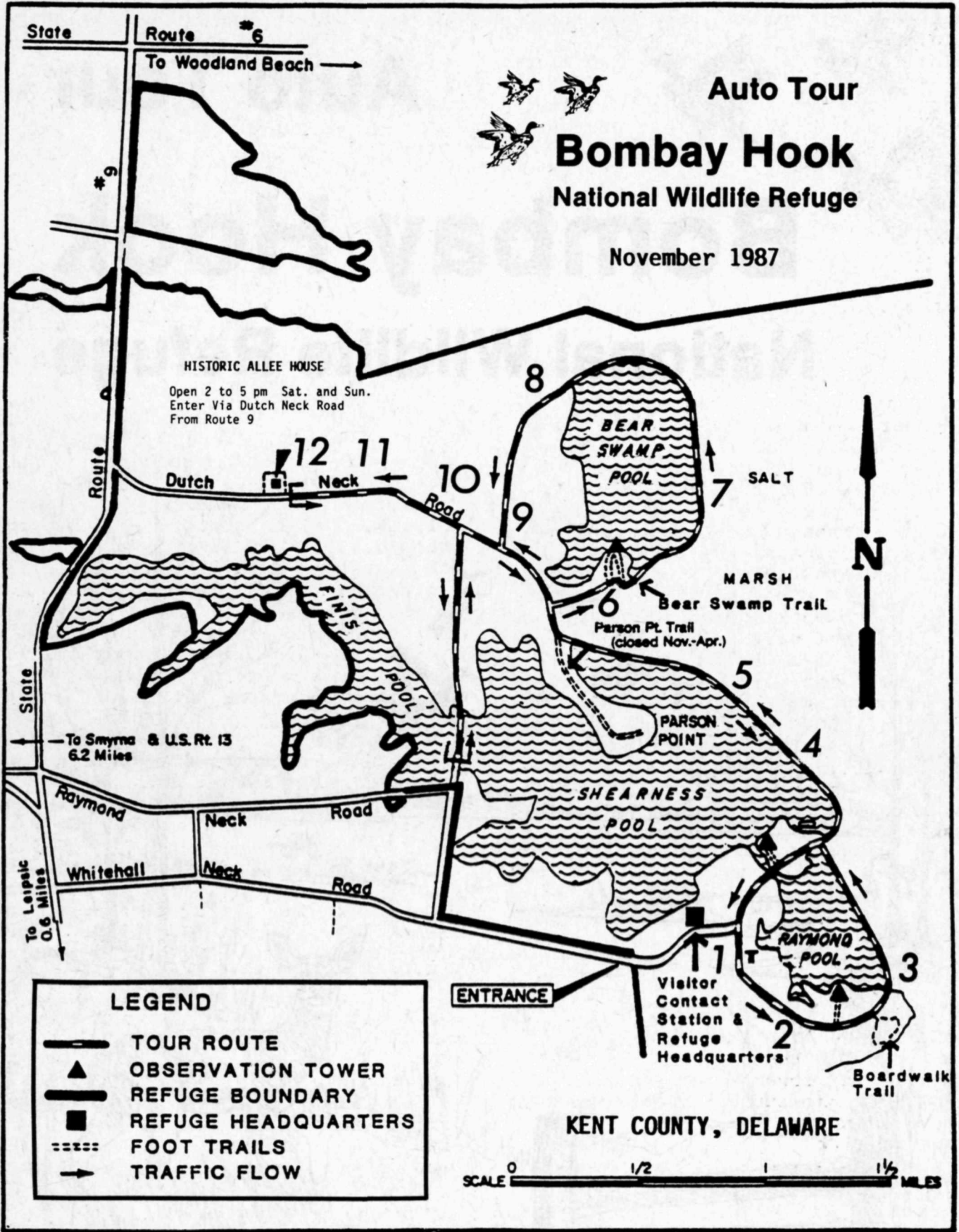


**Auto Tour**

**Bombay Hook**  
**National Wildlife Refuge**





Printing this tour guide has been funded by the Department of Agriculture and Natural Resources, Delaware State College; and by the Society of Natural History of Delaware.

**Welcome** to Bombay Hook National Wildlife Refuge, a haven for wildlife and nature lovers seeking to study, photograph and simply enjoy the environment at its scenic and protected best. This refuge, located ten miles northeast of Dover, Delaware, is managed primarily for migrating and wintering ducks and geese and other migratory birds including the endangered southern bald eagle and the peregrine falcon.

## Bird Migrations

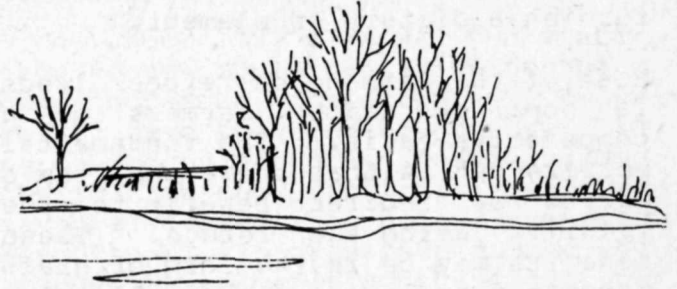
Seasonal migrations provide an excellent opportunity for nature study. Between September and early December, Bombay Hook boasts its highest numbers of waterfowl. These include Canada geese, snow geese, and 16 species of ducks. Spring is the best time to see shorebirds: plovers, greater or lesser yellowlegs, sandpipers, dunlins, black-necked stilts, and dowitchers. It is also a good time to see song birds such as mockingbirds, thrushes, swallows, and martins.

Throughout the year, whitetail deer are easily observed feeding in the refuge fields just before sunset; and the careful observer may also occasionally see some of the more secretive mammal species, such as the red and gray fox, river otter, muskrat, Virginia opossum, eastern gray squirrel, woodchuck, and beaver.

## Trails -- Rest Rooms

During your stay at Bombay Hook, please take advantage of the boardwalk trail located across and up the road from the Raymond tower parking lot, the three thirty-foot observation towers which look over three of the larger impoundments, Parson Point Trail, and the Visitor Center. For your convenience, restrooms are located at the Visitor Center.

During your visit, please drive carefully and use extra care when passing along our narrow roads. If you have any questions, please ask anyone on the Bombay Hook staff - at the Visitor Center, the Refuge Office, or along the road.



## 1 - History

Bombay Hook, (one of over 400 National Wildlife Refuges in the United States) is one of the most important stops along the Atlantic Flyway, a migratory path for waterfowl. Recorded history of the area began in 1679 when the Indian Machacksett, Chief Sachem of Kahansink, sold some marshland called "Boompies Hook" for a price of "... one gun, fower hands full of powder, three Mats coats, one anckor of Liquors and one kittle..."

The settlers that followed cut salt hay, trapped muskrats and terrapins, hunted waterfowl, and plied the tidal streams for fish, crabs, and oysters.

The Bombay Hook Refuge, extending for eight miles along the western shore of the Delaware Bay, was established March 16, 1937. Soon afterward, Civilian Conservation Corps members began constructing pools for waterfowl habitat as well as buildings to administer the area.

Total acreage today is 15,122, approximately 80 percent of which is tidal salt marsh. There are 1,100 acres of fresh water impoundments and 1,030 acres of timbered swamps and uplands, as well as almost 1,000 acres of tillable farmland.

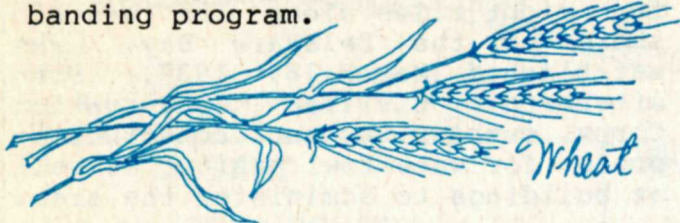


## 2 - Cooperative Farming

A major wildlife objective at Bombay Hook is the provision of food for geese and ducks during the fall migration. Much of this food is supplied by the aquatic environment; however, crops are planted to furnish a dietary supplement.

Most of the farming on refuge lands is done by nearby farmers on a cooperative basis. The fundamental requirement is that there shall be a direct or indirect benefit to the wildlife using the refuge. These benefits may be in the form of grain harvested or left in the fields for food, green browse, or cover crops. Less tangible, but nonetheless important farming practices include green manure cropping, liming, and fertilizing; all of which increase the productivity of the land for subsequent direct benefits to wildlife. In addition, farmers are responsible for control of introduced weeds, such as Canada thistle and Johnsongrass.

Of the approximately 1,000 acres of refuge agricultural land, about 550 is devoted to corn or soybeans, 300 to winter wheat or buckwheat; and 120 to semi-permanent grass/clover pasture. Corn and soybeans are the primary crops harvested by farmers for market, while the other crops are left for wildlife purposes. Farmers also provide some corn for the refuge to use in its waterfowl banding program.

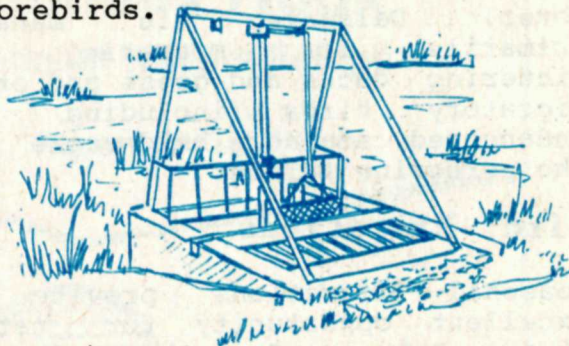


As you travel through the refuge, please notice the many fields used for farming. They are not individually marked on the map because locations vary from year to year.

The grayish green tower on your left is the old banding tower, a lookout for the purpose of catching and banding geese. Further details regarding our waterfowl banding program are given in the information for Stop 8.

## 3 - Fresh Water Impoundments

To your left: Raymond Pool, one of four freshwater impoundments on the refuge. These impoundments provide diverse feeding, roosting, and nesting habitat for waterfowl and shorebirds.



The ability to manipulate the water levels of these pools is the key to creating necessary habitats. The level of the pools is maintained by the use of water control structures (the yellow bar structure). In spring, excess water in the pool is released to the salt marsh (by pulling out the stop logs) thus lowering the water level to create a habitat conducive to the wading birds. During the summer emergent plants thrive and produce seed in the shallow waters and exposed pool margins. In the fall adequate rainfall permits water levels to be gradually raised and flood the seed bearing plants. The flooding provides suitable conditions for waterfowl to feed on the plants, thus maximizing the food supply.

The common aquatic plants found in the pools include wild millet, three square, bull rush, cattail, pond weed, widgeon grass, and wild rice. The most common fish species include white perch, shad, carp, and the American eel. The river otter, a rare fur-bearer in Delaware, also makes its home in these impoundments.

The freshwater impoundments on the Bombay Hook Refuge were built over a 22-year period: Raymond Pool (1939) 95 acres; Shearneck Pool (1956) 560 acres; Bear Swamp Pool (1961) 240 acres; and Finis Pool (1944) 205 acres. The salinity level in the fresh water impoundments is under 6 parts per thousand, while the brackish and salt marsh levels are 7-20 parts per thousand. (Sea water is 35 parts per thousand.)

#### 4 - Tidal Salt Marsh

To your right: a portion of tidal salt marsh which comprises approximately 80 percent of the refuge. Of all the different types of habitat within Bombay Hook, this is the most vulnerable and fragile. It is also the least appreciated.

The salt marsh serves as a nursery area for valuable sport and commercial fish, as well as a supplier of organic material in the form of decomposed plants, which form the basis for numerous food chains in the river, bay, and ocean. Because the area is tidal, a constant circulation of nutrients takes place.

There are two types of tidal salt marsh found at Bombay Hook. One is the "high marsh" which is flooded only during extremely high "spring" tides or a very bad storm. Plants characteristic in this marsh are Spartina patens, commonly called salt meadow cordgrass or salt marsh hay, and Distichlis spicata or salt grass.

The other type of tidal salt marsh is the "low marsh" which is flooded during every high tide. Spartina alterniflora or salt marsh cord grass is common here.

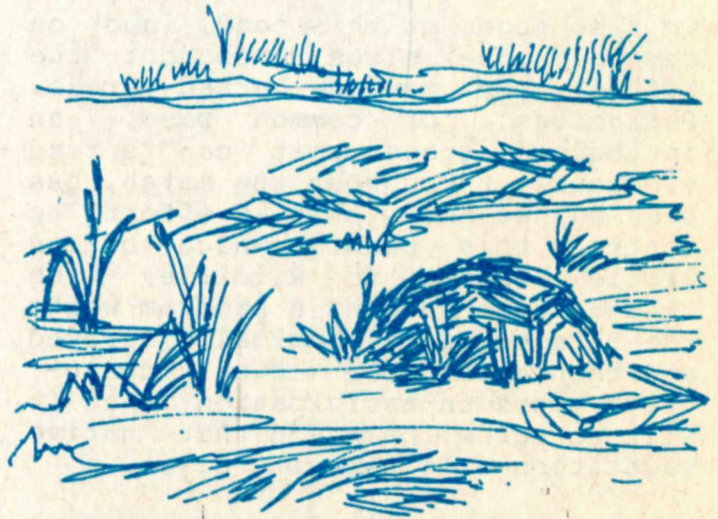


Salt meadow Cordgrass

Salt marsh Cordgrass

A variety of waterfowl nest in the marsh. These include black duck, mallard, gadwall, and blue-winged teal. A large shorebird, the willet, nests throughout the marsh in abundance.

Since about 1980 the fall and winter snow goose population at Bombay Hook has increased dramatically. Snow geese have the tendency to feed in large groups and cause "eat-outs" in the salt marsh. For this reason we have a managed snow goose hunt to keep the flocks dispersed around the refuge, thus lessening the impact on salt marsh grasses.



The mud and reed mounds scattered across the tidal salt marsh are muskrat houses. The muskrat makes its home in these marshes throughout the year. Muskrat trapping by permit is allowed in areas of the marsh where muskrats are abundant. This prevents damage to the marsh plants as well as refuge dikes which can occur through the burrowing activities of an over-population. Other marsh occupants may vary with the changing seasons.

The fish and shellfish populations in the marsh creeks include menhaden, drum, fiddler crab, blue crab, oyster, and clam.

Dike roads give the opportunity to view otherwise inaccessible marsh, and the visitor may also take advantage of a boardwalk trail near Raymond Pool. This trail will provide you with a closer glimpse of the salt marsh and open pools frequently visited by shorebirds.

## 5 - Sheariness Pool

On your left: Sheariness Pool, the largest of the four fresh water impoundments. Here you will have your greatest chance to see southern bald eagles, which may be feeding on fish, crippled ducks and geese, or perched in trees. Immature birds as well as adults may often be seen.

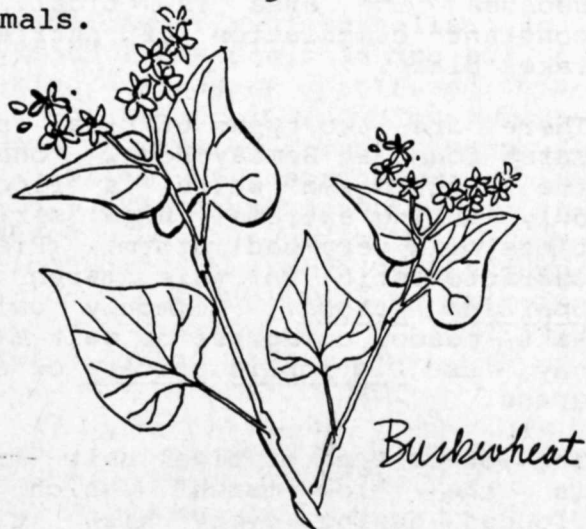
This pond is also an excellent observation location for ducks, geese, and shorebirds. During summer, you may see glossy ibis, cormorants, egrets, and herons.

On the edges of this pond, and on several other sites throughout the refuge, you may see burned areas. Phragmites, or common reed, an introduced grass that can spread vigorously throughout the marsh, has been burned here. In an effort to control this plant, which offers little benefit to wildlife, the refuge is conducting a program where the Phragmites is chemically sprayed and then burned for two consecutive years in anticipation that it will not grow back and that native vegetation will take its place.

The duck trap beyond Sheariness Pool parking lot is used to catch ducks for banding purposes. Banding is discussed at Stop 8.

## 6 - Wildlife Food Plot

To your left: a bicolor lespedeza wildlife food plot. Other plots on the refuge may consist of buckwheat, millet, or autumn olive. These plants, some of which are annuals and some perennials, are attractive to a wide variety of wildlife. They provide a supplement to the natural food sources found throughout the refuge; and in some cases provide winter cover as well. In the spring and summer they may provide nesting habitat for ground nesting birds as well as breeding area for small mammals.



Food plots are usually prepared and planted by neighboring farmers as part of their cooperative farming agreements with the refuge.



## 7 - Loafing Area

The islands to your left, in the Bear Swamp Pool, are loafing areas for wading birds. They are excellent examples of the utilization of habitats by wildlife because of their undisturbed cover.

Throughout the summer, these islands are used by snowy egrets, great egrets, great blue herons, and black-crowned night-herons. The surrounding portion of the impoundments serves as a prime feeding area.

At times during the year, notably the fall hunting season, you may notice grassed water blinds out in the impoundment. These blinds are used for the Young Waterfowlers Program. Youth between the ages of 12 - 18 are taught hunter safety and ethics, Federal and State regulations, and waterfowl identification, before participating in the hunting program on the refuge.



## 8 - Corn Bins

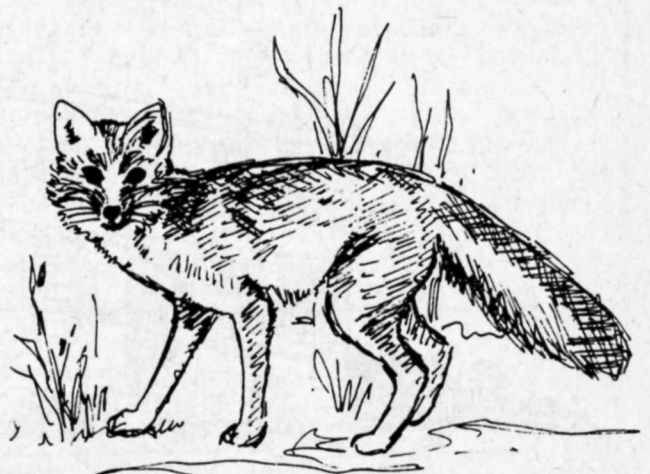
To your left: corn bins used to store the corn for the waterfowl banding program at Bombay Hook. Each year, ducks and geese are captured and numbered aluminum bands are placed on their legs. The numbers are registered at the Bird Banding Laboratory in Laurel, Maryland. When a banded bird is recovered, the number is reported to the Banding Laboratory. The person sending in the band is told by return mail when and where the bird was banded. Much valuable information about waterfowl migrations and populations is gained in this manner.

To capture ducks for the banding program, corn is placed in wire traps which allow ducks to enter but do not permit them to escape. To capture geese, corn is spread on the field in front of a carefully laid out net. Several small cannons with black powder charges are attached to the net. Refuge personnel observe the site from the concealed position; and when an appropriate number of birds have been attracted, the cannons are fired, hurling the net over the birds without harming them.



## 9 - Old Field

This old field has been retired from agricultural production and planted to a grass/clover mixture. Areas such as this throughout the upland portions of the Refuge provide ideal nesting or breeding cover for a wide variety of birds and small mammals including ducks, quail, rabbits, pheasants, and white-tailed deer. The area is mowed every two to three years to prevent the establishment of woody vegetation and ensure that the field can be easily converted to agricultural use at a future date. In this way, fields can be periodically rotated from a cropland to an old field cover.



Red Fox

## 10 - Woodland

To the left and beyond the water: a stand of woodland which comprises 410 acres. This area is managed in a relatively undisturbed state to provide an environment suitable to a wide range of plants and animals. Sweet gum, white oak, and black tupelo are the larger trees found in this woodlot. American holly, jack-in-the-pulpit, and pink lady slipper also grow here.



A wide variety of mammals frequent this woodland for food and cover. These include the white-tailed deer, gray squirrel, opossum, skunk, raccoon, and fox. In the spring the woodlot seems alive with the songs of spring warblers.

## 11 - Grassed Waterway

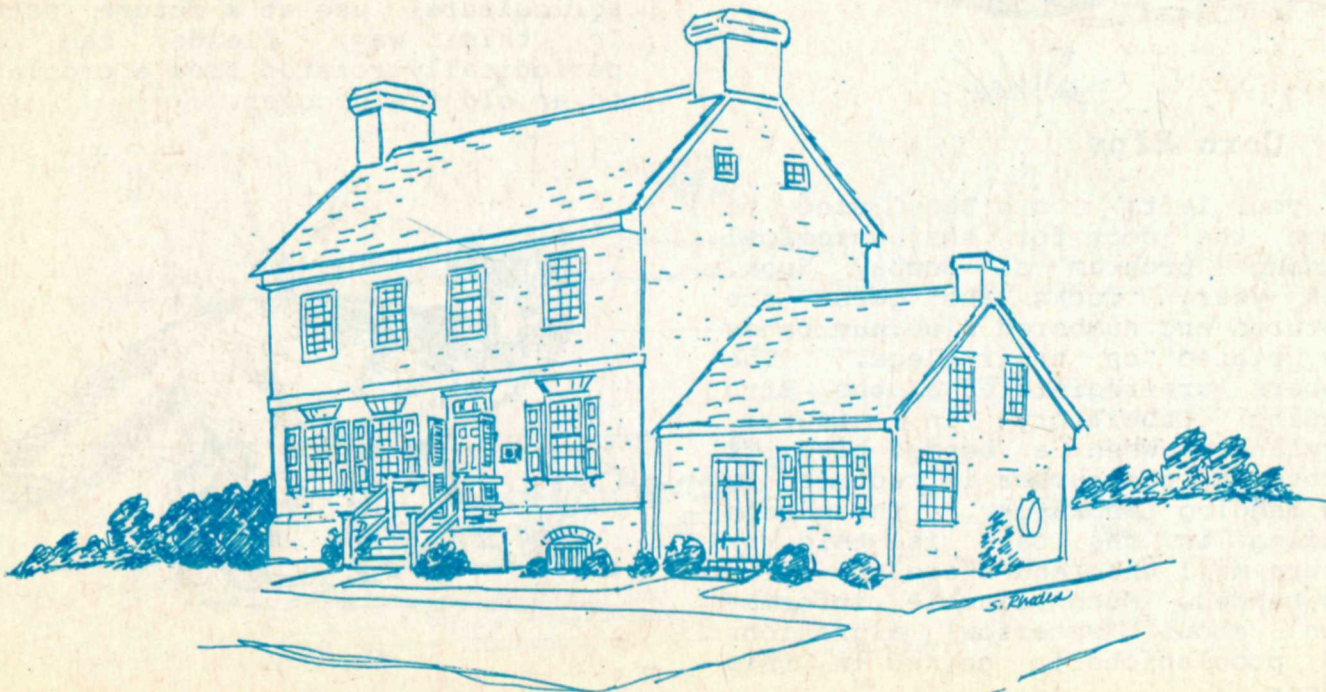
The grass covered depression to the right, which separates the two fields, is a grassed waterway, graded to carry excess water away from the fields to either side without causing an erosion problem.

Grassed waterways are mowed in the non-nesting seasons to prevent woody plants from growing and impairing drainage. Another advantage of this type of drainage system is that farm machinery is able to cross unimpeded.

## 12 - Allee House

During the fall season you will notice goose blinds and deer stands in the fields and woodlands along this road. On specified days individuals with permits may hunt deer and waterfowl.

As you approach the gate you will notice an old brick farmhouse on your right. A bit of history is preserved on the refuge in this small country style dwelling of the Queen Anne period called the Allee House. Built about 1753, it is registered as a National Landmark. The Delaware Division of Historical and Cultural Affairs maintains the home and makes it available for public viewing on weekend afternoons.





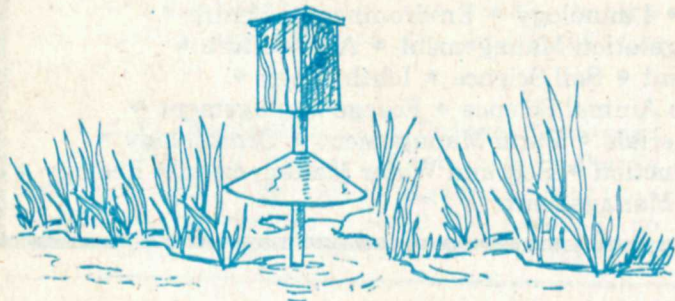
## 13 - Finis Pool

**Finis Pool Area:** This is the freshest of the impoundments on the refuge and provides a great variety of plant and animal life. For this reason, groups studying the habitats on the refuge choose this impoundment for freshwater marsh studies.

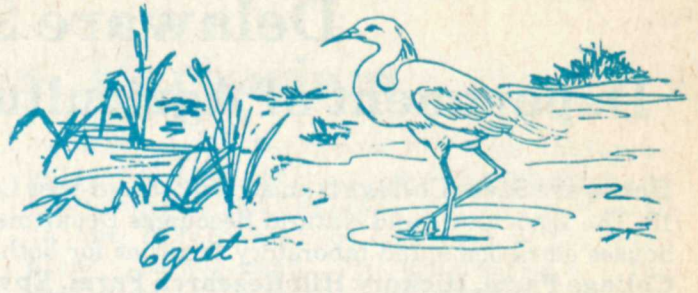
The adjacent woods and grassy areas are also used for outdoor classroom studies. All environmental studies should be arranged through the Visitor Center office.



Beyond the pool is Finis Branch, the primary fresh water source for all our other impoundments. We occasionally trap and relocate beaver from here in order that they do not clog the water control structures and flood the road; however, this area still remains the most likely one to observe these industrious animals.



Also notice the wood duck boxes. Wood ducks need cavities such as those in hollow trees for nesting. Because of the scarcity of hollow trees, these boxes were put up to provide nesting areas. The cone skirts are predator guards, preventing raccoons and snakes from getting into the nest and destroying the eggs or young ducklings.



We hope you enjoyed your self-guided tour of the Refuge. Please let us know about your wildlife encounters, either stop in or record your sightings on the observation list kept in the brochure rack near the rest rooms.

Bombay Hook is one of more than 400 refuges in the National Wildlife Refuge System, administered by the U.S. Fish and Wildlife Service. The Service also manages national fish hatcheries, and provides Federal leadership in habitat protection, fish and wildlife research, technical assistance and conservation and protection of migratory birds, certain marine mammals, and threatened and endangered species

**For further information contact:**

Refuge Manager  
Bombay Hook NWR  
R.D. #1, Box 147  
Smyrna, DE 19977  
Telephone: (302) 653-9345

### Credits

This brochure was developed jointly by the staff of the Bombay Hook National Wildlife Refuge and students, staff, and faculty of the Department of Agriculture and Natural Resources at Delaware State College. Line drawings are by Sandra Rhodes, an Art Major at Delaware State College. Layout by the Environmental Education Workshop, Department of Agriculture and Natural Resources, Delaware State College.

ENVIRONMENTAL  
EDUCATION  
WORKSHOP



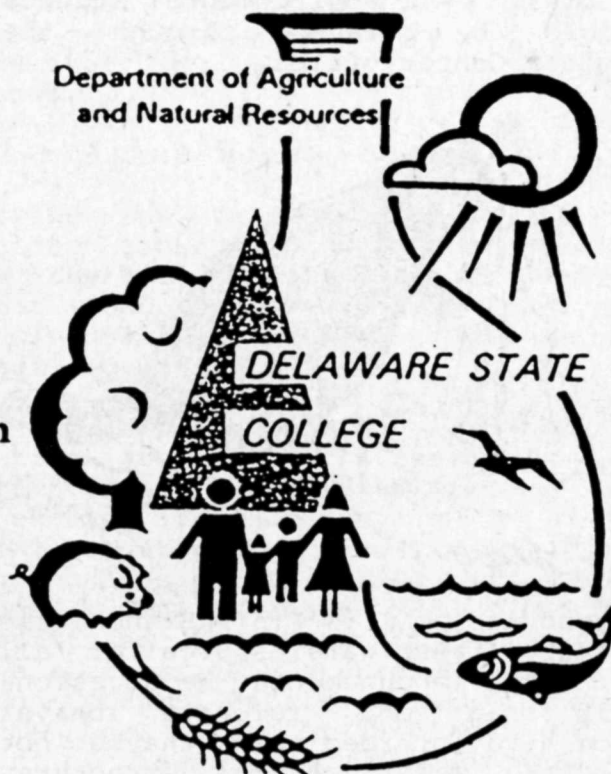
# Delaware State College

## Department of Agriculture and Natural Resources

Delaware State College is an accredited four-year Land-Grant institution located in north Dover on U.S. Route 13. The Agriculture and Natural Resources Department is located in the **James W. W. Baker Center**, which houses classrooms and laboratory facilities for both teaching and research. Additional facilities include the **College Farm, Hickory Hill Research Farm, Environmental Sciences Laboratory, Greenhouses, the Claude E. Phillips Herbarium, Aquatic Ecology Research Area, and the Delaware Cooperative Extension Program.**

### DEGREES OFFERED:

**Agri-Business**  
**Agriculture-Education**  
**General Agriculture**  
**General Resource Management**  
**Plant Science**  
**Park Management and Recreation**  
**Wildlife Mangement**  
**Fisheries Management**  
**Soil and Water Management**  
**Vegetation Management**  
**Environment Health**  
**Pre-Veterinary Medicine**



### COURSES INCLUDE:

Environmental Education Workshop • Fisheries Science • Limnology • Environmental Health • Principles of Fisheries Management • Landscaping • Vegetation Management • Aquaculture • Poultry Science • Plant Pathology • Wild Life Management • Soil Science • Ichthyology • Beef Cattle Production and Management • Introduction to Animal Science • Forage Management • Food Distribution Management • Horticultural Plant Materials • Farm Management • Ornithology • Meat and Meat Production • Fundamentals of Crop Production • Soil and Water Management • Ecology • Mammalogy • Biometrics • Natural Resources and Park Management.

### INTERNSHIP PROGRAMS

Bombay Hook National Wildlife Refuge  
Prime Hook National Wildlife Refuge  
United States Department of Agriculture  
Soil Conservation  
Forest Service  
Agriculture Research Service  
Delaware Department of Natural  
Resources and Environmental Control



SOME OF OUR GRADUATES HAVE BEEN  
PLACED IN THE FOLLOWING CAREERS

Environmental Protection	Park Management
Meat Inspection	Ag Marketing and Sales
Food Processing	Horticulture and
Farm Management	Landscape Design
Range Management	Fisheries Biology
Teaching and Research	Wildlife Biology
Environmental Sciences	Customs Inspection



# Claude E. Phillips Herbarium

**Definition and Purposes:** A herbarium is a collection of pressed and dried plant specimens arranged in a systematic order, with detailed data on habitat, location, date of collection, and collector. It is an historical record of the flora of a particular region. A herbarium is an indispensable tool for mapping floristic distributions, for studying evolutionary trends and genetic variations, and for documenting plant research in the form of voucher specimens. Above all, a herbarium provides a reference collection to serve as a tool for identification to accompany the published manuals. A herbarium further serves the study of economic botany, morphology, ecology, and related disciplines. Wherever critical judgment is required, the herbarium is the court of final appeals in making taxonomic decisions.

**Claude E. Phillips:** A native Delawarean for whom the Herbarium is named, Claude E. Phillips, was trained as an agronomist and weed specialist. Professor Phillips headed the Agronomy Department at the University of Delaware before retiring in 1965 after 38 years of service. "When I retired," Claude said, "the weeds became wildflowers; and in the spring of 1966, a personal project was started to find, identify, and photograph the wildflowers of the DelMarVa Peninsula." **Wildflowers of Delaware and the Eastern Shore**, by Claude E. Phillips, was published by the Delaware Nature Education Society in 1978. Claude traveled 100,000 miles on the Peninsula in his search for plants and, before his death in 1981 at the age of 80, became the leading exponent of the study of our native flora.

**The C.E.P. Herbarium is a Unique Resource:** It is the only herbarium on the DelMarVa Peninsula and the only regional institutional herbarium in the U.S. devoted to the native and cultivated flora of



DelMarVa. The Herbarium has been indispensable in the active, ongoing research on endangered plant species and is dedicated to the development of strategies for rare plant management in Delaware. The Herbarium seeks to interpret the importance of rare plant conservation to the general public.

Out of approximately 573 herbaria recorded in the United States, the Claude E. Phillips Herbarium is the 60th largest herbarium and includes the important collections of: Edward Tatnall (1818-1898); Albert Commons (1829-1919); William M. Canby (1831-1904); John T. Pennypacker (1838-1926); Rev. John P. Otis (1846-1934); Ivar Tidestrom (1865-1956); Robert R. Tatnall (1870-1956); Hugh T. O'Neill (1894-1969); Claude E. Phillips (1900-1981); Paul J. Redmond (1901-19-?); A. V. Smith (1901-1977). Collections of H. R. Baker, M. J. Murray, N. H. Dill, and A. O. Tucker round the herbarium out about 110,000 specimens. The slide book collections of Claude E. Phillips, Charles E. Mohr are additional resources for the study of natural history.

**Funding:** To carry on the activities of the Herbarium during these financially difficult times, the Society of Natural History of Delaware has established a Memorial Fund to continue the botanical work of Claude E. Phillips. The Society of Natural History of Delaware is planning a major campaign to endow the Herbarium with funds to ensure its existence for time to come.

The Herbarium is jointly sponsored by the Department of Agriculture and Natural Resources and the Department of Biological Sciences, Delaware State College; the Department of Plant Science, University of Delaware; and the Society of Natural History of Delaware.

**DELAWARE STATE COLLEGE**

\_\_\_\_ Yes! Please send me more information on the Department of Agriculture and Natural Resources Degree Programs.



**CLAUDE E. PHILLIPS HERBARIUM**

\_\_\_\_ Yes! I wish to support the ongoing research of the C.E.P. Herbarium. Please send me more information.

# The Society of Natural History of Delaware

The Society encourages the study of our natural environment.

This includes biology, ecology, geology, conservation, wildlife management, and to some extent archaeology, astronomy, and meteorology. We seek to do more than just put names on plants, animals, and minerals, making an effort to understand their distribution and interrelationships. Such information aids in the resolution of current conflicts and problems.

## Activities - Illustrated Lectures

Monthly meetings from fall to mid-spring are held on second Mondays in the Wilmington - Newark area. Southern section meetings are generally held on first Thursdays in Dover.

## Special Annual Events

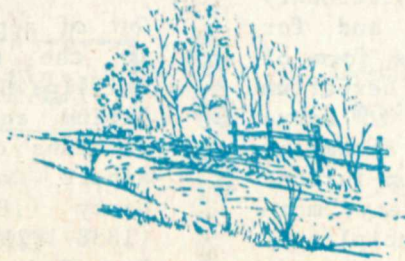
A fall or spring weekend trip to Camp Rodney at the head of Chesapeake Bay is a long-standing family activity. An evergreen walk and wreath making workshop at Blackbird State Forest is a winter tradition.

## Field Trips

Trips include visits to nearby laboratories, explanations of current research in the field, and views of natural history from both land and water. An effort is made to maintain a broad ecological viewpoint. These trips take place throughout the year under the guidance of skilled leaders.

## Conservation Efforts

The Society attempts to provide careful appraisals of environmental problems for our legislators and others on the local, state and federal levels through letters, testimony at hearings, and participation in symposia. Land use planning and the conservation of natural habitats is a prime concern of the Society.



## Other Activities

The Society has also sponsored film programs, college courses (e.g. "Ecology of Delmarva Habitats"), and special lectures by famous naturalists.

## Research

The Society conducts ongoing research such as the current Floristic Survey of the Peninsula.

In cooperation with the department of Agriculture and Natural Resources and Department of Biology of Delaware State College and the Department of Plant Science at the University of Delaware the Society has established the Claude E. Phillips Herbarium housed at Delaware State College.

## Membership

Membership is based solely on interest and not on any special knowledge in natural science. A membership can include one person or a large family, as long as only one address is used. The annual dues are the same in each case. There is a special low rate for full-time students.

While all of the events of the Society are open to the public without charge, members help support the activities and have the advantages of notification of all events by mail and of reduced charges for publications. Contributions are deductible for federal and Delaware income tax purposes within statutory limits.

The Society has no salaried officers. It has a small endowment income, which together with the dues support the activities.



## Publications

Tatnall, R.R., Flora of Delaware and the Eastern Shore.

McDermott, F.A., The Fireflies of Delaware.

Conant, R., An Annotated Check List of the Amphibians and Reptiles of the Del-Mar-Va Peninsula.

Linehan, J.T. & Jones, R.E., The Delaware Bird List.



for more information:

**THE SOCIETY OF NATURAL HISTORY OF DELAWARE**

**Yes!** Enclosed are my membership dues.

Regular	\$10.00
Contributing	\$15.00
Supporting	\$20.00
Sustaining	\$25.00
	or more
Student	\$ 1.00

Checks payable to:  
**The Society of  
Natural History  
of Delaware**



Name: \_\_\_\_\_

Address: \_\_\_\_\_

Mail to: \_\_\_\_\_

DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES  
Delaware State College  
Dover, Delaware 19901