

U.S. Fish and Wildlife Service

Environmental Education Materials

Horseshoe Crabs and the Shorebird Connection

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Horseshoe Crabs and the Shorebird Connection

Lesson Plan Objectives:

1. Students will be able to describe the connection between horseshoe crabs and shorebirds.
2. Students will:
 - a. know why horseshoe crabs are called “living fossils”.
 - b. be able to identify male and female horseshoe crabs; why the male has “boxing gloves” claws on his front legs.
 - c. know that horseshoe crab blood is blue and how it is used in testing drugs.
 - d. be able to describe the horseshoe crabs mating process.
 - e. know that horseshoe crab eggs are green.
 - f. know what the horseshoe crab’s tail or telson is used for.
 - g. know how many eyes and how many legs a horseshoe crab has.
 - h. know approximately how many eggs the female lays in each nest and how many eggs she lays during the spawning season.
 - i. know how old a horseshoe crab must be before sexual maturity.
 - j. know that the horseshoe crab is not a crab but related to spiders.
3. Students will:
 - a. be able to trace the migration of red knots from Terra del Fuego to Delaware Bay and then to Arctic tundra in Canada.
 - b. know why horseshoe crabs are critical for red knots.
 - c. be able to name some of the other shorebirds that come to Delaware Bay to feed on horseshoe crab eggs.
 - d. know how long the red knot’s non-stop migration from South America to Delaware Bay is and how long it takes.

Lesson Plan

Look for Shorebirds

1. Approach the beach as quietly as possible. Are there any shorebirds feeding on horseshoe crab eggs? If so, try to identify the species using a field guide as needed. Make a list of the species you observed.
2. Are there any red knots? Explain why horseshoe crab eggs on the beaches of Delaware Bay are critical for their survival. Why are red knots described as having one of the longest migrations of any shorebird?
3. Did you observe dunlin, ruddy turnstones, semipalmated sandpipers, sanderlings, or short-billed dowitchers on the beach? If so, why are they on the beach, where did they spend the winter, and where are they going when they leave Delaware Bay?
4. Why do shorebirds come to Delaware Bay every spring? When they leave, why do they go to the arctic regions to breed?

Horseshoe Crabs

1. Carefully pick up a male and a female horseshoe crab. Notice the difference in size between the smaller male and the larger female
2. Looking at the top of the crab, find the compound eyes; find the telson (tail) and tell what it is used for; find the hinge.
3. Turn the crab over. Count the legs; find the mouth; find the book gills.
4. After turning both crabs over, notice the boxing glove claws on the front legs of the male and tell what they are used for.
5. Why horseshoe crabs are called living fossils?
6. Why is horseshoe crab blood blue? What is it used for?
7. What is the scientific name of the horseshoe crab?
8. How else are horseshoe crabs used? Why do they need to be protected?

9. Are there tags on any of the crabs you see on the beach? What are the tags for?
10. What do horseshoe crabs eat?

Horseshoe Crab and Shorebird Connection

Write a short essay about what you understand is the connection between horseshoe crabs and shorebirds and why you think it is important.

Horseshoe Crab Facts

- *Limulus polyphemus* is the name given to the species of the horseshoe crabs found on our Atlantic coast. It is not really a crab; rather its closest relatives are spiders, ticks, and scorpions.
- Fossils of horseshoe crabs very similar to those we have today lived 350 million years ago, 100 million years before the first dinosaurs appeared on earth. For this reason, horseshoe crabs are sometimes called “living fossils”.
- Females are twice the size of males. Both sexes have five pairs of legs, but the first pair of legs on the male is modified so that it can clasp the shell of the female during mating. Both have long tails (called a telson) that is used as a rudder when swimming and as a means of righting itself when it is turned over on its back. Both also have gills that resemble the pages of a book to extract oxygen from the water.
- Horseshoe crabs have a mouth on their underside, centered between their legs and surrounded by stiff spines. They plow slowly along the ocean floor, eating almost anything they find, including algae and dead fish, but marine worms and snails are their favorite foods.
- They have a total of ten eyes. Two are compound eyes on the top of their shell that enable them to see light, dark, and shapes in black and white. Other eyes see only light and dark, and one pair senses ultraviolet light. Studies of horseshoe crab eyes and their optic nerve have been very important in contributing to an understanding of human eyesight.

- Horseshoe crabs have blue blood (not red), but the blood has a more important characteristic: the blood can detect bacteria and build a defense against them. An extract made from this blood called Limulus Lysate is used to test drugs to make sure they are free from bacteria.
- In the late Nineteenth Century through the mid Twentieth Century large numbers of horseshoe crabs were harvested from the beaches, ground up, and used for fertilizer. As that practice was ending, it was discovered that horseshoe crabs could be used as bait for conch and eel traps, so the harvest began anew. By the 1990's surveys indicated a decline in the number of horseshoe crabs spawning on Delaware Bay beaches. Subsequent surveys also found a decrease in shorebirds, particularly red knots, that feed on the eggs.
- In recent years there has been a program to tag horseshoe crabs in order to better understand their annual return to Delaware Bay. The tags include a date and place where they were tagged.
- During spawning season, female horseshoe crabs come up on sandy beaches, dig down 4 to 7 inches, and lay 5000 eggs in golf ball sized clusters.

Shorebird Facts

Red Knot

- Of all the shorebirds, the red knot is the species most dependent on the eggs of the horseshoe crab for its survival. Red knots follow one of the longest migrations of all the shorebirds, traveling nearly 20,000 miles from their winter quarters in Patagonia and Terra del Fuego at the southern tip of South America to their breeding grounds in the high Arctic regions of northern Canada, then back again to Patagonia and Terra del Fuego.
- The springtime northbound migration is made in three non-stop flights from Patagonia and Terra del Fuego to the southeastern shore of Brazil (about 1,750 miles), then a five to seven day non-stop flight covering about 7,000 miles to the shores of Delaware Bay, and finally a 1,000 mile flight from Delaware Bay to their breeding grounds in the Arctic tundra of Canada's Northwest Territories and on islands north of Hudson Bay in central Canada.
- At these stop-overs, each lasting two weeks to a month, red knots double their weight. The added fat serves as fuel for these long-range, non-stop flights. On the South American shores they feed on clams, snails, marine worms, and other small crustaceans. On the shores of Delaware Bay they gorge on the eggs of horseshoe crabs, and when reaching the Arctic they first feed on an abundance of insects.
- On the breeding grounds the males conduct an elaborate courtship display followed by nest making and mating. The female lays four eggs that hatch in 21 to 23 days. After about a week after the chicks hatch, the adult females leave to begin their southbound migration. The young learn to fly in 18 to 20 days, and shortly thereafter the adult males also head south, leaving the young alone. Several weeks later the young gather together and begin their trip to South America.
- Some red knots begin their southbound migration from a staging area on James Bay, the southern arm of Hudson Bay, but most go straight from their Arctic grounds to the shores of the Atlantic coast from Massachusetts to New Jersey. After refueling, they again head for South America on a non-stop flight to Brazil and finally to their wintering grounds in Patagonia and Terra del Fuego

Semipalmated Sandpiper

- The semipalmated sandpiper is another long distance migrant that makes a non-stop flight from the beaches of eastern Central and South America to the east coast of the United States, then after working its way north along the Atlantic Coast, arrives on its breeding grounds in subarctic Canada by late May. Each

spring large numbers congregate on the shores of Delaware Bay to feast on the eggs of the horseshoe crab, but they also favor the shallows and mud flats of the salt marshes and freshwater impoundments of Bombay Hook where they probe for marine worms and small crustaceans.

Semipalmated Sandpiper, continued

- Semipalmated sandpipers nest in coastal areas or around lakes and rivers in the subarctic tundra. Egg laying may begin a week after arrival; eggs hatch in 20 to 22 days, and the young can fly by nineteen days later. As is the case with other sandpiper species, the adult females leave the breeding grounds first, followed by the adult males, and then lastly by the young.

Ruddy Turnstone

- The ruddy turnstone got its name from the ability use its strong neck and bill to turn over seaweed, small rocks, pebbles, and other debris on the beaches in order to find crustaceans, mollusks, snails, worms, and other food items hiding under them. They also use their bills to dig holes in the sand to find food. Ruddy turnstones are the only shorebirds that can dig up the buried egg clusters of horseshoe crabs and spread the eggs on the beach for a high protein lunch for themselves and other shorebirds.

Short-billed Dowitcher

- The subspecies of the short-billed dowitcher found on the impoundments and tidal marshes of Bombay Hook spends winters in Venezuela, Brazil, and the West Indies. In the spring they fly nonstop to the Atlantic Coast, many stopping off in Delaware Bay to feast on horseshoe crab eggs and aquatic insects. From there they again fly nonstop to their breeding grounds in Quebec and Newfoundland.
- The short-billed dowitcher's long, straight bill is twice as long as its head, and it probes for food by walking slowly along the beach or mud flat using a "sewing machine" like motion. Because they make long distance, nonstop flights from South America and then on to Canada, short-billed dowitchers bulk up on the protein of horseshoe crab eggs, but they also search the mud flats, such as those at Bombay Hook, for aquatic annelids (segmented worms) and snails.

Dunlin

- For dunlins, horseshoe crab eggs are a welcome source of food, but not a life or death necessity. The dunlin finds other foods by probing mud flats and beaches.
- The dunlins that we see at Bombay Hook in late fall and winter have relatively short migrations. They winter on beaches from Nova Scotia to northern Mexico, and their summer breeding grounds are in the subarctic tundra across Canada.

Sanderling

- Sanderlings are the small, light gray sandpipers seen scampering before the rolling surf on the beaches of Dewey, Fenwick, Bethany, Lewes, and Rehoboth in the fall and winter.
- Sanderlings winter along sandy beaches from the Atlantic Coast of North America as far north as Massachusetts to the coasts of South America as far south as Argentina. For spring migrants, horseshoe crab eggs found on the shores of Delaware Bay are an important food source, and the bay is perhaps the largest single stopover on their way north. But they are also found in the drained impoundments and tidal flats at Bombay Hook.
- Depending on their wintering grounds, sanderlings cover between 3,000 and 10,000 miles in their yearly round trips between breeding and wintering grounds, placing them among the long-distance migrants.
- Sanderlings breed in the high Arctic, well north of most other sandpipers, and usually in coastal tundra areas with gravel beaches or ridges. Some are known to hatch two or three clutches of eggs, the first incubated and hatched by the first male, the second incubated and hatched by the female with a second male partner, and if there is a third hatch, incubated and hatched by a third male partner.
- In addition to horseshoe crab eggs, sanderlings eat a variety of aquatic and terrestrial invertebrates, including insects, small crustaceans, and mollusks.

Other Birds You Might See On The Beach

Greater yellow legs, black-bellied plover, semipalmated plover, willet, ring-billed gull, laughing gull, herring gull, greater black-backed gull

Lesson Plan Relates to Delaware Science Content Standards: (K-3;6.1.A); (K-3;6.2.B); (4-5;6.1.A); (4-5;6.3.A); (6-8;6.1.A); (6-8;6.1.B); (9-12;6.1.H); (6-8;7.1.A); (6-8;7.1.E); (6-8;7.2.A); (6-8;7.2.B); (6-8;7.2.F); (9-12;7.2.D); (K-3;8.1.A); (4-5;8.1.C); (4-5;8.1.E); (6-8;8.1.D); (6-8;8.1.E).