

U.S. Fish and Wildlife Service

Environmental Education Materials

Wildlife Tour Through the Refuge

Bombay Hook
National Wildlife Refuge
2591 Whitehall Neck Road
Smyrna, DE 19977
302/653 6872
FAX 302/653 0684

U.S. Fish & Wildlife Service
1 800/344 WILD
<http://www.fws.gov>
www.bombayhook.fws.gov

Wildlife Tour Through the Refuge

Lesson Plan Objectives:

1. Students observe several varied habitats on the refuge and learn how each contributes to wildlife.
2. Using field guides, students identify common birds and other wildlife seen on the tour.
3. Students learn some of the ways in which refuge staff manages the refuge to enhance wildlife habitat and wildlife populations.
4. Students will observe and understand the concept of forest succession. (Optional)
5. Students will learn the public uses of the refuge. (Optional)
6. Students will learn some of the history of the refuge. (Optional)
7. Students will walk one or more of the five walking trails. (Optional)

(Note: The first three objectives are essential items. The last four are optional depending on the age group and the purpose of the tour.)

Lesson Plan Overview:

The Wildlife Tour follows Wildlife Drive, a twelve-mile trip through Bombay Hook National Wildlife Refuge.

The refuge covers over 16,000 acres, and 13,000 acres are tidal salt marsh. Impounded fresh water pools and brushy and timbered swamps cover about 1,100 acres; another 1,900 acres are forests and grassy uplands. Such varied habitat has resulted in an abundance and diversity of wildlife: 278 species of birds, 34 species of mammals, 14 species of amphibians, 21 species of reptiles, and 21 species of fish are found on the refuge.

Habitats

Freshwater Impoundments. Raymond, Shearneck, Bear Swamp, and Finis Pools were formed by building dikes across the salt marsh to create shallow freshwater impoundments. Each is somewhat different, but all attract shorebirds, wading birds, and waterfowl, depending on the season. By controlling water levels, aquatic plants flourish in the summer and provide food for ducks and geese in the fall and winter. Shorebirds and wading birds find fish, amphibians, and aquatic insects in shallow water and mud flats during spring, summer, and fall. The pools also are home for frogs, turtles, water snakes, and muskrats.

Tidal Salt Marsh. The marsh itself is a mix of habitats. High marsh areas flood only during spring tides, usually twice per month, and during storms. Low marshes flood twice per day, and each marsh type has its own vegetation. Three rivers cross it, the Leipsic, the Simons, and the Mahon. There also are many guts, tidal streams, canals, and brackish ponds. These marshes are breeding grounds for ducks and also serve as feeding and resting grounds for ducks, geese, wading birds, and shorebirds. Muskrats build their homes here, diamond-backed terrapin are found here, and it serves as a nursery for many fish species.

Forests. Over sixty-five species of trees and shrubs have been identified in the wooded sections of the refuge. These trees and shrubs provide berries and nuts eaten by many wildlife species, and forest vegetation is the bottom rung of many food chains. While most are in dry upland forest tracts, some are found in wooded freshwater swamps and bogs. The forests provide food and shelter for many mammals - deer, foxes, raccoons, squirrels, shrews, mice, voles, and bats. They also are home to snakes, tree frogs, salamanders, many species of insects and other invertebrates, and woodland songbirds.

Upland Fields. Grasslands are an important wildlife habitat and recently have been expanded by replacing former agricultural fields, and by increasing the acreage of natural grasses and herbaceous vegetation. Some will be managed as grasslands, others will allow the growth of woody, non-herbaceous plants to eventually develop into the first stage of forest succession. Grasslands provide cover as well as food for deer, woodchucks, rabbits, voles, and mice. Many birds are attracted to seeds and insects found in these fields, including pheasants, bob-whites, meadow larks, bobolinks, sparrows, and swallows.

Suggested Activities:

1. Have students list the wildlife they saw on the tour and tell what habitat they live in.
2. Have students list all of the animals they can think of that are found in each of the four habitats.

Identification of Wildlife

Using field guides and field lists as needed, help students identify as many birds and other wildlife as possible that are seen on their tour of the refuge.

Suggested Activities:

1. For younger students, select a common bird (a great blue heron, a red-wing blackbird) and count the number of times this bird is seen during the tour of the refuge.
2. For older students, maintain a list of birds and other wildlife, and count the number that are seen during the tour.

Management of the Refuge for Wildlife

Controlling Water Levels In Raymond, Shearneck, and Bear Swamp Pools. Water is lowered in one or more of these pools in the spring, summer, and early fall to provide mudflats and shallow pools for migrating shorebirds and, at the same time, allow growth of plants such as millet and spikerush that provide food for ducks and geese. Water levels are returned to depths between 15 and 20 inches later in the fall, winter, and early spring to accommodate migrating ducks and geese.

Reforestation. Specific areas of the refuge are selected for reforestation by planting sapling trees, using species native to the area. But reforestation also occurs by allowing natural fields to grow from grasses to woody plants, and then to sweet gums and the first stage of forest succession.

Nest Boxes. Because of the loss of natural cavities, nest boxes have been provided for many cavity-nesting species throughout the refuge. Wood duck nest boxes with a shield below to prevent predators are found in wooded areas near or in water; bluebird nest boxes are seen in open fields; and barn owl nest boxes are located in out buildings located throughout the refuge. Other cavity-nesting birds also use these nest boxes, including house wrens, tree swallows, and screech-owls. Purple martins nest in gourds or “apartment-type” houses that can be seen just beyond the Visitor Center.

Controlled Burning. Controlled burning in selected upland fields has been used to control undesirable vegetation and promote new growth of desirable grasses. Similar burning in areas of the tidal salt marsh helps to rejuvenate the vegetation. Burning also is used along with herbicides to control phragmites that grow in any moist area where the soil has been disturbed.

Moist Soil Units. Moist soil areas, some formed naturally while others man-made, are slight depressions in upland fields that are flooded by rain in fall, late winter and early spring. They provide habitat for migrating shorebirds before the heat of summer dries them up..

Population Control. The huge flocks of snow geese that have come to the refuge in recent years have destroyed the marsh grasses on Leatherberry Flats, an area across Wildlife Drive from Shearneck Pool. This is a condition biologists call “eat-out,” leaving only mudflats and shallow pools. To drive them from concentrating in a single marsh area, snow goose hunting has been encouraged. Deer hunting also is permitted on the refuge to maintain the deer herd at a manageable level and maintain forest understory for other species.

Banding, Tagging, and Surveying. Waterfowl and shorebirds have been banded to study migration patterns. Volunteers from the refuge have tagged horseshoe crabs. Surveys of vegetation in the impoundments and various studies of the marshes have been conducted. Aerial counts of waterfowl populations have been conducted each year.

Suggested Activity:

Have students write a short essay on how the refuge is managed for wildlife.

Forest Succession (Optional)

Point out to students upland fields where grasses have been replaced by shrubs and small saplings. These fields are the first stages of forest succession. Forest succession is the predictable change in plant species where one community of plants replaces another over time.

The forests, being an ecological system are subject to the species succession process. There are "opportunistic" or "**pioneer**" species that produce great quantity of seeds that are disseminated by the wind, and therefore can colonize big empty extensions, and they are capable to germinate and grow under direct sun exposition. Once they have produced a closed canopy, the lack of direct sun radiation at soil makes it difficult for their own seedlings to develop. It is then the opportunity for shade "**tolerant**" species to get established under the protection of pioneer. When these pioneers will die, the shade tolerant will replace them. The shade tolerant species are capable of growing under the canopy, and therefore, in the absence of catastrophes, will stay. For this reason

it is said then the stand has reached its **climax**. When an important catastrophe will arrive, the opportunity for the pioneers will be open again, provided they are not absent at a reasonable range.

An example of pioneer species, in forests of northeastern North America are *Betula alleghaniensis* (Yellow birch) and *Prunus serotina* (Black cherry), that are particularly well-adapted to exploit large gaps in forest canopies, but are intolerant of shade and are eventually replaced by other shade-tolerant species in the absence of disturbances that create such gaps.

Things in nature are usually not one way or the other way, and there are **intermediates**. It is therefore normal that between the two extremes light/shade there is a gradation, and there are species that may act as pioneer or tolerant, depending on circumstances.

Stage 1. Annual grasses and short-lived herbaceous plants (crabgrass, ragweed) are replaced by taller, perennial plants (Queen Anne's lace, asters, goldenrod). This happens because the shorter grasses are shaded by taller plants. Plant stage first five years.

Stage 2. Shrubs, other woody plants (e.g., sumacs), and tree seedlings and saplings (sweet gum, winged sumac) appear, again shading the non-woody herbaceous plants. Shrub stage six to 25 years.

Stage 3. Full grown trees (sweet gum, wild cherry) take over. Young forest 26-50 years.

Stage 4. The first-growth sweet gums and cherries are replaced by beeches, birches, ash, maple, and similar species. Mature forest 51-150 years.

Stage 5. The mature forest – oaks and hickories with a shade-tolerant understory. Climax forest 150-300 years.

Public Uses (Optional)

Bombay Hook is for wildlife - but Bombay Hook also is for people. Students (and their parents) should know the many public uses offered by the refuge.

1. Bird watching - a popular activity on the refuge.

2. Wildlife Observation - Wildlife Drive - the 12 mile tour through the uplands of the refuge.
3. Wildlife photography - many award-winning photographs have been taken on the refuge.
4. Hunting - deer, snow and Canada geese, ducks, and upland game hunting seasons.
5. Bicycling on Wildlife Drive - a good way to see wildlife.
6. Environmental education - activities for families, school groups, and others.
7. Five walking trails - three leading to observation towers, two are handicapped accessible.
8. Native plant gardening – programs offered to educate about using native plants in home gardens.
9. Periodic open houses, festivals, lectures, exhibits, and guided tours.

History of the Refuge (Optional)

Seventeenth Century Dutch settlers, sailing up the Delaware Bay, named a prominent landmark, a wooded point extending out into the river, “Boomptjes Hoeck”. Before the Dutch, the Native Americans had given it a name, calling it “Canaresse.” The English, who took over the Dutch Colonies on the Delaware in 1664, had great difficulty with the Dutch name, and eventually it became known as “Bombay Hook”. The point itself is actually about one mile north of the refuge.

In 1679 Mechacksett, chief of the Kahansink Indians, sold a 600 acre land grant called “Boompies hock” to Peter Bayard, an early Dutch settler. The price for the land was 1 gun, 4 handfuls of powder, 3 waistcoats, 1 anchor of liquor and 1 little kettle. Its exact location is not known, but it may have included upland and marsh that became the northern portion of the refuge. Mechacksett’s brother, Petequoque, also owned lands that were south of Machacksett’s holdings. Petequoque sold large land parcels that almost certainly included parts of the refuge to John Richardson in 1676 and Barnard Hodges in 1677.

In 1936, the federal government purchased 12,000 acres on Delaware Bay stretching from just below Woodland Beach to Port Mahon, and on March 16, 1937, the refuge was established as Bombay Hook Migratory Waterfowl Refuge. Its primary purpose was to serve as a feeding, resting, and breeding site for migratory waterfowl, but it also was intended to serve other migratory and non-migratory species. It was one of a newly-developed string of refuges on the Atlantic Flyway.

In 1962, the refuge acquired 341 acres adjacent to its northern border. This land was purchased by John Allee, an immigrant from France and a Huguenot, in 1711. It was called Islington Plantation, and when he died in 1719, the plantation was inherited by his son, Abraham. Abraham build the Allee House in 1753, where it stands today very much the same as when it was built.

In order to develop the upland fields with scattered woodlots and the vast tidal salt marshes into a real refuge, Company 3269-C of the Civilian Conservation Corps was assigned to Bombay Hook. The CCC was made up of unemployed, unmarried young men between the ages of 17 and 24, and the company assigned to the refuge was made up of African-Americans. Until they left in 1942, they build a headquarters building, an equipment shed, two houses, an observation tower, a boat house, several boats and a barge. They planted trees, cleared swamps and bogs, planted crops, and helped build Raymond dike.

In World War II the refuge was taken over by the military. In 1943, the Army Air Force converted the 90-foot observation tower, built by the CCC in 1939, into a radio direction finder station to help pilots navigate in the area. They built targets on Kelly Island for an air-to-ground gunnery range for fighter aircraft. They built a rocket launcher near the site of the Visitor Center that fired rockets at a target on Shearness Dike. But the largest project was to test rockets fired from aircraft. A target was set up in Bear Swamp, and planes came in from the northwest and fired on the target.

The most significant environmental change to improved habitats on the refuge was construction of dikes across the edges of the tidal marsh to create freshwater impoundments. The first, Raymond Pool, was started in 1938 and enclosed in 1939. Shearness Pool construction began in 1938 with a causeway to separate it from Finis Pool, but the dike itself was begun in 1941. It was not completed until 1956. The causeway did create Finis as a separate pool. Bear Swamp was started in 1957 and impounded in 1960. Wildlife Drive was constructed on the tops of these three dikes and the Finis causeway.

During the first 25 years most of the major enhancements to improve the habitats for wildlife were completed and the refuge looked very much as it does today.

Walking Trails (Optional)

Five walking trails are available for students doing the Wildlife Tour of the Refuge.

Raymond Pool Observation Tower. About 1/4 mile (round trip) walk bordering a wooded area to reach a 30 foot observation tower that overlooks Raymond Pool.

Boardwalk Trail. A half mile (round trip) walk through a wooded area and over the tidal salt marsh. The trail is handicapped accessible. A descriptive brochure is available.

Parson Point Trail. A one mile (round trip) walk through the forest bordering Shearness Pool. A descriptive brochure is available.

Bear Swamp Trail. A 1/4 mile (round trip) walk through the forest to a 30 foot observation tower and floating platform overlooking Bear Swamp Pool. The trail is handicapped accessible. A descriptive brochure is available.

Shearness Pool Observation Tower. A 1/4 mile (round trip) walk through the woods to a 30 foot observation tower overlooking Shearness Pool.

Lesson plan relates to Delaware Science Content Standards: (4-5;6.1.C); (K-3;8.1.A); (4-5;8.1.C); (4-5;8.2.B); (6-8;8.1.C); (6-8;8.1.D); (6-8;8.1.E); (6-8;8.1.G); (9-12;8.1.D).