, anything that affects the population and habitat of the horseshoe crabs in the Delaware Bay has implications for these other species thousands of miles away.

Procedure

Warm Up

Describe the connection between the horseshoe crab and shorebirds. Utilize the background information provided or any of the other related activities in this guide.

The Activity

Tell students that they are going to demonstrate the concept of a keystone species.

NOTE: You may want to have the class divide into three groups and challenge each group to demonstrate one of options # 1-3. Option #4 requires a large area and group of students.

Optional Activities:

1. **Links in a chain.**
   Have students make a paper chain with each link representing a different species of shorebird. Make one link a horseshoe crab. Connect the links to form a chain, with the horseshoe crab as the center link. Show what happens to the other links when the horseshoe crab is removed (cut).
2. **Building an arch with a keystone.**
   Show examples of building keystones. Have students draw an arch to illustrate the horseshoe crab/shorebird connection. The horseshoe crab is the keystone, and, when removed, the arch collapses.
3. **Building an upside-down pyramid.**
   Using blocks, have students build an upside-down pyramid to show the food pyramid of the shorebirds. The single bottom block is the horseshoe crab, and, when removed, the entire pyramid is no longer supported, and falls.
4. **Performing a lap sit exercise.**
   This is a very physical way to demonstrate the concept of keystone species. This activity takes very little time—but has a lot of impact! Ask the students to number off from “one” to “four.” Tell the students that number “ones” represent horseshoe crabs, “twos” represent sanderlings, “threes” represent red knots,

and "fours" represent ruddy turnstones. Now it's time for a circle. In a large open area, students alternate "one, two, three, four" and stand shoulder to shoulder facing the center of the large area until a circle is formed. Now, ask each student to turn to the right, and at the same time, take one step closer to the center of the circle. Students place their hands on the shoulders of the person in front of them. Students slowly sit down as you count to three. (They sit on the knees of the person behind them, and they keep their knees together to support the person in front of them.) Now, try it again, but this time, have students that represent the horseshoe crabs removed from the circle one at a time until the circle collapses. You can have a horseshoe crab removed by saying:

1. You have just been harvested;
2. You got stuck on the beach at a high tide;
3. You were cut up for bait;
4. You have died of old age, etc.

Wrap Up

Summarize the concept of a keystone species and relate the significance of the horseshoe crab to the survival of migrating shorebirds.

Action

Find out more about this natural phenomenon. Visit a viewing area in late May to witness the migration. Contact the Endangered and Nongame Species Program to find out what you can do to help!

Assessment

As homework, have students describe what a keystone species is and why the horseshoe crab is considered one.

Extensions

Using the resources listed below, have students research other keystone species.

Or, find out what is being done in the Down Jersey region to protect the horseshoe crab population and their spawning areas.

Resources

NJDEP — Endangered and Nongame Species Program
P.O. Box 400, Trenton, NJ 08625
(609) 292-9400
Visit their website: http://www.state.nj.us/dep/fgw

Bagheera website:
http://www.bagheers.com/clasroom/CONSERVE/CONSERVE.HTM

World Resources Institute
1709 New York Avenue, NW, Washington, D.C. 20006
(202) 638-6300; fax (202) 638-0036
http://www.wri.org/biodiv/cascade.html

The Delaware Estuary: Rediscovering a Forgotten Resource
Tracey L. Bryant and Jonathan R. Pennock
University of Delaware Sea Grant College Program
Newark, DE 19716
(302) 831-8083
E-mail: MarineCom@mvs.udel.edu
Website: www.udel.edu/cms/seagrant/

New Jersey Audubon Society Center for Research and Education*
600 Route 47 North, Cape May Court House, NJ 08210
(609) 861-0700; fax (609) 861-1651
Ask for their "Horseshoe Crab Fact Sheet" and other information they may have.

** This is where to get the video* ***The Crabs, the Birds, the Bay***