Bombay Hook National Wildlife Refuge

Smyrna, Delaware

Annual Narrative Report

Calendar Year 1997

U.S. Department of Interior
Fish and Wildlife Service

National Wildlife Refuge System

REVIEW AND APPROVALS

BOMBAY HOOK NATIONAL WILDLIFE REFUGE

Smyrna, Delaware

ANNUAL NARRATIVE REPORT

Calendar Year 1997

Refuge Manager	*Date*	*ARD Central/RW*	*Date*
	4-18-98		7/24/98

INTRODUCTION

Bombay Hook National Wildlife Refuge was established under the authority of the Migratory Bird Conservation Act of 1937 as a refuge for migratory and wintering waterfowl. The refuge is located in Kent County along the western shore of the Delaware Bay. It is within two hours driving time of metropolitan Baltimore, Washington, Wilmington, and Philadelphia, and is less than 10 air miles from the State capital of Dover; (population 32,500) and 8 miles from Smyrna (population 5,500). The surrounding area is characterized primarily by agricultural lands on which corn, soybeans, and wheat are the principal cash crops. The refuge currently comprises 15,978 acres of which approximately 13,100 acres are a broad expanse of brackish tidal marsh, mud flats, and tidal creeks and rivers. Other portions of the refuge include 1,100 acres of agricultural land, four freshwater impoundments comprising 1,100 acres, and the remainder wooded upland and brush. The topography is very flat with almost all of the refuge lying below the 10-foot MSL contour. In addition to waterfowl , Bombay Hook supports healthy populations of whitetailed deer, cottontail rabbits, muskrats, otter, and beaver as well as large numbers of shore, wading raptorial, and passerine birds. The tidal waters within the marsh are home for the commercially important blue crab, white perch, and eels as well as myriads of other marine life forms inherent to a mid-Atlantic estuarine environment. A pair of southern bald eagles resides at the refuge and normally nest in a woodlot adjacent to one of the freshwater pools.

The initial and still basic objective for the refuge of preserving the migratory waterfowl resource is reached through preservation of the natural tidal salt marsh as well as intensive management practices such as croplands management, prescribed burning, impoundment water level manipulation and others which serve to enhance areas for waterfowl and other wildlife. Public use objectives are to provide wildlife-oriented recreational opportunities compatible with habitat and wildlife objectives. Increased emphasis has been placed on development of environmental education and interpretive programs: however, consumptive recreational in the form of waterfowl, deer, and small game hunting still forms a large portion of the refuge program.

INTRODUCTION

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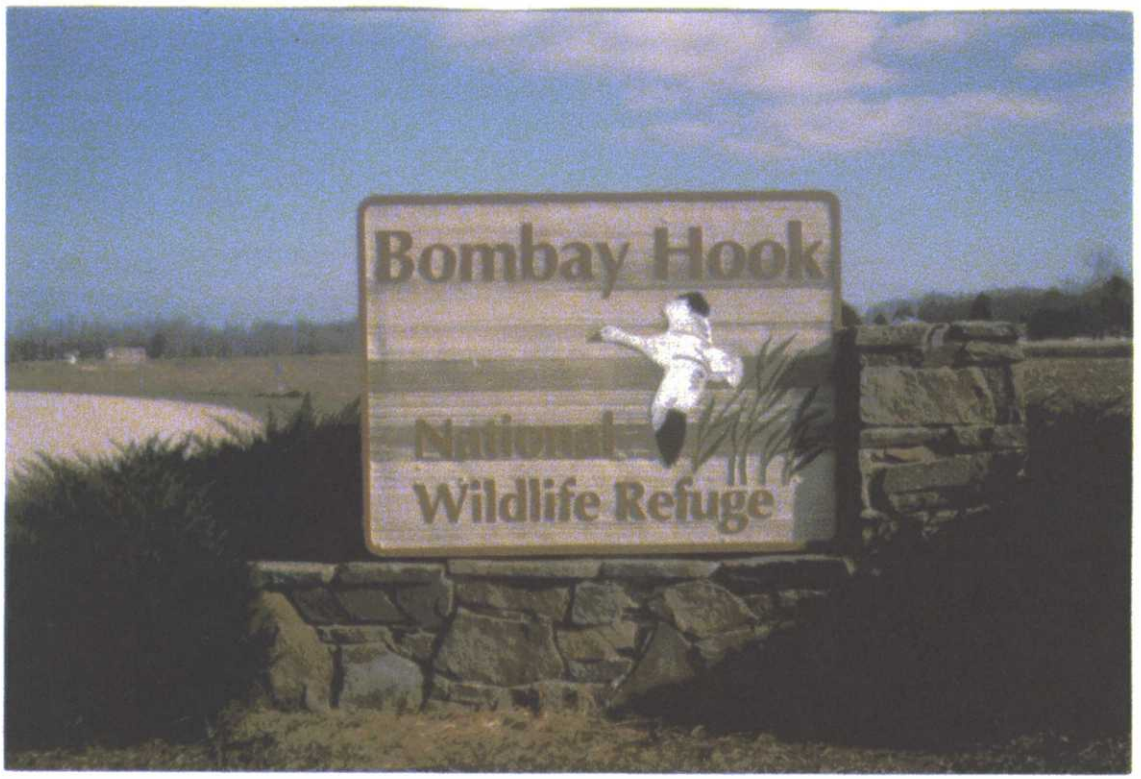
G. WILDLIFE

H. PUBLIC USE



Welcome to Bombay Hook, greater snow goose capital of the Atlantic Flyway.

3/97 Paul Daly

A. HIGHLIGHTS

1. A Memorandum of Understanding was worked out with the Delaware Division of Fish and Wildlife involving management of the State DiFebo Tract and the Refuge Air Force Tract (Section C.3).

2. A private contractor working for the Corps of Engineers completed a contaminant "remedial investigation" on the Air Force Tract (Section D.4).

3. Assistant Refuge Manager Jason Barker transferred to Detroit Lakes WMD, Minnesota in December (Section E.1).

4. Several meetings were held to discuss the Corps of Engineers "beneficial use of spoil" project at Kelly Island (Section F.2).

5. Two new moist soil management units were constructed (Sections F.2.e, I.1).

6. The bald eagle nest west of Shearness Pool produced an eaglet for the fourth consecutive year, a record unequaled since refuge establishment in 1937 (Section G.2.a).

7. A refuge record 198,730 greater snow geese were counted on October 20 (Section G.3.b).

8. A Shorebird Management Workshop concentrating on the Delaware Bay horseshoe crab/shorebird migration connection as well as impoundment management was held in the refuge auditorium in May (Section G.5, J.1).

9. A beautiful bald eagle display was prepared and placed in the Visitor Center at no cost to the refuge (Sections H.6, H.18).

10. A third wheelchair accessible deer stand was constructed in cooperation with the Maryland/Delaware Paralyzed Veterans Association and a dedication ceremony was held (Sections H.8, I.1).

11. The main Shearness Pool water control structure project was completed and a dedication ceremony was held (Section I.2).

B. CLIMATIC CONDITIONS

Precipitation for the past year was near normal with 46.93 inches recorded during 1997 compared to the average 12 month total of 42.3 inches. Snowfall was practically non-existent with only 6.75 inches recorded for 1997 compared to 32.5 inches the previous year. Rainfall was fairly evenly distributed throughout the year although July, September and October were dry. During a two day period in late August nearly 6 inches of rainfall were recorded. This was the only period during the year when excess water was a minor problem. Except for a two week period during the middle of January ice cover was very light during the winter. Open freshwater was prevalent during most of the winter. Temperatures were near seasonal norms throughout the year. Several days of temperatures in the mid 90's were recorded during July and August. The last day in the spring of subfreezing temperatures was April 10 and the first day of subfreezing temperatures in the fall was October 29. Weather data was collected by the Delaware Highway Department at their weather station in Dover, approximately 12 miles southwest of the refuge office.

	Temperature (F)		
Month	Maximum	Minimum	Precipitation (Inches)
January	62	8	2.97
February	71	22	3.31
March	70	23	4.78
April	73	28	4.26
May	85	38	4.76
June	93	49	3.49
July	95	58	1.80
August	95	55	7.66
September	86	49	2.10
October	86	29	2.48
November	66	24	6.55
December	60	25	2.77
		Total	**46.93**

C. LAND ACQUISITION

2. Easements

For yet another year no action was taken on our 1991 recommendation that the Service divest itself of the 1.3 acre Daugherty property Farmers Home Administration easement. This easement which is a farm tax ditch, was turned over to us sight-unseen and is located in far southern Delaware about a 2 hour drive from the refuge. It was not visited in 1997.

3. Other

Several meetings were held between refuge and Delaware Division of Fish and Wildlife personnel during the spring and summer regarding management of the State-owned "DiFebo Tract" and the Service-owned "Air Force Tract". The meeting culminated in a memorandum of understanding submitted through channels by the refuge in August which will allow Bombay Hook to operate the DiFebo Tract, which is contiguous to our Fischer Tract, as a waterfowl sanctuary while including deer hunting as part of our current Regular Hunt Area. In turn the State will manage what is now known as the South Upland Hunt Area on the Air Force Tract and do some upland habitat management for quail, turkeys and other species. The Air Force Tract has been a management problem for the refuge since its acquisition, because it is remote from headquarters and is thus difficult to patrol regularly. It is much closer to the State's Little Creek Wildlife Management Area; therefore each agency has improved management on their respective areas without an actual exchange of ownership taking place.

The DiFebo Tract is contiguous on the east with the refuge Fischer Tract. This view, looking east shows the west boundary of the DiFebo Tract at the tree line.

6/97 Paul Daly

The lodge on the DiFebo Tract (always known locally as "Shanty Gut") can be used by the refuge for storage or other management purposes.

6/97 Paul Daly

D. PLANNING

2. Management Plan

Annual water management, trapping, hunting and prescribed burn programs were submitted and approved.

4. Compliance With Environmental Mandates

During a portion of the time that the tract known as " the Air Force Tract" was owned by the Department of Defense it was used as a practice bombing range and also contained sites where petrochemicals were disposed. The Department of Defense was required to conduct a "remedial investigation" to evaluate the degree of contamination and any risks to health and the environment. Field work for this investigation was conducted during the summer and included in a report. The analysis presented in the report showed that exposures to "constituents of potential concern" in the area were not expected to cause unreasonable risk for adverse noncancer health effects for the populations considered. In

addition, no unreasonable cancer risks are anticipated as a result of exposure for the populations considered. Modeled projections of surficial media constituents of potential concern through the terrestrial food web indicate potential risk from constituent exposure does not exist for the receptors of concern.

5. Research and Investigations

1. Bombay Hook NR89-Response of Greater Snow Geese (Chen caerulescens atlantica) to Hunting at Bombay Hook National Wildlife Refuge and Related Wetland Changes - Conducted by refuge staff in cooperation with Delaware Division of Fish and Wildlife 51550-1

   This project began during 1989 and has been a cooperative effort between the Delaware Division of Fish and Wildlife and the refuge staff. The primary objectives of the study are to monitor snow goose populations on the Bombay Hook and Prime Hook National Wildlife Refuges as well as nearby State wildlife management areas. Efforts have been made to determine habitat use both on and off the refuges and wildlife management areas from arrival in the fall to departure in the spring. Additionally, we have attempted to document vegetational changes in the tidal marshes and impoundments as a result of snow goose feeding and to assess the impacts of hunting the Bombay Hook marshes on the movements and habitat use of the geese in the vicinity of Bombay Hook NWR. Unfortunately, funding has not been provided to continue with the refuge's share of aerial monitoring during the past four years. The State has continued, on a limited basis, to monitor roosting flocks throughout the State. We have continued to monitor vegetational conditions within the marshes and impoundments via sampling and photography as part of our normal management practices.

2. Bombay Hook NR96-Coastal Marsh Project - This project was a joint collaboration between the University of Maryland Department of Geography and NASA's "Mission to Planet Earth" Program. Graduate student Jennie Stevens is the principle student investigator. The purpose of this project was to analyze the surface condition (health) of coastal marshes along the eastern seaboard and to detect areas that were at risk for rapid loss of land area. Bombay Hook's marshes were included in the study area. Global positioning points were established which were used as ground reference and control points for aerial photography and satellite images. The analysis was based on a model that presumes the marsh's physical and hydrological integrity is based on the percentage of marsh surface (excluding the stable channel network and other historical hydrologic features) covered by water. The assumption is that significant areas of marsh loss are due to the formation of small, interior ponds, usually in the high marsh and from the expanding and widening of tidal channels. Once interior ponds begin to form, the surrounding area becomes subject to increased erosion. The researchers tested the

model's classification at Bombay Hook by comparing its results with actual field conditions.

3. Bombay Hook NR97-Taphonomy of Marsh Foraminiferal Assemblages: Implications for Rates and Mechanisms of Holocene Sea-Level Rise - This investigation is being conducted by graduate student Scott Hippensteel under the direction of Drs. Ronald E. Martin and James E. Pizzuto of the Department of Geology at the University of Delaware. The past year was the first of two years of data collection. In early April they selected a site near the refuge boardwalk for foraminiferal research. The site was surveyed to determine elevations relative to sea level. Three 10 square meter plots were marked within the site in different marsh subenvironments (high marsh, "transitional marsh", and low marsh).

   In June, September, and December three 1-meter cores were taken in each plot (for a total of 9 cores). Samples were taken throughout each core for foraminiferal analysis. At present, they have counted and identified a total of over 5,000 foraminiferal specimens.

   In early December they also took a core from the low-marsh site that will be used for geochemical analysis. The core was processed and sent to the College of Marine Sciences in Lewes, DE for radio tracer analysis.

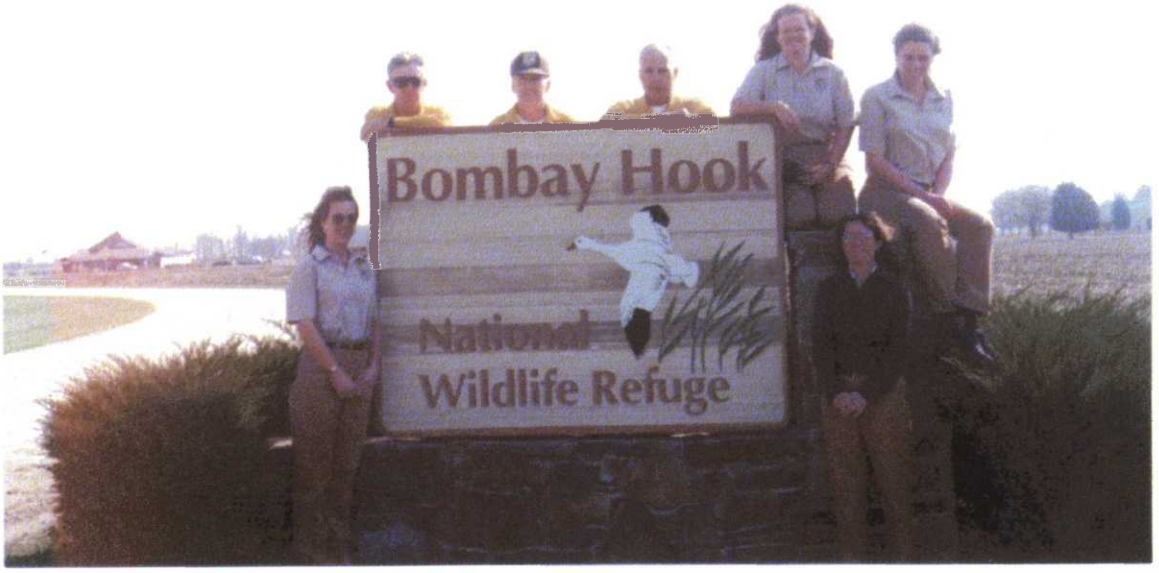
   They plan to continue their seasonal sampling of marsh plots in 1998. By July they hope to have enough data to draw some conclusions about foraminiferal preservation and sedimentation rates in the marsh.

4. Bombay Hook NR96-Geological Investigation of the Sea-Level and Paleoenvironmental History of Coastal Wetlands in the vicinity of the Mouth of the Leipsic River - This investigation by Dr. James E. Pizzuto and student Daria Nikitina of the University of Delaware involves the collection of sediment cores over a two year period from portions of the refuge's tidal saltmarsh in an effort to better understand the development of marshlands in our area. This past year was the first of data collection.

E. ADMINISTRATION

1. Personnel

Name	Position	Grade	FTE	APT
1. Paul D. Daly	Refuge Manager	GM-13	1.0	PFT
*2. Jason A. Barker	Asst. Refuge Manager	GS-12	1.0	PFT
3. E. Franklin Smith	Wildlife Biologist	GS-11	1.0	PFT
4. Marian Johnson-Pohlman	Outdoor Rec. Planner	GS-11	1.0	PFT
5. Barbara J. Straughn	Office Assistant	GS-06	1.0	PFT
6. Suzan M. Staley	Office Automation Clerk	GS-04	1.0	PFT
**7. Kelly L. Boscher	Office Automation Clerk	GS-03	1.0	PFT
8. Arthur T. Straughn	Maintenance Worker	WG-08	1.0	PFT
9. Vacant	Tractor Operator	WG-06	1.0	PFT
10. Verna Price	Recreation Aid	GS-03	0.3	TPT
11. Christina Watson	Recreation Aid	GS-03	0.3	TPT



Bombay Hook Staff from left to right - 1st row: Suzan Staley, and Marian Johnson-Pohlman; top row: Arthur Straughn, Paul Daly, Frank Smith, Barbara Straughn and Kelly Boscher.

3/97 Teresa Burrows

*After almost four years duty as assistant manager, preceded by tours here as cooperative education student and assistant manager trainee dating back to 1985, Jason Barker and family transferred on December 7 to Detroit Lakes WMD in Minnesota. Jason's dedication to always working energetically for the wildlife resource will be missed by his many friends hereabouts. The refuge staff and almost 40 of the Barker family's friends gathered at a local restaurant on November 23 to give Jason, Julie, Samantha and Bubba (Labrador Retriever) Barker a rousing send off to the frozen northland.

**On March 31 Office Automation Clerk Kelly Boscher began a full time assignment at Bombay Hook. Kelly, who previously had divided her time between the refuge and the Delaware Bay Estuary Project, works about 50% of the time as Recreation Assistant and 50% of the time as Clerk.

Following is a summary of staffing levels over the last five years:

Year	PFT	PPT	Temp	FTE
FY97	9	0	2	9.6
FY96	8	0	1	8.6
FY95	7	2	4	8.5
FY94	8	2	4	9.7
FY93	7	1	5	8.7

Refuge staff attended training throughout the year as follows:

Paul Daly	CPR	3/18	Bombay Hook NWR
	Annual LE Refresher	4/7-11	Patuxent NWR
	Shore Based Water Rescue	5/28	Bombay Hook NWR
	Role Player Training	8/18-22	Glynco, GA
Jason Barker	CPR	3/18	Bombay Hook NWR
	Annual LE Refresher	4/7-11	Patuxent NWR
	Shore Based Water Rescue	5/28	Bombay Hook NWR
Frank Smith	Oil Spill Response	2/11-12	Hadley, MA
	CPR	3/18	Bombay Hook NWR
	Annual LE Refresher	4/14-18	Patuxent NWR
	Shore Based Water Rescue	5/28	Bombay Hook NWR
Arthur Straughn	CPR	3/18	Bombay Hook NWR
	Annual LE Refresher	4/14-18	Patuxent NWR
	Shore Based Water Rescue	5/28	Bombay Hook NWR

Barbara Straughn	CPR	3/18	Bombay Hook NWR
	Shore Based Water Rescue	5/28	Bombay Hook NWR
Suzan Staley	Outreach Workshop	2/12	Patuxent NWR
	Automated Time & Attendance	2/24	Herndon, VA
	CPR	3/18	Bombay Hook NWR
	Shore Based Water Rescue	5/28	Bombay Hook NWR
	Pagemaker	6/4-5	Wilmington, DE
Kelly Boscher	Outreach Workshop	2/12	Patuxent NWR
	Automated Time & Attendance	2/24	Herndon, VA
	CPR	3/18	Bombay Hook NWR
	Shore Based Water Rescue	5/28	Bombay Hook NWR
	Pagemaker	6/4-5	Wilmington, DE
Marian Pohlman	CPR (Instructor)	3/18	Bombay Hook NWR
	Shore Based Water Rescue	5/28	Bombay Hook NWR
	Pagemaker	6/4-5	Wilmington, DE

4. Volunteer Program

Volunteers have been active here since 1983. Another successful year in 1997 resulted in 81 volunteers contributing over 2,700 hours to the refuge. Of this total, 1,941 hours were donated in visitor services which included activities such as staffing the Visitor Center, working with school, scout and other special groups, drafting text and graphic layout for brochures and displays, staffing exhibits at off refuge programs and assisting with the cooperative association sales outlet. Since the program began over 27,000 hours have been donated to the refuge.

Although staffing the Center continues to be the main volunteer need at the refuge, volunteers particularly enjoy helping with wildlife surveys, so this activity has become a type of "reward" for volunteers who help with staffing the Center. Volunteers from around the state helped count horseshoe crabs and tag 1,000 of them during the May and June new and full moons, and also assisted in counting shorebirds along the Delaware Bay Beaches from Bombay Hook to Cape Henlopen State Park. Volunteers for this survey covered a wide spectrum of individuals, from scouts, to high school and college biology students and teachers, residents along the Delaware Bay beaches, Delaware birders, as well as regular Bombay Hook volunteers.

Each year a group of enthusiastic birders joins in the annual Christmas Bird Count and Spring Bird Count. The Spring Bird Count totaled 150 species; while 100 species were counted during the Christmas count.

Volunteers helped out during Earth Day at Bombay Hook conducting tours, trail walks, boat trips, etc. On Make a Difference Day (October 25), volunteers worked on getting our trails in better condition by brushing back vegetation that had grown into them, laying wood chips, and preparing the brackish pond for study by school groups. They also ran the Adopt-a-Highway Program at the refuge, cleaning up refuge roads. One volunteer also assisted in conducting an environmental education workshop for teachers and other volunteers. During National Wildlife Refuge Week in October, volunteers led wildlife management tours for the public and staffed wetland exhibits in the auditorium. These interactive wetland exhibits were produced by the State of Delaware. Volunteers also helped make the annual field day a success by leading interpretive trail walks, wildlife talks, boat and canoe trips, and staffing the Center.

Retired Bombay Hook Maintenance Worker and now volunteer Ken Liehr conducted a session on building bluebird nest boxes during the annual field day and National Wildlife Refuge Week celebration.

10/97 Marian Pohlman

Two volunteers built five additional picnic tables to accommodate the many school children that use the refuge during the fall and spring. One volunteer, with some help from others, improved the Center aquarium exhibit by adding native plants and some rocks and driftwood.

ORP Pohlman and two volunteers joined staff from Eastern Neck NWR and the Maryland Park Service in conducting outdoor classroom activities for the Kent County, MD fourth grade environmental education program during the fall. Over 200 students were reached.

ORP Pohlman conducted spring and fall volunteer workshops and orientation sessions. A total of 27 volunteers attended the spring and fall workshops. Volunteers were also encouraged to attend the two day environmental education workshops offered in the spring and fall. Volunteer attendance at the above 15 hour workshops was 10.

Four individuals represented the refuge volunteer corps at the state volunteer dinner on May 1. The Friends of Bombay Hook Cooperating Association paid for their dinners. Volunteers were also treated to two field trips this year, one to the Ward Decoy Museum and the other to a canoe trip of Eastern Neck NWR. We also try to help other volunteer groups by sharing our ideas and experiences. A volunteer group from the Philadelphia Zoo and another from Pine Run Nature Center visited the refuge for a tour and an orientation to our volunteer program.

Volunteers and Friends enjoyed one of the quarterly trips offered by ORP Pohlman; this one was to the renowned Ward Brothers Decoy Museum on Maryland's Eastern Shore.

3/97 Marian Pohlman

The Annual Christmas party and awards ceremony for volunteers was held on December 20 with 40 volunteers in attendance. Awards were presented in various categories ranging from staffing the Visitor Center, and working with educational groups, to assistance with horseshoe crab surveys and tagging, bird surveys, trail maintenance, operation of the sales outlet and building picnic tables. Awards included volunteer T-shirts and caps, mugs, service pins and certificates, items from the sales outlet for special recognition and items from a volunteer awards catalogue. The catalogue items included calculators in a miniature briefcase for those staffing the Center, flashlights for those counting horseshoe crabs at night, water bottles for trail maintenance volunteers, memo pads, magnets, key chains, buttons and pins. All of the catalogue items had the inscription "Volunteers Make It Happen". A second volunteer has now received the Service's 1,000 hour pin; two more received the Service's 500 hour pin (total now 13); and four additional received the Service's 250 hour pin (bringing the total to 29 volunteers). Eighteen volunteers received special recognition awards. All in attendance enjoyed the pot luck buffet, gift exchange and lots of friendship and fun.

This program has proven to be extremely valuable over the past 15 years, and much has been accomplished that would never have been possible with limited staff. Over the years, our core volunteer group has become a very dependable group of folks!

5. Funding

Bombay Hook Fund Allocations for the past five years are as follows:

Year	1261	1262	6860	Fire	Total
FY98	*503.6	84.0	2.0	5.8	595.4
FY97	425.8	51.4	2.0	7.2	486.4
FY96	430.9	72.0	2.0	2.0	506.9
FY95	318.7	136.3	2.0	1.0	458.0
FY94	296.1	154.2	2.0	0.5	452.8

*Prior to this FY, money for PCS moves was paid out of a Regional Office account. This year the money for the PCS move of the new assistant manager has been placed in the refuge allocation ($43,000). Whatever is not utilized in that move will be taken back by the Regional Office; therefore it does not represent an actual budget increase.

During 1997 other sources provided funds to Bombay Hook as follows:

North American Waterfowl Management Plan	$3,088 Phragmites Control
Delaware Division of Fish & Wildlife	$3,088 Phragmites Control
Friends of Bombay Hook	$8,056 Outreach Materials

In addition, the Delaware Division of Fish and Wildlife provided an excavator and operator to assist in the construction of the 7.5 acre Steamboat Landing moist soil unit. (see Sections F.2.e, I.1). By doing the project force account with State assistance rather than contract approximately $2,442 was saved.

6. Safety

Joint safety meetings with Bombay Hook and Prime Hook staff were held monthly except for July when most staff was on vacation and October/November when workloads precluded them. A schedule is developed each year whereby staff members alternate in chairing the meeting and choosing a topic. The safey meetings during 1997 dealt with the following subjects:

January	Personal Safety in Law Enforcement or Civilian Situations
February	Eye Protection
March	CPR Training
April	Air Bag Safety
May	Water Safety and Rescue
June	Recreation Activity (Travel, Camping, etc.) Safety
August	Avoiding Back Injury
September	Pfiesteria (Delmarva Outbreak and Significance)
December	Regional Safety Meeting at Eastern Neck NWR

There were no lost time accidents this year, and in fact none dating back to January 9, 1984.

One accident involved the visiting public this year when a deer hunter tumbled out of his stand (elevated platform) and fell about 10 feet to the ground on December 19. He called the refuge office with his cell phone and Refuge Officers Daly and Smith were contacted, arriving at the scene within approximately ten minutes. The hunter had an obvious limp and was transported to his vehicle, where he insisted that he would drive himself home (about 5 miles distant) and seek medical attention. A DI-134 was filed on the case and we have not heard whether the leg injury turned out to be a sprain or a break.

During the May "Water Safety and Rescue" meeting presented by State enforcement personnel, refuge staff had the chance to practice actual rescues. Here a "victim" dons the protective GUMBY WETSUIT.

5/97 Marian Pohlman

Each rescuer was shown various positions to use in particular circumstances for effecting a successful rescue.

5/97 Marian Pohlman

Here Assistant Manager Barker (rescuer) approaches the floundering Biologist Smith (victim) under the watchful eyes of the instructors.

5/97 Marian Pohlman

7. Technical Assistance

During April, copies of the newly completed refuge Cropland Management Plan were provided to Wallkill Refuge and to the Delaware Nature Conservancy, both of which are planning to institute cooperative farming programs. Also during April a copy of the Bombay Hook Annual Water Management Program was provided to Great Bay Refuge.

Office Assistant Barbara Straughn traveled to Back Bay NWR during the period August 13-15 to help train their office assistant in policies and procedures regarding fiscal administration.

During October snow goose population data and habitat information was provided to Gary Costanzo of the Virginia Game and Fish Commission and Austin Reed of the Canadian Wildlife Service for use in developing the Arctic Goose Habitat Working Group report on the greater snow goose.

On November 13 and again on December 16 Biologist Smith attended meetings of the newly formed state predator committee. The committee is composed of a member of the Division of Fish and Wildlife Advisory Council (Chair), an upland game hunter/manager, a waterfowl hunter/manager, a fox or raccoon hunter/manager and a professional wildlife scientist. Their charge is to make recommendations to the Delaware Division of Fish and Wildlife regarding mammalian predator management, especially the red fox, which is a species that because of overpopulation has been a problem for years in the state, and is the only resident wildlife species directly controlled by the State Legislature. Meetings will continue into 1998.

Manager Daly provided assistance to Mr. John Haynes of the National Park Service, Washington, D.C. in December by sending him diagrams of the refuge boardwalk.

8. Other Items

Biologist Smith and Maintenance Worker Straughn participated in the Atlantic Flyway Wingbee during the period January 27-30 at Patuxent WRC.

On February 18 Biologist Smith attended a meeting of the Delaware Partners in Flight search and monitoring committee held at the Ashland Nature Center in Wilmington.

Assistant Manager Jason Barker attended a meeting of the Delaware River/Delmarva Coastal Ecosystem Team February 11-12 in Cape May, New Jersey.

The annual spring meeting of Bombay Hook/Prime Hook Refuge staffs and Delaware Division of Fish and Wildlife to discuss results of past season refuge hunt programs and plan for next years program was held on March 27. Attending from Bombay Hook and

Prime Hook were Refuge Manager Daly, Assistant Managers Barker and O'Shea and Biologists Smith and Larsen. Delaware Division of Fish and Wildlife was represented by Director Andy Manus, Wildlife Administrator Lloyd Alexander and Greg Moore of the Wildlife Division. Among the variety of topics discussed were the new pilot user fee hunt program and a new cooperative venture for youth deer hunt day the first Saturday in November. Youths and their accompanying adult would meet at a central location, either Bombay Hook or a nearby State Wildlife Area and deer stand permits would be issued by daily lottery from that location. This meeting is always an excellent one where we get to work closely with our State partners. Another important addition to our program which was discussed was the proposed cooperative management agreement whereby Bombay Hook would begin management of the State owned DiFebo Tract (adjacent to our Fischer Tract) and the State would similarly manage the refuge owned Air Force Tract. (Section C.3)

On March 18 and 24 Manager Daly and Biologist Smith met with Shana Fernhoff, a graduate student at the University of Pennsylvania, to discuss management of non-game wildlife species on refuges, especially passerine bird species.

Manager Daly attended the Region 5 Project Leaders meeting in Baltimore, Maryland during the period March 10-14.

On April 2 Terri Neyhart (RO - Refuges) visited Bombay Hook to go over MMS and personal property equipment lists.

On April 3 Manager Daly, Assistant Manager Barker and Biologist Smith attended a wetlands management tour conducted by the Delaware Division of Fish and Wildlife at their Little Creek and Ted Harvey Wildlife Management Areas. Terri Neyhart (RO Refuges) and Tracy Casselman (Forsythe NWR) also attended this tour, a highlight of which was observing the water control structures (patterned after the rice-field "trunks" used in the southeast) in place at these areas.

The Refuge Revenue Sharing Check in the amount of $44,428 covering FY96 payments to Kent County, Delaware was delivered to the Secretary of the Levy Court on April 25. Subsequently, the manager was invited to appear at the May 27 meeting of the Court where he was presented with a certificate of tribute in appreciation for the revenue sharing check.

Biologist Smith attended a Partners in Flight meeting on July 2 at the Delaware Division of Fish and Wildlife Aquatic Education Center.

On August 27 Biologist Smith attended a meeting of the Delaware Bay Shorebird Working Group in Cape May, NJ. Results of the 1997 surveys were presented as well as various progress reports on ongoing research. This year by far most of the shorebird

usage of Delaware Bay occurred on the Delaware side. Spawning by horseshoe crabs was down significantly on the New Jersey side. Reports by representatives from the states of Delaware and New Jersey were presented on the status of efforts to limit the harvest of horseshoe crabs.

Manager Daly traveled to Lamar, PA on September 2-4 to attend a meeting of the Delaware River/Delmarva Coastal Ecosystem Team.

Manager Daly attended the Region 5 Refuge Project Leaders Meeting September 8-10 at the National Conservation Training Center in Shepherdstown, W.VA.

A group of Senate and House Appropriations Committee staffers visited Bombay Hook NWR on December 10 accompanied by three National Fish and Wildlife Foundation personnel. Neal Sigmon of the Foundation initiated the trip. Refuge Manager Paul Daly and Biologist Frank Smith carried the group on a refuge tour during which they observed many thousands of greater snow geese, a variety of duck species, a pair of bald eagles, shorebirds (including a rare marbled godwit) and wading birds. After the tour the group was shown a slide show in the Visitor Center auditorium and Manager Daly answered their questions. Many in the group were quite knowledgeable regarding refuges and their questions naturally gravitated toward budgets and other fiscal matters. They enjoyed their day and were invited back to view the shorebird migration in May or June.

F. HABITAT MANAGEMENT

1. General

Over 13,000 acres of Bombay Hook's 15,978 total acres consist of tidal salt marsh. Other important habitats include freshwater impoundments (1,146 acres), croplands (1,070 acres), and scattered blocks of various forest types including upland hardwoods, hardwood swamps and shrub communities. Many of these habitats are intensively managed to meet refuge objectives for waterfowl maintenance and production, endangered species, wildlife diversity and various public uses.

North American Waterfowl Management Plan (NAWMP)

The North American Waterfowl Management Plan -- an international agreement signed between the U.S. and Canada in 1986 to protect, enhance, and restore wetland habitats across the continent -- presents a number of new opportunities and challenges for NWR's. The Plan establishes conservation goals for wetland habitats in specific regions of the continent; sets objectives for restoring waterfowl populations, and provides a framework for accomplishing local, regional, and international goals. In the United States, six key waterfowl breeding, migration, and wintering habitat regions, called Joint Ventures

(JV's), have been established to implement the plan. In Region 5, The Lower Great Lakes/St. Lawrence Basin and the Atlantic Coast JV's have coalitions of federal, state, and private partners working together to restore waterfowl populations.

The Bombay Hook NWR lies within the Atlantic Coast JV and is playing an active role in achieving the objectives of the JV and NAWMP through the management of the refuge. Bombay Hook was established in 1937 as a refuge and breeding ground for migratory birds and other wildlife. Waterfowl management centers on manipulation of water levels in the impoundments and agricultural crops within the uplands to favor growth of plant communities and habitat conditions desired by waterfowl. Black ducks, pintails, and Canada geese are of particular management concern at Bombay Hook.

NAWMP Activity Highlights on Bombay Hook in 1997

Challenge grant funding obtained through Ducks Unlimited purchased water control structures which were utilized in the completion of two additional moist soil units during the past summer. The two units together totaled 8.5 acres. All work was force account and included the assistance of the Delaware Division of Fish and Wildlife which provided an excavator and operator to assist in construction of the larger of the two units. In addition, the water control structure in an existing unit (BMH-6) was replaced with one funded through Ducks Unlimited.

Approximately 200 acres of Phragmites, cattail, and red maple within Shearness and Bear Swamp Pools were aerially treated with the herbicide Rodeo. One hundred acres of this total was funded via a partnership among the State Division of Fish and Wildlife and the Service through NAWMP funding.

2. Wetlands

Tidal Marsh

Bombay Hook's salt marsh is a rather unique habitat on the mid to North Atlantic coast in that it mostly remains in a pristine, unditched condition; having escaped the grid-ditching done for mosquito control on similar marshes in previous decades. The overall acreage can be divided roughly into two-thirds high, irregularly flooded Spartina patens/Distichlis spicata short form Spartina alterniflora association, and one-third low, regularly flooded tall form Spartina alterniflora.

Present habitat management primarily focuses on preserving the integrity of the marsh community and is focused on reducing the adverse effects of feeding by concentrations of snow geese in the low marsh. When the refuge populations reached 70,000 birds in the mid-80's, extensive "eat-outs" were created (approximately 1,000 acres) in the Money Marsh and Leatherberry Flats areas, as well as around George's Island. Between 1988

and the present the areas devegetated by geese have remained roughly the same, but have varied up or down in size by as much as 80 acres per year. The snow goose hunt, conducted as a management tool on the critical marsh sites since 1983 appears to have influenced the timing of the "eat-outs" if not the total extent of it. In any event, the data collected from our annual vegetative transects indicates that the vegetation does re-populate the "eat-outs" to a similar extent each year based on percentage of aerial cover. However, previous studies at Bombay Hook indicate that total plant biomass is reduced.

Other than the snow goose hunt, the only active management on the tidal marsh is prescribed burning. Selected marsh units are scheduled for burning in mid-winter to divert the attention of snow geese away from the vulnerable low marsh. No burning has been conducted during the past two years, however, due to adverse burning conditions and unavailability of enough manpower to conduct the burns.

Kelly Island, the saltmarsh island located at the southeast corner of the refuge, has been designated as one of the most rapidly eroding areas in Delaware. During the past 50 years dozens of acres of saltmarsh habitat have been converted to open shallow waters of Delaware Bay. During 1994 the Corps of Engineers approached us with a proposal to utilize dredge material excavated from the planned dredging of the Delaware Bay shipping channel to restore some of the island back to its 1960 dimensions. Our office has met periodically with the COE and the Delaware Department of Natural Resources and Environmental Control to come up with recommendations and plans that would meet the objectives and concerns of our agencies. Some of our greatest concerns are to have a project that will enhance the area's value to migratory birds (especially shorebirds) and thus not degrade but enhance the area for spawning horseshoe crabs. This year we again met on occasion with COE, DNREC, and our Ecological Services Division to ask questions and provide information to ensure that the concerns of our agency are adequately addressed in any planned project. Interestingly, we discovered during our meeting processes that any land created by "re-claiming" the bay bottom that was formerly Kelly Island will in fact belong to the State of Delaware rather than the Fish and Wildlife Service. Given this fact, the refuge will attempt to work out a Memorandum of Understanding with the State of Delaware which will result in our cooperative management of any new wetland area to be constructed.

On August 26, 1997 the Service submitted comments via the New Jersey Field Office after review of the Delaware River Main Channel Deepening Project Final Supplemental Environmental Impact Statement. Efforts were made to coordinate the comments from four Service program areas (i.e., Fisheries, Refuges, Coastal Estuary Program, and three Ecological Service Offices) within the project area, which includes the States of Pennsylvania, New Jersey, and Delaware. In order to minimize adverse impacts to fish and wildlife, the following measures are recommended:

1. Enhance wildlife habitat on existing upland disposal sites.

2. Deed restrict, or place conservation easements on, all upland disposal sites after disposal capacity is reached.

3. Use dredged material beneficially for direct beach nourishment or wetland restoration, rather than stockpiling material in subtidal areas.

4. If sand stockpiles are used, select less ecologically diverse sites for sand stockpiling.

5. Resolve concerns relating to sand stockpile areas through the NEPA process rather than through Plans and Specifications phase of the project.

6. Coordinate with the Service during the Plans and Specifications phase of the project regarding the management of Kelly Island and other beneficial use sites.

7. Develop a Memorandum of Agreement between the Service and the Delaware Department of Natural Resources and Environmental Control to cooperatively manage the Kelly Island wetland restoration site and jointly prepare management plans.

8. Coordinate with the Service to refine the Kelly Island project design to ensure unrestricted tidal exchange in the wetland over time. Develop an agreement among the State and federal agencies on this issue prior to requesting a special use permit for Kelly Island from the Service.

9. Monitor water quality, oyster, and shellfish populations prior to, during, and following dredging activities to verify salinity and circulation modeling.

Impoundments

All water management units (WMU's), including the four major impoundments as well as the smaller moist soil units were managed as one dynamic wetlands complex. The objectives for each area were based on water management capabilities within each unit as well as providing a variety of freshwater habitats for the overall benefit of migratory bird resources not only for this specific refuge but for the entire flyway. Consideration is given to a diversity of species such as reptiles, amphibians and invertebrates, but our primary emphasis remains providing optimum habitat for wetland dependent migratory birds.

1997 rainfall totals were near normal and we did not encounter the problems of excess water supply during the growing season that made management efforts difficult during 1996.

Two more moist soil units were constructed during the summer within low lying agricultural areas of the refuge. One unit (BMH-221) was constructed in the Raymond Neck Farming Unit in field #403. The second 7.5 acre unit (BMH-222) was constructed in the Steamboat Landing Unit. All work was force account and included the assistance of the Delaware Division of Fish and Wildlife which provided an excavator and operator to assist in construction of the larger unit (Section I.1).

The water control structure in Unit BMH-6 was replaced during the summer.

The DNR Mosquito Control Division treated 100 acres of Raymond and Shearness Pools with the insecticide Altosid (methoprene) to control salt marsh mosquito larvae on August 25. The State is limited to the use of methoprene or BTI for mosquito larvae control within our impounded areas.

On June 30, 100 young green frogs were collected within BMH 15 and examined for possible deformities at the request of the Ecological Services Division. No deformities were discovered.

For the fifth consecutive year we utilized the vegetative plot method of collecting vegetative data in Raymond, Shearness, and Bear Swamp Pools. Transects were run in Finis and in the tidal saltmarsh. All sample plots and transects are marked in the field with permanent markers to insure that the areas are sampled similarly each year. Data from this sampling effort was loaded into the Vegdata program developed by the South Zone Biologist.

For the fourth year we utilized the Waterlev database to monitor water level and salinity data in the WMU's.

For the fifth consecutive year weekly water bird surveys of managed wetlands were conducted throughout the entire year. This data was logged into the wildlife inventory database (CENSUS). This data is one of the main tools with which we can evaluate the success of our management strategies.

Below is a discussion of the conditions and events which were observed in each unit during the past year.

a. Bear Swamp Pool (BMH-1)--240 acres

For the fourth consecutive year we did not intentionally dewater this unit during the growing season. Water levels during January and February were 9 inches to a foot above those achieved during 1996 and closely approximated objective levels. Near objective levels were maintained through June as levels dropped due to evaporation and transpiration. During the dry month of July water levels dropped

well below objective and remained lower than planned through the remainder of the year and significantly below 1996 levels. The lower water levels during the summer resulted in higher soil salinity readings. Samples taken during August varied between 2.76 ppt. and 4.67 ppt. compared to 1996's readings of 0.62 ppt. to 2.30 ppt.

Summer vegetation sampling yielded similar plant coverage estimates for fleabane, cattail, and bare ground to the previous year. However, sprangletop increased from 5 to 18% coverage while spikerush declined from 28 to 17%. The open water areas of the pool showed declines in Potomageton coverage from 7 to 2%. Heavy algae mats appeared to have effectively choked out the pond weeds. However, the algae mats were full of insects which duck broods found attractive during the summer.

Waterfowl use was similar to previous years. Canada goose peak use was recorded in January when 3,000 birds were recorded. Snow geese in numbers up to 15,000 fed on the roots and rhizomes of the pool during much of the fall and early winter. Green-winged teal numbering up to 1,250 birds along with pintails (582 peak) used the impoundment throughout the period September through March.

As is normally the case low summer water levels resulted in excellent summer feeding opportunities for wading birds. Peaks of 66 great egrets, 95 snowy egrets, 34 great blue herons and 12 Little blue herons were recorded during August.

Black necked stilts again nested in the impoundment while yellowlegs and dowitchers were found actively feeding there during October.

Wood duck banding operations were conducted within the pool during the summer and in excess of 200 birds were banded.

b. Shearness Pool (BMH-2)--560 acres

A comparison of water gauge readings for this pool during the past two years are somewhat deceiving in terms of pool bottom conditions. Although the gauge readings were similar during the July and August periods for the past two years bottom conditions were actually quite different. The pool bottom during July of 1997 was virtually 99.9% free of standing water and mildly moist. Conversely, during 1996 the pool bottom remained quite wet with lots of pockets of standing water throughout the summer period. This year's conditions were much more favorable for desirable emergent vegetation establishment and growth. Vegetation sampling yielded significant favorable changes from 1996. Sprangletop coverage increased from 11 to 34%. Panic grass increased from 9 to 16% and Walters

Millet increased from 9 to 14%. Cattail coverage declined from 5 to 2% and bareground declined from 54 to 22%.

Following the dewatering of the pool we again encountered a significant carp die-off in one isolated pocket of water where the fish became trapped.

As one might expect with drier conditions soil salinities were somewhat higher than the previous year and averaged about 6 ppt. except for one concentrated area just inside the north water control structure which was up to 16 ppt.

During August a significant portion of the solid cattail stands and all remaining Phragmites patches were treated with Rodeo herbicide. In addition, a swath two boom widths wide of the red maple stands was also treated.

The relatively dry fall period did not result in significant water within this pool to flood the emergent vegetation. On October 6 the flap gate was opened and stop logs were set at the 1.000 level which permitted some tidal exchange over perhaps 20% of the pool bottom. This resulted in enough water to entice migrating pintails and green-winged teal to utilize the impoundment after snow geese knocked down some of the emergent plants. On October 17 the flap gate was shut and only rainfall was utilized throughout the remainder of the fall to raise water levels. Frequent monitoring of the salinity within this pool indicated that salinity levels quickly declined following the late fall rains. We believe that introducing brackish water in this manner (i.e. via tidal exchange) is less likely to result in soil salinity problems later on than simply trapping brackish water in the impoundment.

Fall and winter waterfowl use was very similar to that encountered during 1996 in terms of peaks by species. Pintail use peaked at 10,372 birds in November and 10,236 green-winged teal were recorded during November as well. While pintail use remained at a relatively high level throughout the fall period green-winged teal use declined sharply during December. This phenomenon was not restricted to this impoundment but was noted refuge wide and especially within the tidal saltmarsh. Snow goose use remained high during the fall as up to 30,000 birds were recorded resting and feeding within the impoundment. The birds continued to use the pool in numbers exceeding 20,000 as a roosting site after much of the food was depleted.

The much ranker emergent growth this year again proved desirable to migrating sora rails during late summer. This contrasts with little use noted by this species during 1996 when vegetation was shorter and less dense.

Wading and shorebird use was significant if not spectacular. Dunlin (400) and dowitchers (345) peaked in October and August respectively. Glossy Ibis (53) and great egrets (55) peaked in May.

c. Finis Pool (BMH-3)--205 acres

Pool levels this year fluctuated much more widely than those of 1996. Late winter and spring levels approximated our objectives. However, summer levels were lower than planned but neared objectives by the end of the year. Unfortunately, only one of the 3 permanent vegetation transects within this pool was completed this year due to a shoulder injury to the biologist. However, plant composition was similar to the previous year. Swamp loosestrife which was a problem here two years ago remains scarce as it did in 1996. Sedges were quite abundant and cattail remained at a desirable low level. Bidens growth was good but appeared to be less abundant than 1996.

Migratory bird use of this pool followed a pattern similar to previous years. Heaviest utilization occurs during December through March. The area continues to be a favorite brood rearing area and fall roost site for wood ducks. It is difficult to survey due to the heavy wooded cover over much of the pool. Beaver activity remains high and contributes to making the upper portions of the pool attractive to wading birds, waterfowl and reptiles and amphibians. Representative species peaks recorded were as follows: mallards 282, gadwall 25, black ducks 16, and shoveler 12. All peaks were recorded during December.

d. Raymond Pool (BMH-4)--95 acres

Water levels remained lower than objective from June 1 throughout the remainder of the year. A beautiful blanket of spikerush carpeted the pool during June. The dry conditions of July and August stressed it but remarkably most of the spikerush survived the summer and offered prime teal food for early migrants. Results of the vegetative sampling were interesting in that most plant species occurred in similar percentages during both the very wet summer of 1996 and the relatively dry summer of 1997 with one notable exception. Cattail occurred in 29% of the sampled plots during 1996 but was totally absent during 1997. Percentage of pool bottom consisting of bareground remained almost identical during 1996 & 1997. Soil salinity varied between 4.07 ppt. and 7.61 ppt. this year which are very low levels for this impoundment.

Waterfowl use during early fall was impressive as green and blue-winged teal fed heavily on the abundant spikerush. Peaks of 970 green-wings and 170 blue-wings were recorded. Pintails moved into the impoundment during late fall when 1,495

were recorded. Snow goose use by roosting birds was consistent with tradition with over 10,000 birds frequently recorded there during dawn surveys.

Wading bird use of this unit was quite low but shorebird use was significant particularly during late summer and early fall. Peaks of 1,850 dunlin, 300 avocet, and 100 semi-palmated plovers were observed.

e. Moist Soil Units

As of the writing of this report a total of 18 small moist soil units varying in size from 1 to 12 acres have been completed. Virtually all of these units began the year at or near full pool but completely dried out during the growing season. Fall and early winter rainfall was not sufficient to reflood many of the units by the end of December. Following is a summary of each of these units during the past year.

BMH-5 (A-Pool)--12 acres--This pool received minor waterfowl use during February and March. Peak daily use was never more than 35 birds, primarily green-winged teal and mallards. By early July the pool bottom was completely dewatered. Sufficient water did flood 60% of this unit during late fall and early winter. A peak count of 150 mallards was recorded on December 5. Vegetation consisted primarily of rushes and sedges in the wetter areas to more upland type plants such as broomsedge in the higher portions. The location of this unit immediately adjacent to the auto tour route is a detriment to bird use. Most use is noted during early mornings or during periods of very limited public use.

BMH-6 (B-Pool)--8 acres--Excellent water conditions during the January-February period resulted in significant waterfowl utilization during the late winter/early spring period. As many as 300 pintails, 50 mallards, and 100 Canada geese were recorded there. Water levels quickly dropped, however, and the entire pool was dewatered by May due to muskrat damage to the ditch plug and evaporation. During June a new water control structure was installed and the pool was disced on June 27. Japanese millet was planted and a good stand resulted but the area remained dry through the fall and early winter as rains were insufficient to reflood it.

BMH-7 (Straughn Pool)--2 acres--Full pool levels were maintained until April when a complete drawdown was initiated. The April drawdown was instituted in an effort to favor the growth of smartweed in the pool. The pool remained completely dewatered during the growing season for the first time in several years. Excellent emergent growth was achieved. Phragmites is no longer a problem following last year's herbicide treatment but cattail continues to be a nuisance and may receive treatment this next year.

Winter waterfowl use was moderate with peaks of 25-30 mallards being the most common species.

During November sufficient water was available to flood approximately 60% of the pool bottom. The leakage that was so apparent in previous years from muskrat burrowing apparently has corrected itself since it does not continue to be a problem.

BMH-8 (Hourglass Pool)--2 acres--The full pool water levels of winter were reduced to dry bottom by mid-May. Although emergents such as barnyard grass and panic grass were abundant fall rainfall was insufficient to reflood the pool. Waterfowl use very minimal and confined to the January through March period.

BMH-9&11 (each one acre)--Both of these units are cropped fields with ditch plugs. Both areas flooded out of the ditch banks sufficiently during late winter to flood crop stubble. However, waterfowl use was negligible.

BMH-10 (one acre)--This unit again demonstrated its poor water holding capabilities. Even with the abundant rainfall at the beginning of the year this pool rarely contained enough water to provide adequate wetland habitat. Willow sprouts have also become a problem in this unit. During June the bottom was disced in an effort to set back succession.

BMH-12 (Cottman Pool)--one acre--This unit again held water remarkably well throughout the year. It is simply a dug out pond and cannot be dewatered. During the dry periods of the summer the pool level dropped and the exposed fringe produced an excellent growth of emergents. Spikerushes, cattail, and barnyard grass were the dominant species. Bird use was low for the second straight year following the initial year after construction when it was impressive.

BMH-13 (2 acres)--This dugout pond on the Fischer Tract held water only during the first four months of the year. It was completely dry by May and did not reflood. Bird use was light with the exception of some excellent shorebird use during April. A peak count of 278 yellowlegs was recorded here during that month.

BMH-14 (2 acres)--Water supply was abundant during the winter and spring but declined and the pool was dry by June. A dense cattail cover invaded most of the pool bottom although spikerush and sedges were present in good supply and annual emergents such as millet and panic grass were found along the moist open areas. Water bird use was less than expected. Mallard, black duck, and teal use was moderate with 20-30 birds being peak one day counts and was all confined to the late winter period.

BMH-15 (DU Pond)--4 acres--Full pool levels were maintained through early May. An intentional drawdown beginning June 1 completely dewatered the pool except for a small deep spot in front of the structure. Cattail was not a problem this year. A nice cover of moist soil vegetation (primarily spikerush) blanketed 80% of the pool bottom. Late winter waterfowl use was disappointing. Fall rains didn't flood the pool to optimum depths but approximately 70% of the pool bottom was partially flooded by the end of the year. Moderate use by primarily mallards was noted. Green frog populations in this unit were spectacular. One hundred frogs were collected for examination as part of a regional deformed frog survey. No deformities were noted.

Tremendous numbers of green frogs were noted in DU Pond this year and 100 were collected. All the frogs appeared quite normal.

6/97 Paul Daly

BMH-216-BMH-221 (10 acres total)--All of these units except 221 which was just finished this year contained sufficient water during the winter and spring to provide additional waterfowl feeding and resting habitat. All units were completely dry by June through natural drawdown and were disced and seeded to Japanese millet. None of these units were reflooded during the fall and early winter.

BMH-222 (7.5 acres)--This unit was completed during late summer of this year. Upon completion the pool bottom was planted to buckwheat to provide vegetative cover. The buckwheat was consumed by Canada and snow geese.

3. Forests

Wooded habitat includes 489 acres of upland hardwoods (primarily white oak, red oak and hickory), 385 acres of hardwood swamp (black gum, sweet gum, red maple and yellow poplar) and 192 acres of shrub community (buttonbush, wax myrtle and sumac). Most acreage is contained within scattered woodlots and along field and marsh edges rather than in large blocks. Management activities conducted in these habitats during 1997 included bird surveys, deer hunting, and wood duck box checks. The resident bald eagle pair utilizes a portion of this habitat adjacent to Shearness Pool for their annual nest site.

4. Croplands

Since 1993 most farming operations have been conducted by two cooperative farmers. During the ten years prior to that time four farmers were utilized. Refuge shares during 1997 were based on charging the cooperators $50 per acre for use of refuge fields to grow and harvest their corn and soybeans. In lieu of actually receiving rental payment from the farmers, services are provided equal in value to the rent owed. A limited amount of force account farming also was accomplished this year. Ladino clover seeding and mowing, wildlife food plot plantings, thistle and Johnsongrass control in unharvested fields, and a small portion of winter wheat and buckwheat planted as goose browse were force account tasks accomplished during 1997.

We are staunch supporters of ladino clover as a wildlife crop in the agricultural lands of Bombay Hook. It is a highly preferred goose browse for both Canada and snow geese, fixes abundant nitrogen for the soil, and is also utilized by a myriad of game and non-game animals since it tends to support abundant insect populations. Wild turkeys find the clover to be especially attractive during the summer when brooding young poults as they are frequently observed gorging themselves on grasshoppers. To maintain a healthy stand frequent mowing is necessary; as many as four cuttings a summer may be required during a summer of abundant rainfall. Heavy snow goose feeding can severely decimate a clover stand and some reseeding is usually necessary during late winter if the stand is to be maintained for more than one year. Frequently stands heavily decimated by geese must be rotated after one growing season since virtually no regrowth occurs.

This marked the third year of incorporation of the Steamboat Landing Tract into our Cooperative Farming Agreements. Prior to this year the entire 100.6 acres of cropland in this tract was included in land to be farmed by the cooperator. During 1997 field #502 (12.5 acres) was held out of the agreement. Within this field was constructed a 7.5 acre

moist soil unit. The remainder of the field was seeded to winter wheat force account. When we acquired this tract we also inherited a major Johnsongrass problem. During the first two year's of tillage under our ownership the fields were planted to soybeans to permit the cooperator to control this nuisance plant. The Johnsongrass appeared to be under control until we planted corn within the 88 acres assigned to the cooperator during 1997. The plant was again a problem and we will go back to soybeans during 1998 until we are certain we have it under control. We eventually hope to incorporate these fields into our basic rotation of corn, soybeans, winter wheat/ladino clover.

Portions of the approximately 1,100 acres (some fields were double cropped) of refuge croplands were planted to the following crops during 1997:

Corn	394.6
Soybeans	211.3
Sorghum	10.0
Buckwheat/Crimson Clover	33.0
Ladino Clover	205.9
Game Bird Mix	10.0
Winter wheat (early fall drilled)	191.2
Winter wheat (drilled in corn/bean stubble	171.3
Ryegrass (aerially overseeded over soybeans and corn)	117.3

Refuge shares provided by the cooperators this year consisted of the following unharvested crops and services:

187.2 acres of early fall drilled wheat
117.3 acres of ryegrass aerially seeded over soybeans and corn
33.0 acres of buckwheat overseeded with crimson clover
10.0 acres of drilled sorghum
Provided 160 pounds of ladino clover seed
Provided 24 bushels of certified wheat seed
31.5 acres of corn left standing
Provided 125 bushels of shelled corn for banding
Provided 400 pounds of Game Bird Mix
Provided 15 gallons of Roundup herbicide

Coop farmers experienced harvests of corn and soybeans that varied between poor and very good in the various fields. Corn harvests varied between 60 and 140 bushels per acre while soybeans varied between 40 and 53 bushels per acre.

Johnsongrass and Canada thistle continue to be our most troublesome noxious weeds. Mowing and application of Roundup herbicide are our traditional methods in clover, wheat, and fallow fields. The efforts to limit Johnsongrass seem to work better than our thistle control although as mentioned previously Johnsongrass is a serious problem on the Steamboat Landing Tract.

All cropland information is incorporated into a computer database which aids in information retrieval and evaluation of program effectiveness. Goose use data for the agricultural fields is also incorporated into the database and serves as a method to evaluate the effectiveness of the farming program on an annual basis and to detect use patterns for different fields or crops. Emphasis of the cropland program continued in two main areas: providing green browse for geese in the form of clover, wheat, and ryegrass and maintaining hot foods in the form of standing corn.

5. Grasslands

Normal routine mowing of road and dike edges was accomplished throughout the growing season; both as a safety measure to promote visibility for visitors and as a discouragement of duck nesting since virtually 100% of all duck nests on the upland sites are destroyed by predators. Fields which are in either sericea lespedeza or wild grasses are burned or mowed periodically to prevent invasion of shrub species.

On October 28 refuge staff attended a warm season grass demonstration put on by the Maryland DNR near St. Michaels. We plan to plant a couple of small fields to these species this summer to further enhance habitat diversity for ground nesting birds, mammals, and other species.

6. Fire Management

Prescribed burning is a habitat management tool utilized at Bombay Hook to set back succession in field situations and to make an area more attractive for a specific species group, especially snow geese. It is also utilized where possible as one of the tools for Phragmites and cattail control. Areas designated for treatment with herbicide are ideally burned during the winter before chemical application to remove dead canes and stems and thus expose only actively growing plant material to the chemical spray. Following chemical treatment the area is burned again during the winter to remove the dead plant material and thus permit the growth of more desirable vegetation.

Although no tidal salt marsh was burned this year due to weather and personnel limitations we did conduct the following upland burns:

02/27/97 Two small fields totaling 18 acres southeast of Bear Swamp were burned this date in an effort to remove dead plant matter, stimulate grass and forb

growth and to retard brush encroachment. Results of the burn were excellent as over 95% of standing grass and forb material was removed.

03/07/97 Two fields located at the southern and western fringes of Raymond Pool totaling 20 acres were successfully burned removing virtually all forbs and grasses and enveloping many of the shrubs in the unit. Following the burn the standing blackened shrubs were mowed.

03/12/97 Four small fields within the Dutch Neck farm unit as well as the 10 acre area northwest of the headquarters building were burned on this date. A total of 27.6 acres was burned. Three of the fields were burned to control brush invasion while the fourth was burned to ready it for spring tillage.

03/17/97 A total of 5 acres of Raymond and Shearness dike as well as ditch banks along the Raymond-Shearness connector ditch were burned successfully to remove dead Phragmites canes.

One wildfire was encountered on the refuge during the year. On June 20 at approximately 11:30 A.M. a visitor stopped at the refugeVisitor Center and advised that there was a brush fire near the entrance gate. Refuge Manager Daly and Biologist Smith investigated and discovered a broken electrical line which was causing vegetation to smolder. 911 was contacted who notified Delaware Electric Cooperative and Leipsic Volunteer Fire Company. Within ½ hour the power company shut off power in the vicinity of the break and the fire company doused the smoldering area with water from a truck. The total area burned was less than .1 acre. The line was repaired and power restored by 1:30 P.M.

10. Pest Control

The following herbicides were applied on portions of the cropland management units during 1997:

Herbicide	Crop	Target Species
Roundup	All crops & edges	Johnsongrass and Canada thistle
Scepter	Soybeans	Broad leaved weeds
Command	Soybeans	Grasses & broad leaved weeds

Dual weeds	Corn	Grasses & broad leaved
Broadstrike leaved weeds	Corn	Broad leaved and narrow
Prowl	Soybeans	Annual grasses and broad leaved weeds

Good control was achieved on most target species with the notable exception of Canada thistle. Application was made by cooperative farmers with the exception of Roundup sprayed force account on the fields which are not the responsibility of the cooperator.

On August 26, 200 acres of cattail and Phragmites were treated with Rodeo herbicide within Shearness and Bear Swamp Pools.

The Delaware Mosquito Control Section made the following applications of larvicides and adulticides on refuge lands during 1997 (1996's totals in parenthesis):

Pesticide	**#'s A.I. Applied**
Dibrom	171 (228)
Abate	332.4 (296)
Altosid	31.7 (23)
Vectobac	0 (2,760)*

*pounds of product rather than a.i.

As reported during 1994 the Service and the State of Delaware have developed a "Working Agreement for Saltmarsh Mosquito Control in Delaware" in which the State Mosquito Section and the Service are striving for a minimization of the use of chemical insecticides on the refuge. This agreement is valid until November 1998. These events led to the development of a draft Environmental Assessment which went out for review during 1993. During the late summer of 1994 the current director of the Delaware Division of Fish and Wildlife sent a letter to the director of Region 5 of the USFWS urging a "revisit" of the three existing EA alternatives as response to "new conditions and opportunities" that had arisen since the process had begun, particularly the addition of the Steamboat Landing Tract and the ongoing studies of the effects of temephos and methoprene on non-target organisms. We expect several meetings on this subject during 1998 prior to November when the Working Agreement must be reviewed.

11. Wilderness and Special Areas

Marshall Island (50 acres) and an unnamed 70 acre island to its west in the Leipsic River from the Marshall Island Research Natural Area. Classification of the area is Type A-7 Tidal Salt Marshes. Wildlife surveys by the refuge staff were the only activities taking place in 1997 on the predominately saltmeadow cordgrass and saltgrass islands.

The Service owns a historical residence in the Dutch Neck portion of the refuge. The Allee House, a country style brick structure of the Queen Anne period is now maintained as a residence and is rented to a local couple who open the building on selected weekends for the public to visit.

G. WILDLIFE

1. Wildlife Diversity

Bombay Hook's habitat mixture supports a wide variety of animal species. There are documented records of 315 species of birds (44 being accidentals), 34 mammals and 27 reptiles/amphibians. Of the bird species, 55 are confirmed nesters, and 31 are probable nesters.

2. Endangered and Threatened Species

a. Bald Eagle

The resident nesting pair of eagles used the same poplar tree in Finis Woods for the fourth consecutive year. By mid-February the birds appeared to be incubating. One young bird was successfully fledged after being banded in the nest on May 14 by Paul Burns of the Delaware Division of Fish and Wildlife. The young bird hung around much of the summer and was frequently observed in and around the Island near the Shearness observation tower.

Fortunately, some folks actually enjoy heights! Delaware Fish and Wildlife Officer Paul Burns looks forward to banding eaglets each year.

5/97 Marian Pohlman

Successful production in our nest for the fourth year in a row!

5/97 **Paul Burns**

On April 28 we were notified by a local farmer that a dead eagle was laying along a county road about a mile west of the refuge boundary. We investigated and discovered the adult bird which apparently struck an electrical line alongside the road. We feared that the bird, which was an adult, was one of our mated pair, but fortunately this was not the case as both our birds survived the nesting season.

b. Peregrine Falcon

Although peregrines are frequently sighted during the fall, winter and spring we have never had a successful nesting attempt on the saltmarsh nesting tower. Great horned owls regularly utilize the nest tower for perching and occasional nesting.

Our efforts to discourage the owls to date have been unsuccessful. We have tried to discourage them by removing their eggs but they always return each year.

This year was normal in that peregrines were frequently seen, particularly during the fall, chasing waterfowl or shorebirds over the saltmarsh or the impoundments. However, horned owls were the exclusive residents of the nest tower once again.

3. Waterfowl

Total waterfowl use days for CY97 were a record 15,215,198. This was largely a result of a 42% increase in snow goose use days for the year. Duck, Canada goose and swan use days were actually down from 1996 levels.

Table G.3.1 Waterfowl Use-Days 1994-97

Species	1994	1995	1996	1997
Tundra Swan	9,056	4,803	8,082	2,232
Ducks	3,724,607	2,579,336	3,522,201	3,032,954
Canada Geese	487,927	622,164	899,357	606,431
Snow Geese	5,684,300	5,944,122	6,696,714	11,573,488

Duck use remained impressive although peak numbers for some species, particularly green-winged teal, were well below those of recent years. The mild fall and winter of 1997-98 did enable use by pintails through December since ice up was non-existent. Mallard and black duck numbers averaged very similar to recent years but did not include the very high one-day peaks of 1996. Scaup were another species that significantly boosted use day figures for 1996 but were not found in abundance during 1997. Canada goose use was below that of the previous two years. This phenomenon was also true for the central part of the State.

Waterfowl use data is developed from a compilation of several survey techniques. Four different inventory procedures are utilized to monitor waterfowl populations within Bombay Hook. Weekly surveys by foot and vehicle are conducted over the upland and managed wetlands of the refuge throughout the year by refuge personnel. Aerial surveys of the entire refuge including the saltmarsh are conducted biweekly from September through March by Service personnel provided funding is adequate and pilot and aircraft are available. Boat surveys by service personnel are conducted weekly over a route through the saltmarsh from April through mid-June. These three surveys are supplemented by aerial surveys of the entire state conducted monthly October through January by Delaware Division of Fish and Wildlife personnel. All data collected by Service personnel is collected by survey units of which we have 25 within the refuge so that habitat management efforts such as water level management and croplands

management can be evaluated. All aerial work by refuge personnel during 1997 was conducted utilizing Service owned aircraft and pilots assigned to the Migratory Bird Office at Patuxent WRC. Table G.3.1 compares the last four years use day figures.

a. Canada Geese

Although Canada goose use days were down from 1996, normal wintering period populations on the refuge varied between 2-4,500 geese, which was similar to previous years but did not include the peaks which were recorded during January of recent years. No more than 8,100 birds were recorded during any of the state's surveys of northern Kent County and 4,600 was the peak number of birds actually recorded within the refuge boundary. Statewide Canada goose numbers were up during 1997 compared to the previous year during the months of October through December but were down during the month of January.

Our resident Canada goose flock is still a concern. This year we instituted egg shaking within Bear Swamp Pool. Although several broods were observed we don't think our resident flock has increased above 1996's total of 150. Unfortunately, this will probably require ongoing attention since many of our neighbors continue to encourage nesting Canadas.

b. Snow Geese

Just when we thought we might have peaked out on snow geese at Bombay Hook, the refuge saw an increase of over 40% in use days by these eating machines. Snow goose numbers were relatively low during the January-March period when aside from a high count of 77,500 on January 6 no remaining surveys yielded more than 30,000 birds. February and March were particularly low use months. The fall period was another story. The birds began trickling in during late September and arrived in mass during the first week of October. The refuge population soared from 1,820 on September 30 to over 100,000 by the 7th of October. Still the birds arrived. On October 20, state biologist Whittendale recorded 198,730 snows within Bombay Hook during a dawn aerial survey. Although the birds began making feeding forays west and south of the refuge counts of over 100,000 continued through mid-December. The birds did not confine their feeding activities to the refuge marshlands and croplands and did surprisingly little damage to either. Although most clover and wheat fields were browsed they were not, for the most part, extirpated. The saltmarsh was denuded similarly to previous years but not significantly worse.

Age ratio data was again recorded this fall by refuge personnel during November in conjunction with family group count data collected for the Migratory Bird

confirming another excellent production year.

c. Swans

Tundra swan use of the refuge was lower than the past couple of years. Virtually all use occurred during the January-February period. Peak numbers for the year were recorded on February 10 when 88 birds were recorded. As in previous years most swan refuge use was confined to the large impoundments where they rest and roost, while most of their feeding activities occur in neighboring agriculture fields planted to green browse crops.

d. Ducks

Duck use during 1997 declined from 1996 levels in terms of total use days. As mentioned above the most significant declines were noted in use by green-winged teal and scaup. The mild winter weather may have explained the low scaup numbers during the fall but reasons for the teal declines are puzzling based on the optimistic fall flight forecasts. October teal numbers were down statewide but were similar to the previous year during November.

Following is a listing of species and peaks during the past three years based on aerial and ground surveys by the refuge staff and State biologists.

Species	1997	Date	1996	Date	1995	Date
Black duck	4,987	2/03	12,405	12/17	4,433	12/04
Mallard	5,831	10/17	10,584	12/17	3,712	12/04
Gr-winged teal	10,236	11/19	20,068	10/23	22,594	11/20
Pintail	11,822	10/30	19,850	10/23	12,270	10/16
Shoveler	780	10/20	556	3/23	847	3/31
Gadwall	235	12/14	4,315	12/17	553	12/04
Wigeon	550	11/19	1,573	10/23	425	10/16
Common Merg.	293	2/19	123	3/11	112	3/13
Scaup	2,225	10/30	19,420	12/17	4,620	11/20
Canvasback	254	12/16	1,552	12/17	100	11/20

The wood duck nest box program again received considerable attention. Maintenance Worker Straughn once again did an excellent job in monitoring all 209 boxes, checking each 2-3 times during the nesting season, erecting new boxes where needed, moving boxes, and keeping detailed records of bird use and nesting success.

This year marked another improvement in terms of eggs hatched and young

This year marked another improvement in terms of eggs hatched and young produced over the previous year although hatchability declined 2%. Clutch size remained the same with no significant change in the amount of dump nesting. Table G.3.2 summarizes box data for the past 14 years.

Table G.3.2 Comparison of Wood Duck Nesting Success

Year	# Boxes	Total Eggs	Eggs Hatch	% Hatch	Mean Clutch	# Nest
1997	209	1,947	1,076	58	13.9	133
1996	209	1,604	954	60	13.9	115
1995	207	968	685	71	11.5	84
1994	214	1,014	601	59	13.5	75
1993	198	1,981	1,180	59	14.4	138
1992	178	2,629	1,297	49	17.2	153
1991	157	3,359	1,577	47	19.9	169
1990	158	3,123	1,168	37	18.6	168
1989	141	2,135	1,510	71	14.4	148
1988	126	1,706	1,252	73	14.5	118
1987	95	1,571	904	58	17.1	92
1986	78	874	408	47	17.5	50
1985	68	563	277	49	13.1	43
1984	80	551	104	19	13.8	40

Production estimates for waterfowl species other than wood ducks remain little more than educated guesses. We do not have a reliable method to estimate waterfowl production in the saltmarsh. Significantly, that is precisely where most production occurs. Aerial pair counts of the saltmarsh and brood observations within the impoundments are our principal means of arriving at production estimates.

Table G.3.3 Estimated 1994-1997 Waterfowl Production

Species	1994	1995	1996	1997
Mallard	175	250	275	275
Black Duck	150	150	175	150
Wood Duck	318	343	477	538
Blue-winged Teal	20	20	20	20
Gadwall	100	100	100	100
Total Ducks	763	863	1,047	1,083

4. Marsh and Water Birds

Marsh and water bird use data is collected weekly within the refuge impoundments throughout the year and weekly within the saltmarsh during the period April through June. Table G.4.1 illustrates representative peak populations of various species observed during the past three years. Wading bird peaks vary considerably and are greatly influenced by our water management schemes (particularly impoundment drawdown dates). Shallow impoundment water levels during the late summer often concentrate prey items which in turn attract large numbers of waders.

Table G.4.1 Marsh and Water Bird Peaks 1995-1997

Species	1997	Date	1996	Date	1995	Date
Dbl-crested Cormorant	47	5/05	255	5/01	339	4/27
Great Egret	67	7/08	109	5/30	223	6/05
Snowy Egret	192	8/18	126	6/04	160	7/31
Glossy Ibis	110	4/24	688	6/04	500	6/05
Great Blue Heron	36	8/18	13	7/10	21	7/31

5. Shorebirds, Gulls, Terns and Allied Species

Concentrations of spawning horseshoe crabs along the bayshore during May and early June normally serve as a major attractant to migratory shorebirds. Weekly surveys were conducted by boat during the May-June period along the refuge's bayshore and interior marshes. Additional shorebird information is collected weekly from bird surveys within the impoundments throughout the year. Peak counts of the predominate species from these surveys are listed in table G.5.1. These numbers do not represent total refuge populations for these species, but rather are an index since the same survey routes are censused weekly during the same period each year.

Table G.5.1 Shorebird Peaks 1995-1997

Species	1997	Date	1996	Date	1995	Date
Dunlin	2,047	5/05	5,430	5/10	12,460	5/23
Ruddy Turnstone	3,064	5/29	3,165	5/22	10,912	5/23
Knots	133	6/05	8	6/05	1,751	5/23
Semi-palm. Sand.	6,075	5/22	4,989	5/10	9,298	5/11
Dowitchers	441	5/22	1,129	5/22	2,512	5/23
Avocets	300	8/28	300	10/31	275	10/05
Stilts	34	6/10	41	7/22	32	8/07
Yellowlegs	302	4/07	110	8/01	175	8/07

Bombay Hook Refuge shorebird data was again provided to the Manomet Bird Observatory in Massachusetts as part of their cooperative shorebird population survey program.

6. Raptors

No unusual raptor population fluctuations were detected this year. Raptor population information is collected during weekly bird surveys around the refuge croplands and impoundments. Kestrels, great horned owls, screech owls, barn owls, black vultures, and red-tailed hawks were all known to have successfully produced young during 1997; and it is likely that the northern harrier, turkey vulture, and barred owl did so as well.

7. Other Migratory Birds

This was the tenth year of Maintenance Worker Straughn's bluebird nest box program which this year included 48 boxes. During 1997 we noted a slight upturn in production from a year ago. Nine boxes were utilized by bluebirds and 41 young fledged compared to the 1996 estimate of 28; however this is still down from 1995's record year of 91 young produced. Box utilization by other species included: tree swallows 29, house wrens 9, and English sparrows 4.

Point count surveys for breeding and forest and marsh birds were completed during the first two weeks of June. This is the fourth year the marsh points have been surveyed and the third for the forest points. No significant deviations from previous years were noted although cedar waxwings were present on several points during the forest surveys and actual nesting was noted by Arthur Straughn in the maintenance area. This is the first known documented nesting of this species on the refuge. Wood thrush continue to be the most prevalent species within the refuge's forest lands and they have remained at a stable population level during the past three years. This contrasts with reported thrush declines in many other nearby areas.

In cooperation with the Cornell Laboratory of Ornithology we participated in the collection of wood thrush data for their "Birds in Forested Landscapes" project.

8. Game Mammals

a. Big Game

The only big game mammal present on the refuge is the whitetail deer. The population, estimated through regular winter spotlight surveys is relatively stable. Spotlight surveys during the past 5 years have never deviated more than 12% from the 5 year average. Throughout most of the state the deer herd is expanding at a rapid rate. The judicious utilization of public deer hunting on the refuge has

enabled us to prevent the herd from expanding rapidly and reducing the quality of the habitat for other species. Since deer readily adapt to controlled hunting situations it is necessary to constantly evaluate the hunting techniques permitted. As a result regulations have been modified several times in recent years to result in an adequate annual harvest. Expanding the daily and seasonal bag limits; the use of antlerless tags; additional hunt days; and expansion of areas open to hunters are all techniques utilized at Bombay Hook in recent years. Habitat remains in excellent condition with no browse line and no apparent increase in crop depredation. Herd health remains excellent as reflected in the average weights of fawns and 1 and ½ year old animals.

Tables G.8.1 and G.8.2 summarize deer weight and age data collected during the past five years.

Table G.8.1 Summary of Age and Weight Data 1993-97*

Age	93	94	95	96	97	93	94	95	96	97
		#Bucks					Avg weight Bucks			
0.5	33	47	45	57	39	55	56	55	56	60
1.5	25	23	26	20	24	118	115	115	105	117
2.5	5	9	9	6	4	136	147	153	141	153
3.5+	2	1	3	4	1	176	178	153	157	185
		#Does					Avg weight Does			
0.5	20	47	46	39	37	53	49	52	53	54
1.5	16	13	19	15	13	94	93	93	90	98
2.5	6	9	15	16	6	107	107	106	105	94
3.5+	2	2	2	6	1	113	119	108	94	115

*All weights are expressed as field dressed weight.

Table G.8.2 Age Class Ratios 1993-1997

Percent of Total Harvest

Age Class	1993	1994	1995	1996	1997
0.5	48.6	62.3	56.2	58.9	60.3
1.5	37.6	23.8	27.3	21.5	29.4
2.5	10.1	10.6	14.5	13.5	7.9
3.5+	3.7	2.0	3.0	6.1	2.4

b. Muskrat

Portions of the saltmarsh which historically were some of the most productive muskrat habitat on Bombay Hook have been significantly degraded in recent years by snow goose feeding activities. The area known as Money Marsh and Leatherberry Flats have had 1,000 acres of tall form Spartina alterniflora removed annually for ten years, thereby rendering them unsuitable for muskrat use. Several portions of the marsh still do support excellent populations, but the overall refuge population is certainly less than that which occurred during the early 70's. Due primarily to low demand for fur (thus low prices) and little interest by local trappers the refuge marshes were closed to trapping during the 93-94 season for the first time in many years. Interest by local trappers increased during the fall of 1994 and accordingly selected portions of the marsh were opened to trapping during the 94-95 season. Interest has remained fair and trapping has been permitted during the past three seasons (Section H.l0).

c. Raccoon

The raccoon is extremely abundant on Bombay Hook both in the uplands and throughout the saltmarshes. We know that they prey heavily on nesting waterfowl and other ground nesting birds and would desire a much reduced population. Commercial trapping is normally allowed; however, only box traps are permitted and the annual harvest probably has negligible impact on the population. A rabies outbreak depressed the local population significantly during 1991-92 but their numbers seem to have rebounded to near pre-outbreak levels.

d. Otter

Otter sign is common within the refuge impoundments and saltmarsh, although sightings of the animals are far from common. We have no reliable estimate of their population size but have not seen any indications that would lead us to believe that there has been a significant population change from previous years.

e. Red Fox

Red fox are extremely numerous on the refuge and are commonly infected with mange. Delaware law prohibits the trapping of red fox and has only recently passed a law permitting limited killing of the animals without possessing them ("leaving them lay"). At present disease and parasites are the only things regulating fox numbers and those numbers are too high. Diseased animals are humanely destroyed when possible.

f. Other Mammals

Beaver were seen throughout the year and are flourishing throughout Finis Pool, the upper end of Shearness Pool as well as the back portions of Bear Swamp. Occasionally they plug the water control structures in Finis Pool during dewatering operations but they do not create significant problems. In fact, the "compartmentalization: of Finis Pool via beaver dams has improved the diversity of the impoundment".

No changes were noted in cottontail rabbit, grey squirrel, opossum, and woodchuck populations. Interestingly, striped skunks sightings have become extremely rare on and in the vicinity of the refuge. No sightings were made during our six winter spotlight surveys. Perhaps populations of these animals were reduced during the rabies outbreak which went through the raccoon population during 1991-92.

10. Other Resident Wildlife

Bobwhite and ring-necked pheasant are sighted commonly on the refuge. Although no population data is collected on these species the populations seem to be relatively stable based on casual observations. Plans for 1998 include the establishment of some warm season grass plantings which should be beneficial to these ground nesting species.

Wild turkeys which first moved on the refuge during 1993 continue to do well. Sightings of adult birds and broods were frequent during the year. Ladino clover fields in the Dutch Neck Area are very attractive to this species during the summer and fall where they are routinely sighted feeding on the abundant grasshoppers there.

15. Animal Control

Two individuals were issued special use permits to remove snapping turtles from refuge impoundments. Benefits of this activity are noted mainly in the survival of wood duck broods in Bear Swamp and Finis Pools.

16. Marking and Banding

The 1997 Bombay Hook waterfowl banding quota called for pre-season banding of 200 mallards and 200 wood ducks. Black ducks encountered in the traps were also banded. No post season duck quota was assigned. Additionally, screech owls and barn owls were banded as they were encountered in nesting boxes.

Although the wood duck quota was met we were unable to complete our mallard quota. Wood ducks were captured and banded at two sites within the Bear Swamp

impoundment. Floating traps were used exclusively. Additionally, 12 adult hens were captured and banded in nest boxes. Mallard trapping was attempted at the bayshore location adjacent to Hay Ditch. Raccoon predation was an intolerable problem this year and we had to suspend operations due to the animals either killing birds in the traps or scaring them from the site. We removed several raccoons from the site but were unsuccessful in eliminating the problem.

Tables G.16.1 and G.16.2 summarize the results of banding efforts during 1997.

Table G.16.1 Bombay Hook Duck Banding Totals 1997

Species	HY Male	HY Female	AHY Male	AHY Female	Total
Wood Duck	59	57	56	35	207
Black Duck	2	2	2	1	7
Mallard	4	5	27	16	52
GW Teal	0	0	3	0	3

Table G.16.2 Bombay Hook Owl Banding Totals 1997

Species	L-U	HY-U	AHY-U	Total
Screech Owl	--	3	2	5
Barn Owl	22	-	1	23

H. PUBLIC USE

1. General

Emphasis in our public use programs continued to be centered on the refuge station message, including wildlife management techniques, the importance of wetlands and endangered species, and biodiversity. We will highlight a few of the many programs and events that occurred this year. General public events included activities celebrating Earth Day, Migratory Bird Day, National Wildlife Refuge Week, The Service's and Bombay Hook's birthdays in March, and Make a Difference Day. Details on these events and other programs are covered in other sections of this narrative.

Public use visits totaled 116,674, the third highest year on record. Wildlife observation accounted for most visitor activities, followed by environmental education (to include on-refuge interpretation, outdoor classrooms, and educational assistance) and hunting/trapping. Interpretation off site included programs for 1,426 individuals.

This was the ninth full year of charging entrance fees. Following is a comparison of the fees collected and passes issued during the past five years. Abbreviations for the passes are as follows: Daily pass (DP), Golden Eagle Pass (GEP), Golden Age Pass (GAP), Golden Access Pass (GACP), and Federal Duck Stamp (FDS). Funds are rounded to the nearest dollar. This year the Bombay Hook (BH) pass was added as a service to the local community. Most visitors, however, including locals, visit other areas and therefore choose one of the other passes. The Golden Eagle Pass sales dropped significantly when the price was increased from $25 to $50. Fortunately, beginning at the end of March the refuge started getting back 80% of funds taken in, instead of the previous 30% due to participation in the pilot fee program. Our FY share for passes was $14,481 compared to $5,774 the previous year.

	1993	**1994**	**1995**	**1996**	**1997**
DP ($)	18,045	16,330	17,454	12,183	15,695
GEP(#)	131	169	177	225	92
GEP ($)	3,275	4,225	4,425	5,625	4,600
GAP(#)	402	156	158	154	138
GAP($)	free	1,560	1,580	1,540	1,380
GACP(#)	12	34	60	48	65
FDS(#)	390	220	332	289	280
FDS ($)	5,850	3,300	4,980	4,335	4,200
BH (#)					36
BH ($)					432

Table H.1.1 - Public Use Activity 1984-1997

Year	Total Visits	Interpretation	Outdoor Classroom	Observation Vehicle	Observation Foot	Number Groups
1997	116,674	39,869	7,149	108,793	10,879	207*
1996	123,369	48,140	7,025	96,768	11,335	173
1995	122,556	42,043	7,467	113,769	11,373	124
1994	91,078	43,154	3,654	84,035	8,403	146
1993	84,418	45,637	5,747	78,488	7,918	160
1992	81,945	40,295	3,613	74,004	8,973	145
1991	78,133	52,088	2,292	69,565	6,622	103
1990	81,676	60,433	1,756	70,469	7,046	101
1989	78,258	36,232	1,694	70,090	6,635	105
1988	83,347	44,648	1,597	74,519	7,156	110
1987	83,286	36,194	1,337	74,968	7,380	113
1986	81,987	40,313	1,786	72,626	6,957	124
1985	77,752	32,564	2,093	67,735	6,773	103
1984	55,890	24,860	1,672	52,302	3,736	111

*Includes 166 groups done by refuge staff and volunteers, and 41 groups done by the Delaware Nature Society. Their program started last year.

ORP Pohlman continued to provide assistance to Prime Hook and Eastern Neck Refuges as requested. She helped Manager Kaehny of Eastern Neck in activities for the more than 200 Kent County (MD) students which included a study of the Chesapeake Bay with direct hands-on experience using a seine net. Two environmental education workshops were offered at Prime Hook this year. The workshops were six hours long for 2/5 in-service teacher credit. They included an orientation to Prime Hook Refuge, an interpretive walk along the boardwalk trail, and habitat studies of the forest, marsh, pond, and beach. Seven individuals attended.

2. Outdoor Classrooms - Students

Many of the 7,149 students that toured the refuge this year, also engaged in environmental education activities, e.g. wetland and forest studies. Students can dip for animals in the fresh, brackish or salt marsh areas; some of the older students also conduct water quality studies and plant studies. In the woodlands, students dig in the soil and look under logs for herps and invertebrates and also study plants. Students also received information about our wildlife management program and endangered species. Many groups also take interpretive walks along the trails, with emphasis being placed on the importance of wetlands to wildlife and on how refuge management practices contribute to biological diversity while emphasizing our migratory bird "trust" species. October,

November, April and May are our busiest months for school groups and the general public. We have groups almost every day during those months. See Table H.1.1. under Public Use general to compare how the number of students and groups has increased over the years and also the number of programs conducted. Interpretive brochures, lesson plans, and equipment are available for use by school groups, whether they are staff or volunteer led, or teacher/leader led.

Here students are enjoying one of the many habitat study programs offered at the refuge. They are searching for animals and their evidence, along with interesting plant species in the tidal marsh.

10/97 Marian Pohlman

Two years ago an arrangement was made with the Delaware Nature Society which permits them to bring one school per day to Bombay Hook during the busy fall and spring seasons. They coordinate their schedules with ours so that refuge conducted school groups (also one per day) would not conflict with theirs. This worked out well and has helped us increase the number of students and schools the refuge can accommodate, adding 2,050 students to our total student visitation during 1997.

Many schools now include a Delaware Bay beach study as part of their environmental education program at Bombay Hook. Schools have been making use of Woodland Beach to the north of Bombay Hook for seining and Port Mahon to the south for observing/ studying the horseshoe crab/shorebird connection.

ORP Pohlman again participated in the 4th Grade Environmental Education program for Kent County, Maryland at Eastern Neck Refuge. About 200 students from around the county participated in staff and volunteer led activities during this program. Again this year other agencies (Maryland Forest Service and Department of Natural Resources) participated in conducting this program. The agency cooperation was necessitated because the Kent County Board of Education could not approve trips to both Remington Farms and Eastern Neck. As a compromise, the agencies involved agreed to work together at Eastern Neck. At the request of the Board of Education, lesson plan booklets were prepared for the students to use at the different sites. The FWS activity focused on the Chesapeake Bay. Participants used a large 10' seine net to sample life in the Bay.

3. **Outdoor Classrooms - Teachers**

Outdoor Recreation Planner Pohlman offered two (one in the spring and one in the fall) fifteen hour environmental education workshops for one in-service credit each. Seventeen (17) teachers and volunteers attended these workshops. Refuge workshops include an orientation slide show and wildlife management tour, sessions on management techniques and surveys, endangered species (and the ESA), habitat studies (which include fresh, brackish and saltwater marshes and bay beach areas, forest and meadow), educational resources review, simulated activities (from such sources as OBIS, Wonders of Wetlands, Project Learning Tree, Project Wild and Aquatic Wild), and activities on current environmental issues and problems. This year we again included a tour of the Allee House. Teachers also prepare their own lesson plans to be presented to the group at the end of the workshop. Attendees receive a packet of materials that includes workshop activities, all refuge brochures, several of the Service-wide brochures, and various posters. The Service habitat pacs are provided at the workshops, and are also available to any teachers wishing to bring their classes to the refuge and/or conduct environmental education activities on school grounds. Environmental education equipment including jars, pans, trowels, water test kits, nets and identification guides are available on advance request.

ORP Pohlman worked with the Aquatic Resource Education Center of the Department of Natural Resources and Environmental Control in conducting a 7 day wetlands workshop for teachers in July. One full day was spent at Bombay Hook doing wetland activities at the fresh/brackish and salt marshes and along the Delaware Bay. This workshop also included Wonders of Wetlands (WOW), Project Wet and Wild, the Wetland Display Education Kits, and field trips to Pea Patch Island and along the St. Jones River. This workshop is also proving to be beneficial to the instructors as they get ideas from each other and other wetland programs and activities. Twelve teachers received 3 credits for this course through the University of Delaware. Pohlman also worked with the Aquatic Center in conducting a 3 hour teacher workshop on the horseshoe crab/shorebird connection for 30 teachers interested in furthering their students knowledge on this subject.

Pohlman conducted a wetlands workshop at Grove Point for 37 scout leaders from the Chesapeake/Delaware Bay Areas. They were shown activities they could do with their scouts on the bay, river and freshwater marsh areas.

ORP Pohlman and Assistant Manager O'Shea conducted fall and spring teacher workshops at Prime Hook. This six hour workshop covered wetland and forest studies, interpretive walks and tours, and wildlife management techniques.

4. Interpretive Foot Trails

Interpretive brochures are available for the Boardwalk, Bear Swamp and Parson Point Trails. These brochures make it easier for teachers and leaders to conduct their own interpretive walks, and also give the general public additional information when walking the trails. Experience with data from a traffic counter has allowed us to estimate that approximately 10% of the visitors to the refuge also walk a trail. Interpretive walks were conducted for 3,844 individuals, mainly school children.

5. Interpretive Tour Routes

A twelve mile (round trip) auto tour route is interpreted by a brochure that corresponds to numbered posts along the route. This brochure covers the wildlife management techniques used at this refuge and information about the wildlife seen along the tour route. Nine site specific interpretive signs made by Wilderness Graphics are presently on the route. Subjects include the bald eagle, shorebirds and the horseshoe crab connection, waterfowl, wading birds, water level management, cooperative farming, tidal salt marsh, snow geese, and biodiversity.

A new tour route sign was received this year, on Biodiversity. It was purchased with challenge grant funds (Friends of Bombay Hook was the other partner).

The New Biodiversity sign was installed on the auto tour route near Finis Pool.
2/97 Paul Daly

An interpretive auto tour tape made by ORP Pohlman is available for use by the visually impaired or by visitors that prefer this form of media over a brochure. It is available on loan through the Friends of Bombay Hook sales outlet.

Conducted and self-guided tours emphasize the station message, which includes wildlife management techniques utilized at this refuge; species of interest, including endangered species; plant and animal identification; environmental issues and ecological principles. Trained volunteers, field work students, teachers, and refuge staff gave conducted tours to 4,339 individuals. The Delaware Nature Society conducted programs for 2,050 students. The visiting groups fell into the following categories:

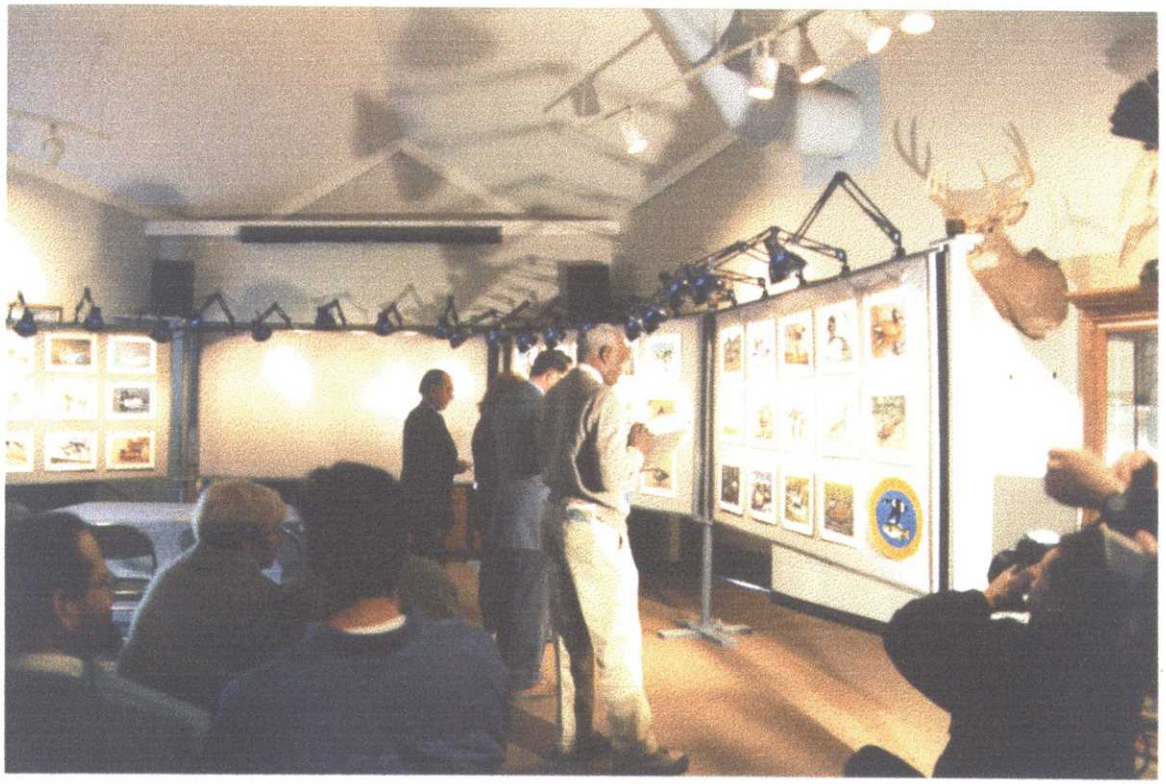
127 elementary or secondary schools
22 colleges and universities
16 scout groups
7 senior citizen and groups with disabilities
39 miscellaneous groups (including birding, conservation, garden club, civic club, church, camp, general public, and volunteer groups)

6. Interpretive Exhibits/Demonstrations

A six panel outdoor kiosk near the Visitor Center covers the following topics: endangered species in Delaware, popular species at Bombay Hook (waterfowl and shorebirds), opportunities and facilities, North American Waterfowl Management Plan, land agencies (NPS, FWS, USFS, and BLM), and wildlife management practices at Bombay Hook. A new panel on wildlife watching etiquette was purchased this year from Wilderness Graphics and is on display in the restroom lobby, which is always open to the public during daylight hours. Both sites are beneficial in providing refuge information, particularly when the Center is closed.

The refuge has a portable velcro exhibit which is used for various off-site events. Wildlife Management techniques, refuges on the Delaware and Chesapeake Bays, and the importance of wetlands are the usual topics covered on this exhibit. This year Recreation Aid Watson made a new set of pictures and texts for it which covered the history of the Fish and Wildlife Service and Bombay Hook. This exhibit is used each year at Coast Day in the fall, Earth Day events in April, at Blackwater Refuge in May for their "Spring Fling", the State Fair in July, and Ducks Unlimited Green Wing Program in April at the Fairgrounds. The wetlands education kits, which are (interactive displays developed by Department of Natural Resources and Environmental Control [DNREC]), were used at all of our major events and one set is now on display full time at the refuge.

On March 7, the selection of the 1997-98 Delaware Duck Stamp was conducted in the Bombay Hook NWR auditorium. A panel of four judges selected the winner, featuring a pair of white-winged scoters. The print was selected from 58 entries. A sizeable crowd assembled to observe the contest and the prints were left on display at the refuge for a week. Also featured were the winning prints from the Delaware Junior Duck Stamp contest.



Judging from among many quality entries in the duck stamp competition can put considerable pressure on the judges, since it is all done in full view of the audience.

3/97 Marian Pohlman

"And the winners are": the first, second and third place prints are shown here.

3/97 Marian Pohlman

The Junior Duck Stamp entries weren't bad either!

3/97 Marian Pohlman

This year we added a new display which was a joint effort by several people. Mr. George Roof of "The Good Stuff" Taxidermy Studio in Magnolia, Delaware, prepared for free an extremely professional looking display mount featuring an adult bald eagle (donated by law enforcement officer Perry), in a glass case donated by the Friends of Bombay Hook. The refuge only had to pay for the table to place it on. We have received many compliments on this new display.

Taxidermist George Roof stands next to the bald eagle display he prepared.
4/97 Marian Pohlman

7. Other Interpretive Programs

Wildlife slide shows, movies, and videos continued to be offered on a regular basis in the Visitor Center auditorium to the general public as well as organized groups.

Tours of the historic Allee House were given by Jim and Angie Hewes to visitors on spring and fall weekends from 2:00-5:00 p.m. Jim, who used to work at Bombay Hook as a field work student, works for the Delaware Division of Fish and Wildlife and he and his wife live in the Allee House. Volunteer Frances Remley occasionally substitutes in giving the tours. The Allee House dates back to 1753 and is an example of a Queen Anne farmhouse. It is restored with period furniture on loan from the State historic society. The house was built by Abraham Allee, a Justice of the Peace and Chief Ranger of the County. The house is on the National Register of Historic Places. A brochure covering the history of the Allee House is also available.

The Bombay Hook Annual Field Day was held as part of National Wildlife Refuge Week. Volunteer instructors from the following conservation groups conducted programs that day: Delaware State University, Ashland Nature Center (Delaware Nature Society) and Delaware Department of Natural Resources and Environmental Control. Visitors were offered refuge tours, nature walks, boat trips, canoe trip, wetland studies and plant walks. Many of the same individuals that helped with the annual field day, also assisted with

other events like Earth Day and Migratory Bird Day. This year at the refuge Earth Day event, Ken Liehr, (a retired Bombay Hook maintenance worker) held a workshop on building blue bird houses. The Friends group funded the materials so visitors could keep the blue bird box they made. One refuge volunteer was assigned to represent the refuge at Brandywine Zoo for Earth Day. Most refuge staff time this year relative to Earth Day concentrated on the statewide event at the Delaware Museum of Natural History. The state focus this year was on history, so the refuge emphasized the history of the Service and Bombay Hook Refuge, the Endangered Species Act and history of the bald eagle nesting pair on the refuge, and the horseshoe crab/shorebird connection on the Delaware Bay. This same exhibit on history was used first at the Service and refuge birthday celebration in March. Approximately 700 people visited the refuge during this birthday celebration.

On International Migratory Bird Day, May 10, Gene Hess from Delaware Museum of Natural History led a birding tour on the refuge. A signed print of snow geese by Nancy Howe, previous federal duck stamp winner, was auctioned off by silent bid. This print, "Summer Above the 60th Parallel", went to the highest bidder at $150. The local chapter of Partners in Flight is interested in being involved in the celebration of this day. ORP Pohlman has been meeting with this group in planning next years migratory bird event.

ORP Pohlman, Recreation Aids Verna Price and Tina Watson, and volunteers Frank Loftus and Bob Mayer conducted 20 off-site programs this year on various wildlife topics and opportunities for careers in fish and wildlife management. They also participated in a state sponsored school program entitled "What in the World", providing information on wildlife and Service careers. Approximately 1,426 individuals were reached off-site with the Service and refuge message.

8. Hunting

Hunting remains a traditional and widely practiced pastime in the State of Delaware. Much of the best hunting lands are privately owned and are available only through expensive lease type arrangements. Quality public hunting land is therefore highly sought after and the refuge continues to receive a tremendous response to its hunt programs each year. We conduct a variety of migratory waterfowl, upland game and deer hunts during portions of the regular State seasons. A total of 7,790 acres of our total 15,978 acres is open to some form of hunting.

Waterfowl-South Area

The South Waterfowl Area, also known as Kelly Island, consists of 20 refuge maintained blinds accessible only by boat. Hunting is permitted on the area on Mondays, Wednesdays, Fridays and Saturdays. Each blind may accommodate up to three hunters. A fee of $5 per hunter is charged. This differs from the $10 per blind charged in recent

years. Permits for the blinds are issued the day of the hunt by lottery at the Little Creek Wildlife Management Area state checking station. All check-in is conducted by State personnel in conjunction with check-in for state management area blinds.

Delaware duck season was 70 days this year, and the State Advisory Council and Division of Fish and Wildlife agreed to up the bag limit to 6 birds, as permitted in the liberal option of the Adaptive Management guidelines that the Service provided. The season was split into three portions similar to 1996-97 although this year's season was longer. The splits were as follows: 1) October 1-4, 2) October 31-November 8, 3) November 24-January 17. To meet flyway management goals, black duck harvest was open only during the period November 24 to January 3. A total of 489 hunters took 478 ducks (0.98 birds per hunter) with harvest composition as follows: shoveler 17.8%, green-winged teal 16.9%, black duck 14.9%, and mallard 14.2%, and the remainder scattered among gadwall, wigeon, ruddy ducks and mergansers. This was the first year that mallards, black ducks, or green-winged teal were not the most abundant species harvested.

Table H.8.1 South Waterfowl Hunting Area

97-98 Season	# Hunters	#Ducks Harvested	#Blacks Harvested	% Kill Blacks	#Ducks/ Hunter
10/1-4	58	63	0*	0.0	1.09
10/31-11/8	91	120	0*	0.0	1.32
11/24-01/17	340	295	71	24.1	0.87
Total	489	478	71	14.9	0.98

*Entire split closed to taking black ducks.

Waterfowl-West Area

This area consisting of eleven upland field blinds is designated for the hunting of Canada geese. Due to the third straight year of season closure in the Atlantic Flyway the West Area was again closed to Canada goose hunting.

Waterfowl-Snow Goose Area

Managed hunts on tidal marsh portions of the refuge have been allowed for several years to alleviate the significant impact of concentrated numbers of geese making large "eat-out" areas where all vegetation is removed. Free permits were issued for hunting on the

designated snow goose area on Mondays, Wednesdays and Fridays during the State season in an attempt to move the birds to other areas.

With record numbers of geese arriving in October, a liberal 10 bird per day bag, and a sizeable portion of juveniles in the flock, hunt success was excellent during the first two weeks of the season. However, shortly after that time the birds "wised up" and began exiting the hunt areas during daylight hours. Hunter interest quickly declined and hunting was discontinued after the end of November. Hunter harvest was the highest since 1988-89 and the ratio of birds bagged per hunter was the highest on record. Over 95% of the birds harvested were taken during the first 3 weeks of the season. This year's state season ran from October 8-11, October 20-November 21, November 24-January 17, and February 10-March 10.

Table H.8.2 Snow Goose Area Hunt Success

Year	#Hunters	#Snows Taken	#Birds/Hunter
97-98	247	758	3.06
96-97	199	174	0.87
95-96	219	152	0.69
94-95	388	626	1.61
93-94	314	747	2.38
92-93	246	76	0.31
91-92	422	688	1.63
90-91	426	389	0.91
89-90	670	721	1.08
88-89	661	1,079	1.63
87-88	552	757	1.37

Waterfowl-Youth Program

This was the second year for a special state-wide youth only waterfowl hunt, conducted on October 25, outside the regular season. The refuge hunt was held on the South Waterfowl Hunt Area (no fee charged) but received little participation. Only a couple of blinds were utilized.

Again this year the refuge hosted the Young Waterfowlers program, where local youths are run through a four session class discussing ethics, safety, regulations and identification. The class culminates with a hunt in Bear Swamp Pool, one of the refuge's fresh water impoundments. This year there were two Young Waterfowler Classes; one from Kent County and one from New Castle County, and each was given their own day to

hunt. Approximately 20 youngsters graduated from the two classes. Hunter success was

hunt. Approximately 20 youngsters graduated from the two classes. Hunter success was good at nearly two birds per hunter.

South Upland Area

This area, known as the "Air Force Tract" and locally as the "Davey Crocket Area", consists of 551 acres of brush, woodlands and marsh on the southwest portion of the refuge. It is open to all types of game in accordance with applicable State and Federal regulations without the requirement of a special refuge permit. The isolation of this tract from the other refuge units make it difficult to obtain accurate information on harvest or hunter success, however random patrols of the area indicate that it is very popular and highly utilized; particularly for rabbit and deer hunting. In accordance with the agreement between the refuge and the Delaware Division of Fish and Wildlife, the State now is responsible for hunt management on the South Upland Area.

Deer

Public deer hunts during portions of the State archery, muzzleloader and shotgun seasons continued to be offered during 1997 and are were very well received by the hunting public. Refuge firearm deer hunting permits are awarded by a pre-season lottery. The interest in hunter participation for refuge hunts is evidenced by the ratio of permit applications to available openings shown in Table H.8.3.

Table H.8.3 Applications Made/Openings Available

Hunt Location	97-98	96-97	95-96	94-95
Headquarters (shotgun)	740/117	703/117	701/114	764/114
Regular Area (shotgun)	638/318	710/300	656/245	764/245
Regular Area (muzzle.)	363/159	400/150	391/147	414/147
Steamboat (shotgun)	558/68	703/68	518/51	758/51

This year a Delaware state hunting license permitted a hunter to take two deer. Similar to last year the possession tags on the license allowed the hunter one antlerless only deer and one "hunter's choice"; antlered or antlerless. In addition an unlimited number of state issued antlerless deer permits could be purchased for $10.00 each. Essentially, with the exception of only one antlered deer there is no limit to the number of animals that can be taken by an individual.

Some hunt user fees were increased after having been in place for six years. The application fee went from $2.00 to $3.00 and the hunt fee increased from $5.00 to $10.00 for the Regular and Steamboat Areas and remained at $10.00 for the Headquarters Area. Archery fees on the self-service areas remained at $2.00.

Archery hunting was permitted on the Regular Hunt Area on the first two Saturdays of the September State archery season (58 hunters killed 5 deer). In addition both the

Steamboat and Fischer Tracts were open to self-serve archery hunting weekday mornings in October (24 hunters killed 1 deer).

During the October Muzzleloader season the refuge was open for three days of hunting on the Regular Hunt Area and the Fischer Tract (166 hunters killed 19 deer).

On November 1 Delaware held its second annual youth deer hunt. Bombay Hook served as the hunter check-in spot for not only the refuge but several state wildlife management areas. The areas of the refuge open were the Fischer Tract and Steamboat Landing. A total of 27 hunters took 7 deer.

The total kill this year was 126 which was down from last year's 164. We are not clear at this time if this represents an actual decline in the size of our deer herd or simply a response to weather conditions during the hunts (el Nino?). Results of our late winter night spot lighting should be helpful in our evaluation. Total deer harvest during the past 12 years and a summary of deer harvested by hunt area are depicted below in Table H.8.4 and Table H.8.5 respectively. For more information on the composition of the harvest refer to section G.8.

Long-time Bombay Hook deer hunter Mike Gumrot poses with the nicest trophy taken during this year's hunt, an 8 pt. 185 pound buck harvested on November 19.

11/97 Paul Daly

Table H.8.4 Total Deer Harvest-all Weapons 1986-1998

Year	Archery	Muzzleloader	Shotgun	Total
1986	2	3	51	56
1987	1	6	47	54
1988	2	13	43	58
1989	2	7	54	63
1990-91	0	2	72	74
1991-92	3	19	56	78
1992-93	2	25	99	126
1993-94	2	31	76	109
1994-95	6	23	123	152
1995-96	2	23	140	165
1996-97	2	15	147	164
1997-98	6	20	100	126

Table H.8.5 Deer Harvest by Hunt Area and Season

		Reg Area *51-92	George's Island	HDQ 1-19	HDQ 20-32	Steam	Fisch	Total
Archery	95-96	2	-	-	-	0	0	2
	96-97	2	-	-	-	0	0	2
	97-98	5	-	-	-	1	0	6
Muzzle.	95-96	21	-	-	-	-	2	23
	96-97	14	-	-	-	-	1	15
	97-98	13	-	-	-	-	7	20
Youth Shotgun	95-96	-	-	-	-	-	-	-
	96-97	-	-	-	6	5	0	11
	97-98	-	-	-	-	7	0	7
Nov. Shotgun	95-96	32	3	15	14	8	7	79
	96-97	43	4	21	13	3	7	91
	97-98	30	-	15	16	2	5	68
Dec. Antler.	95-96	27	0	2	8	9	1	47
	96-97	12	0	8	7	0	1	28
	97-98	7	-	2	3	3	1	16
Jan. Shotgun	95-96	8	-	-	-	6	0	14
	96-97	15	-	-	-	0	2	17
	97-98	7	-	-	-	1	1	19
TOTAL	95-96	90	3	17	22	23	10	165
	96-97	84	4	29	26	8	11	164
	97-98	62	-	17	19	14	14	126

*Stand numbers located on each hunt area.

10. Trapping

For the trapping period that began in mid-December 1996 through March 1997 a total of 1,242 muskrat and 16 raccoons were reported. The three permitted trappers paid a total of $2,194.05 for the trapping rights. Sealed bids were opened on November 1 for the

1997-98 season. A total of $3,282.56 was collected and 3 successful bidders were awarded trap units.

11. Wildlife Observation

Wildlife observation continued to be the reason most visitors come to Bombay Hook. This year individuals or families drove their personal vehicles along the auto tour route (108,793 visitors), and took walks along the trails (10,879 visitors). Peak public use always occurs during the waterfowl season, particularly the months of October and November. The next highest visitation period is during the spring shorebird season of March through May, which corresponds to the arrival of the horseshoe crabs along the Delaware Bay. Visitation is much lower during the winter months and also during the summer due to large numbers of pestiferous mosquitoes and biting flies; however an interesting observation is that more visitation is now realized during the December through February period than was the case several years ago, and summer visitation has also increased probably because of the increased number of sightings of bird species on the refuge "Accidental" list.

A Mark II binocular scope was installed at Shearness Overlook, a good vantage point for seeing the bald eagles, waterfowl and shorebirds. This was part of a challenge grant, the partners of which were the Friends of Bombay Hook and Walter and Kate Roshon, the children of a deceased volunteer.

Beret Films visited the refuge during 1997 to film for an upcoming nature movie. We have purchased several of their movies in the past for public and school group viewing and eagerly await this next one which will show our own refuge.

12. Other Wildlife Oriented Recreation

The Delaware Bay Retriever Trial Club held their fall trial October 17-19. The group, which has conducted trials on the refuge annually for over 42 years, had about 300 individuals attend the trial. Because of drought conditions in refuge pools many events were conducted off-refuge.

16. Other Non-Wildlife Oriented Recreation

We continue to get a few joggers and runners plus an occasional cross-country skier. These are the only non-wildlife oriented recreation activities which regularly take place on the refuge.

17. Law Enforcement

During most of 1997 the refuge had four collateral duty officers on the staff. This was

reduced to three when Assistant Manager Jason Barker transferred to Detroit Lakes, Minnesota early in December. Although we have outlined the need for a full-time refuge officer at this station, the Bombay Hook/Prime Hook Complex, such a position has not been funded to date.

On January 6 Bombay Hook Refuge Officers Daly, Smith and Straughn met at the Delaware Division of Fish and Wildlife (M&M Lodge) with the new State Chief of Law Enforcement, Jim Graybeal, and the new FWS Special Agent for Delaware, Rick Giovengo. Numerous State personnel who are involved with law enforcement, including Director Andy Manus, Wildlife Administrator Lloyd Alexander and State Officers, as well as SRA Ward attended the meeting which was held mainly to meet the new personnel.

On March 20 and 23 Assistant Manager Jason Barker and Prime Hook Assistant Manager George O'Shea conducted night law enforcement surveillance at Prime Hook NWR. This operation was done in conjunction with Delaware Department of Natural Resources and Environmental Control, Enforcement Staff in an effort to detect and then stop the illegal night commercial fishing for American eels (elvers) as they attempt to migrate into fresh water areas. These eels which are less than the State legal size limit of 6 inches can be found in phenomenal concentrations on the refuge. Current market prices for young eels had risen to $350.00 per pound.

Refuge Officers Daly and Barker completed their annual 40 hour Law Enforcement Refresher Training April 7-11 at Patuxent NWR. Refuge Officers Smith and Straughn completed the same training at Patuxent April 14-18. All four officers requalified with their Service handguns and shotguns at the Broadkill Sportsmans Club October 23.

Bombay Hook Refuge Officers Jason Barker and Arthur Straughn assisted Special Agent Rick Giovengo on July 30 in the apprehension and arrest of a subject who is charged with placing poison (Furadan) which resulted in the death of a bald eagle and a variety of other wildlife. Officer Barker participated on the search team which executed a warrant at the premises of the subjects' father, while Officer Straughn assisted in the arrest and transport of the subject to the Magistrate in Wilmington. The violation took place in southern Delaware near the town of Millsboro. Other FWS Agents and Delaware Fish and Wildlife wardens participated in the operation, which was the culmination of an extensive investigation.

Refuge Manager Daly traveled to FLETC, Glynco, GA August 18-22 to assist as a role player during the Refuge Officer Basic LE Training (ROBS) practical exercises. A cadre of role players is being developed for practical exercises when the ROBS course is moved to the National Conservation Training Center in 1998.

The refuge provided "suggested forfeitures of collateral" for various 50 CFR refuge violations to Special Agent Rick Giovengo. He in turn is working with the Assistant U.S. Attorney in Wilmington in an attempt to upgrade the fines in Magistrate Court. The current collateral schedule dates back to the early 1980's and is woefully inadequate compared to the States surrounding Delaware.

18. Cooperating Associations

The Friends of Bombay Hook Cooperating Association started a sales outlet in the Visitor Center in September of 1990. The sales outlet set a new one month sales record in October, 1997 grossing $4,056.33. A one day sales record was set on October 11, 1997 during our bake sale in conjunction with the Refuge Annual Field Day. Almost $500 was brought in that day through sales of baked goods and sales outlet merchandise. A five-day weekday record was set in November with sales of over $800. The 1997 Friends Outlet sales total was $21,781.36, also a new record total.

The Association was in a position to offer approximately $10,250 in financial assistance to the refuge program. They donated awards for volunteers; posters, mobiles, and patches for school and scout groups; and gifts to visiting dignitaries and volunteers from other refuges. They also paid for 4 volunteers to attend the State Volunteer Dinner. The largest amount of donated funding goes to printing brochures. This year the Friends group reprinted the following brochures: general refuge, bird list, auto tour route interpretive brochure, amphibian and reptile, nature calendar, and Prime Hook Boardwalk Trail brochure. Also funded was the printing of the new bird list booklet. Friends continue to add to or update the environmental education equipment used by groups of visitors. The Friends group also purchased the glass display case that houses the Bald Eagle Exhibit. Friends agreed to allocate money as their share of the following challenge grants which have now been approved: new format general brochure, a second order of the new formatted bird list booklet, drop ceiling for the auditorium, and 3 Mark II binocular scopes. The Friends of Bombay Hook have donated over $35,700 to environmental education and interpretation programs since 1990.

As part of the "Friends Adopt a Highway Program", two clean up days were held, one in April and one in October, with 14 helping over the 2 day period. The Association has been complimented by the State for having the required number of clean-up days yearly and for doing this consistently.

The Association has a quarterly newsletter for its members. Manager Daly contributes articles on wildlife management, ORP Pohlman on wildlife happenings, upcoming public events and field trips, President Bob Mayer writes the "President's Corner" on a variety of public use topics, Verna Price and Chris Smith gives a sales outlet update, and the Association officers submit articles as appropriate and needed. An experienced volunteer birder, Faith King, writes "Bird Notes".

Two field trips were offered to Association members this year, and both were attended by enthusiastic participants. One trip was to the Ward Decoy Museum at Salisbury, Maryland, and the other was a canoe trip at Eastern Neck NWR led by ORP Pohlman. There were three joint meetings of cooperating associations at Chincoteague, Blackwater and Eastern Neck, and our association was well represented at each meeting. Much of the day to day business of the association is handled by Recreation Aids Verna

Price and Tina Watson, and the rest is handled by ORP Pohlman and the refuge volunteers.

Overall, the Association has been very successful and has done a wonderful job of funding refuge environmental education projects and programs. Membership in Friends of Bombay Hook is approximately 250.

I. EQUIPMENT AND FACILITIES

1. New Construction

Two new moist soil units were constructed force account during 1997, primarily by Maintenance Worker Straughn and Assistant Manager Barker. The larger of the two (BMH-222) which created approximately 7.5 acres of wetland, is at Steamboat Landing; while the other (BMH-221) comprises 1 acre and is in field 403 north of the Gage house.

Refuge Manager Daly, Assistant Manager Barker and Maintenance Worker Straughn met with Delaware Division of Fish and Wildlife personnel (Greg Moore and Gene Gerardi) at the site of the planned moist soil unit at Steamboat Landing on June 23. Our State partners assisted us in construction of the 2,000 linear foot levee which controls the water levels in the approximately 7.5 acre unit. Construction began in July with the State providing the excavator and operator and the refuge providing the fuel and water control structures. The unit was completed on July 16. Assistant Manager Jason Barker and Maintenance Worker Arthur Straughn did the site survey work, conducted the fine grading and installed two Agri-Drain stop-board structures with 8" diameter pipes (one 20 foot, the other 28 foot length) in the northwest and northeast corners of the levee. This moist soil habitat was created in four days at a total cost to the Service of $1,658 (staff time and fuel for refuge and State equipment). If we had contracted for this construction total cost would have been about $4,100, thus resulting in a savings of $2,442.

Work on the new BMH-222 unit began with construction of the west levee.
7/97 Paul Daly

At the northwest corner of the unit one of the two water control structures was installed.
7/97 Paul Daly

Here the State operator with excavator is proceeding east with construction of the north levee.

7/97 Paul Daly

Finally the north levee connects up with the east side levee. The second water control structure can also be seen.

7/97 Paul Daly

This view, looking northeast, shows the new unit after sufficient winter rains.

12/97 Paul Daly

From a slightly different angle, looking directly north, the water control structure in the northwest corner of the levee can be seen.

12/97 Paul Daly

Bombay Hook Maintenance Worker Straughn constructed and installed an additional stand (platform) for wheelchair bound deer hunters on the Dutch Neck portion of the refuge. Materials were purchased with funds secured by the Delaware/Maryland Paralyzed Veterans Association (PVA) and the Service Challenge Grant program.

On Friday August 15 a ceremony was conducted to dedicate the wheelchair accessible deer stand built in late 1996 north of the Gage house. This stand was also made possible through a partnership between the PVA, Delaware Lumber and Millwork and the refuge. The PVA arranged for the donation of the lumber and other materials needed and refuge staff constructed the stand. Local news media (Smyrna Sun-Times) covered the event where remarks were made by Wayne Carter, who arranged for donation of the lumber, Ron Hoskins, President of PVA and Refuge Manager Paul Daly. A plaque was mounted on the platform describing the partnership that made it possible.

Wayne Carter, Manager Daly and Ron Hoskins are shown prior to placement of the plaque on the new deer stand.

8/97 Smyrna Sun-Times

Messrs. Carter and Hoskins installed the placque on the platform.
8/97 Paul Daly

The partnership has resulted in fine publicity for the refuge over the past several years.
8/97 Paul Daly

2. **Rehabilitation**

The refuge submitted the final programmatic and financial reports the week of July 28 to the National Fish and Wildlife Foundation covering their $25,000 grant to assist in replacement of the Shearness Pool water control structure. The final activity completing the project was the purchase of over 200 tons of gravel which was placed on the auto tour route in the structure vicinity; replacing that which was lost during the construction. A dedication ceremony was conducted on May 31 recognizing our partners at Ducks Unlimited and the National Fish and Wildlife Foundation for their contribution to replacement of the water control structure. Refuge tours were conducted by vehicle, followed by a ceremony at the structure site and then a boat trip on the refuge tidal marsh. Regional Director Lambertson presented plaques and certificates to Ducks Unlimited and the Foundation at the dedication ceremony, after which a sign was unveiled which relates the contributions ($25,000 from each organization) made by our partners to the project. WBOC-TV reporter Andrea Duckworth came to the refuge on June 2 to interview Manager Daly regarding the completion of the Shearness project and the contributions to it by Ducks Unlimited and the Foundation. Funds for the project from the DOI Natural Resource Damage Fund emanating out of the Coker Landfill Superfund Site were also discussed. The interview was broadcast on the June 3 evening news.

National Fish and Wildlife Foundation and Ducks Unlimited representatives were presented with placques and certificates by Regional Director Lambertson at the ceremony.

5/97 Marian Pohlman

Ceremony participants then boarded three refuge boats for a tour of the tidal marsh at the height of shorebird migration.

5/97 Marian Pohlman

As the group heads out on the boat tour past the tidal side of the new structure, note the extensive rip-rap protection which was placed as part of the project. The average daily 5-7' tidal amplitude here coupled with long tidal fetches in certain areas during winter caused by snow goose destruction of the marsh vegetation necessitates protection for the levee bank.

5/97 Marian Pohlman

Assistant Manager Barker and Maintenance Worker Straughn replaced the water control structure at B Pool. The old structure which controls water levels in the eight acre pool had been leaking due to muskrat burrowing and infiltration of shrub roots. The new agri-drain structure consists of a 40' long 18" diameter pipe with 6' high riser. Rip-rap was placed around the new structure and at the levee toe to minimize future problems.

Two views of the new B Pool structure; the first looking northwest.....
6/97 Paul Daly

.....and the second looking northeast.
6/97 Daly

The office/visitor center heating system was inoperable for virtually the entire month of December. We were able to get a proposal to do a major rehabilitation of the unit from Hiott Heating/Air Conditioning for NTE $20,000. A request was made of the Regional Office to approve an emergency purchase even though it was sole source, since we were unsuccessful in getting other contractors to come out and give a proposal to fix this very complicated system. The request was approved on December 23, and job completion extended into 1998.

3. Major Maintenance

Quite a bit of work was done to Quarters #1 during the year. In January Maintenance Worker Straughn tore up the bathroom floor after water damage from a defective toilet and replaced the sub-flooring. Then in February new floor coverings were purchased and installed in the kitchen and bathroom, the commode was replaced, two new ceiling fans were installed, a new kitchen range was purchased and major repairs were made to the furnace. A new tenant, Ed Christoffers of the Delaware Bay Estuary Project, moved into the residence in late May and painted the interior walls of the house.

All deer stands were inspected during August and repaired as necessary. Several stands were constructed and installed on the Regular Hunt Area as replacements. In addition, four additional stands were placed on and adjacent to the DiFebo Tract, which came under refuge management through our agreement with Delaware Division of Fish and Wildlife.

During September the 16' V-hull boat, motor and trailer received much work, including engine repair, a new bow platform to aid ingress/egress, a new trailer jack and new elevated trailer lights. The boat and motor were also painted.

4. Equipment Utilization and Replacement

In September a new Seecoast fixed spotting scope was received and installed at the Shearness Pool overlook.

A Sharp SF-2025 copier for the office was purchased in October.

The old office file cabinets were replaced this year.

A new John Deere 425 lawn/garden tractor with 54" mower deck was received during October.

A new John Deere 13'7" model 630 disc was received during May.

12/97 Paul Daly

6. Computer Systems

A new Hewlett Packard Deskjet 694C printer was received during July. This equipment will enable us to copy color photographs and provide a variety of other printing options.

In August two new Dell Dimension XPS 266 MHz computers were purchased.

7. Energy Conservation

The following table depicts non-vehicle energy use over the past five years:

Table I.7.1 Non-vehicle Energy Use

	Electricity		Fuel Oil		Propane	
Year	KHW	Cost	Gallons	Cost	Gallons	Cost
1993	70,934	$6238	649	$472	1013	$1067
1994	52,948	$4651	380	$242	1035	$1128
1995	86,725	$7659	402	$402	1408	$1380
*1996	113,030	$9512	-	-	2799	$2788
1997	76,387	$6459	250	$184	1480	$1912

*Calendar year 1996 saw the replacement of an oil furnace with a gas furnace in the maintenance shop.

J. OTHER ITEMS

1. Cooperative Programs

On April 22 Assistant Manager Jason Barker met with USDA animal damage control personnel Doug Hall (Georgia) and Leslie Terry (Maryland) as well as Dr. Lisa Muller (Delaware State University) and several members of DNREC Fish and Wildlife Section regarding various deer damage control methods and efficacy.

Biologist Smith once again assisted in the annual waterfowl surveys in Canada. He departed on May 7 and returned to Bombay Hook May 27. Poor weather delayed many of the surveys this year.

A Shorebird Management Workshop with 30+ attendees and a focus on Delaware Bay was held in the refuge auditorium May 21-24. The workshop was presented by the Delaware Coastal Management Program, The Western Hemisphere Shorebird Reserve Network and Manomet Bird Observatory. Topics included shorebird and horseshoe crab population status as well as management strategies and plans for the Kelly Island beneficial use of dredge spoil project and its potential effect on shorebirds, crabs and other wildlife resources. Two clear conclusions of the majority of workshop participants were that well managed impoundments were of tremendous benefit to shorebirds and that horseshoe crab populations were declining, probably as a result of recent over harvest. Emergency legislation is being sought to restrict this harvest.

Dr. Carl Schuster, nationally known expert on horseshoe crabs, gave an interesting talk on this ancient mariner following the workshop.

5/97 Marian Pohlman

Bombay Hook Assistant Manager Jason Barker met with Regional Ducks Unlimited Biologist Ed Temple and Memphis, TN office Waterfowl Biologists Scott Stephens and Mark Petrie on September 17. The group toured the complex looking at projects completed in the past with the assistance of DU funding. All participants were very impressed with the variety and amount of moist soil vegetation awaiting the fall arrival of birds. Funding for future projects was also discussed and it appears that the two agencies will continue to be able to work closely together.

3. Items of Interest

A get together was held on March 24 in the refuge auditorium honoring Office Assistant Barbara Clark and Maintenance Worker Arthur Straughn who were married on March 25. The couple departed the next day for a trip to Key West, and the rest of the refuge staff tried to survive without these two key employees while they were absent.

A proposal was submitted to CGS in the Regional Office to advertise and sell by high bid the remaining "tenant" house on the Steamboat Landing Tract. The high bid was $5,500 and the successful bidder was given 180 days from date of final payment to move the house off-site. He took almost all of that, but finally moved the house. Maintenance Worker Straughn then took the refuge dozer and cleaned up the site (foundation, old dog pens, etc.).

The Steamboat Landing tenant house was in too good a shape to simply demolish; so we sold it.

1/97 Paul Daly

After removal by the successful bidder, Maintenance Worker Straughn and the refuge dozer left only the old driveway as evidence. We were promised that the $5,500 could be returned to the refuge budget, but after numerous calls and written follow-ups to the RO and Denver Finance Center it appears that it will not happen.

12/97 Paul Daly

On April 21, Jim Clark of the National Conservation Training Center visited Bombay Hook Refuge and met with Refuge Manager Daly. They are planning field trip sessions of the Refuge Manager Academy for 1998 (April and May, 1998). Bombay Hook and in all likelihood Prime Hook Refuges will be stops on the field trip for the academy attendees. Important issues facing Bombay Hook and which could be presented to the class, such as Mosquito Control, greater snow goose superabundance, oil spill potential and hunt program/general visitation conflict were discussed. Manager Daly then met on September 11 and 12 with Greg Knadle to plan field trip scenarios for the 1998 Refuge Academy trainees. Mr. Knadle is on a 30 day detail to the National Conservation Training Center and is assisting with preparation for the 1998 Academy program. Six scenarios were selected based on difficult resource problems at Bombay Hook and Prime Hook Refuges. The academy field trip is scheduled for late April, 1998.

4. Credits

Paul Daly - Sections A, C, E (except 4), H.17, I and J
Frank Smith - Sections B, D, F, G and H.8-10
Marian Johnson-Pohlman - Sections E.4, H.1-7, H.11-16 and H.18

Photo credits are with each picture. Office Assistant Straughn and Office Automation Clerks Boscher and Staley proofread, typed and assembled the report.

U.S. Fish and Wildlife Service

Bombay Hook is one of over 500 refuges in the National Wildlife Refuge System administered by the U.S. Fish and Wildlife Service. The National Wildlife Refuge System is a network of lands and waters managed specifically for the protection of wildlife and wildlife habitat and represents the most comprehensive wildlife management program in the world. Units of the system stretch across the United States from northern Alaska to the Florida Keys and include small islands in the Caribbean and South Pacific. The character of the refuges is as diverse as the nation itself.

The Service also manages National Fish Hatcheries, and provides Federal leadership in habitat protection, fish and wildlife research, technical assistance and the conservation and protection of migratory birds, certain marine mammals and threatened and endangered species.

For further information, contact:

Refuge Manager
Bombay Hook National Wildlife Refuge
2591 Whitehall Neck Road
Smyrna, DE 19977

Office: (302) 653-9345
Visitor Center: (302) 653-6872

Hearing impaired visitors may call the Delaware Relay Center at 1-800-232-5460 TDD/1-800-232-5470 voice.

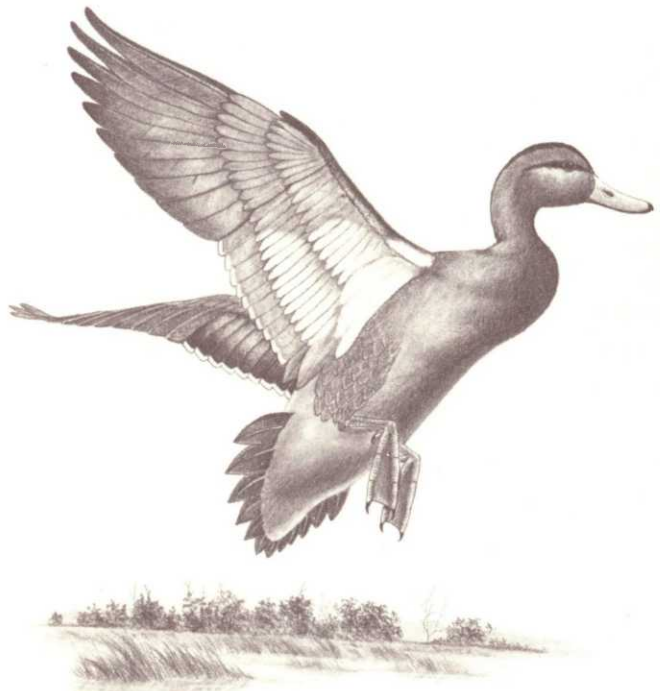
This brochure is also available upon request in a large print version.

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE

RL-51550 March 1997

Bombay Hook

NATIONAL WILDLIFE REFUGE



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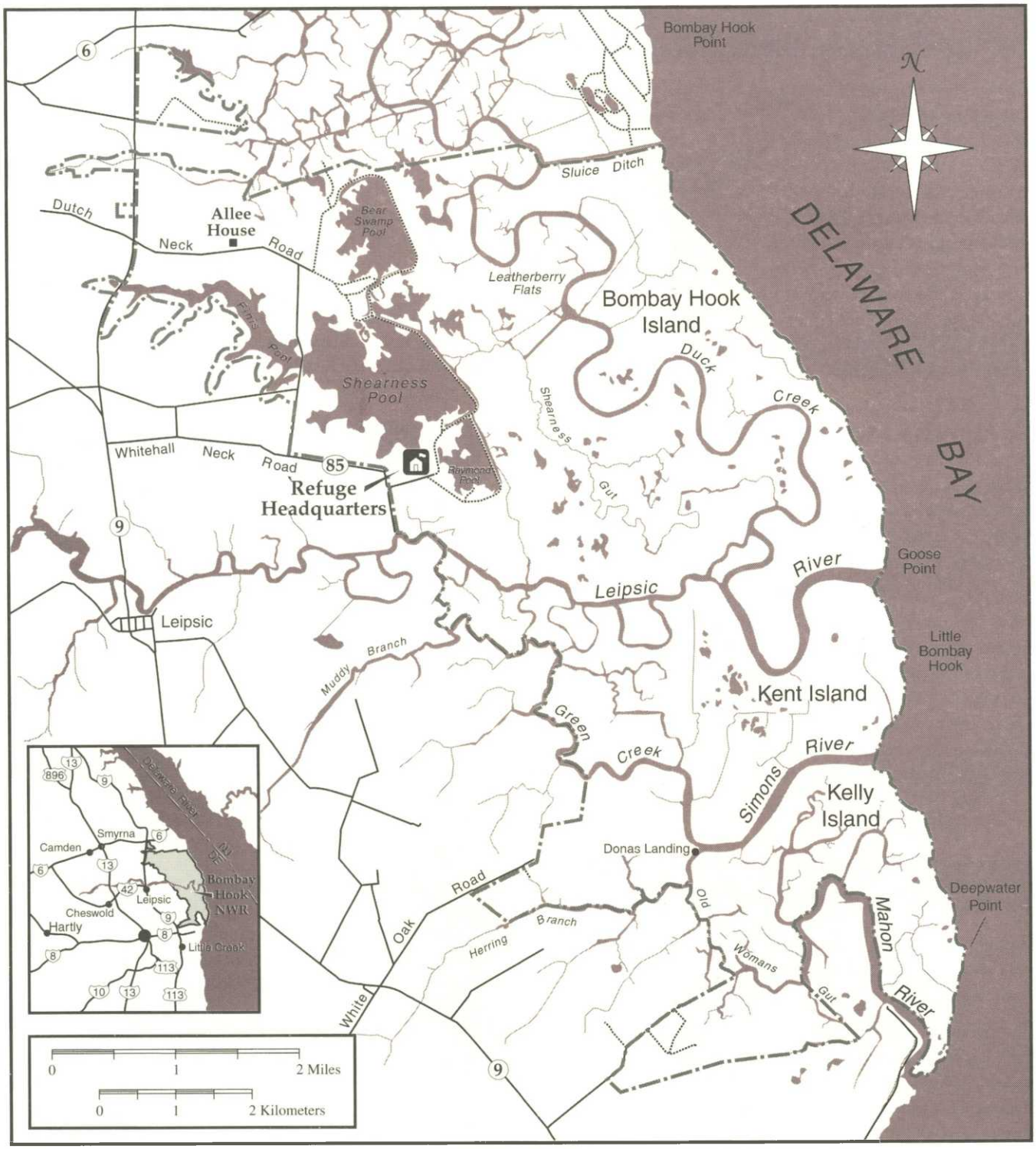
Smyrna, Delaware



11/93

Heading North on Route 13 from Dover, take Route 42 East to Route 9, Leipsic. Proceed North on Route 9 for 2 miles to Whitehall Neck Road, which ends at the refuge entrance. Heading South on Route 13 from Smyrna, take Route 12 East until it merges with Route 9 (5 miles), and take a left on Whitehall Neck Road after 1/4-mile.

© Julien Beauregard

Canada goose

Welcome

Bombay Hook National Wildlife Refuge comprises 15,978 acres, approximately three-quarters of which is tidal salt marsh. It also includes 1,100 acres of impounded fresh water pools, brushy and timbered swamps, 1,100 acres of agricultural lands, and timbered and grassy upland. The general terrain is flat and less than ten feet above sea level.

Bombay Hook was established in 1937 as a link in the chain of waterfowl refuges that extends from Canada to the Gulf of Mexico. It is primarily a refuge for migrating and wintering ducks and geese, but also offers haven for numerous other species of migratory birds. The value and importance of Bombay Hook for the protection and conservation of waterfowl has increased greatly in the past 25 years, primarily due to the loss of extensive surrounding marshland to urban and industrial development.

Entrance Fee Options

To help pay for the purchase of more wildlife habitat and for management of refuges, Congress passed the Emergency Wetlands Resources Act in 1986. The law authorized the Fish and Wildlife Service to charge entrance fees at national wildlife refuges such as Bombay Hook.

Visitors may pay the daily fee or purchase one of two annual passes — the Federal Duck Stamp and Golden Eagle Passport. Both are sold at the refuge. Anyone who is 62 years of age or older may purchase the lifetime Golden Age Pass for $10. Permanently disabled persons are eligible for a free pass. Both passes will admit you and your passengers or family. Children under 16 are admitted free. Educational and scientific groups may enter free with prior notice. Refuge staff will be happy to issue a pass and answer any questions.

History

The recorded history of the Bombay Hook area began in 1679 with the sale of marshland from Mechacksett, Chief of the Kahansink, to Peter Bayard of New York. Early Dutch settlers cut salt hay from the marsh, trapped muskrats, and hunted waterfowl. The tidal streams that interlace the marsh were plied for fish, crabs, and oysters.

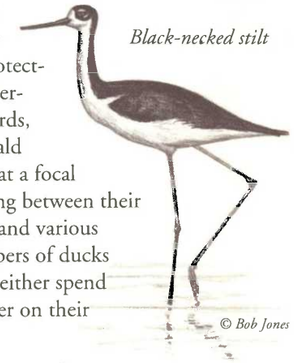
Following establishment of the refuge and through the early 1940s Civilian Conservation Corps members based at Leipsic constructed dikes and buildings on the refuge. With the onset of World War II, the Army Air Corps based at Dover used parts of the refuge for experimentation and training in air-to-ground rockets.

© Julien Beauregard

Snow Goose

Refuge Management and Objectives

The refuge management programs are primarily aimed at developing and protecting desirable habitat for waterfowl and other migratory birds, including the endangered bald eagle. The refuge is located at a focal point for waterfowl migrating between their northern breeding grounds and various wintering areas. Large numbers of ducks and geese arrive each fall to either spend the winter or merely stopover on their way southward.



Black-necked stilt

© Bob Jones

Water levels in refuge impoundments are manipulated to produce desirable emergent and underwater plants for waterfowl. While pools are drawn down, excellent populations of shore and wading birds use the mudflats. Upland agricultural crops are produced on approximately 1,100 acres to provide a supplemental food supply to waterfowl and other migratory birds.

Tidal salt marsh is the most valuable wildlife habitat in the State of Delaware. Large portions of the refuge have been maintained in a near pristine state. The marsh, with its intersecting tidal streams and rivers, provides excellent natural habitat for the birds and mammals of the area and also serves as a nursery and breeding area for marine organisms, many of which are of sporting and commercial interest.

Wildlife Calendar

Though wildlife can be seen year round at Bombay Hook, fall and spring offer the best opportunity for observing peak concentrations of migratory birds.

The period from October 1 through November 30 is generally the most interesting to the refuge visitor as this is the season during which waterfowl populations are at their peak. Over 100,000 ducks and geese utilize the refuge at this time.

Spring is another preferred season for the visiting public. March is the second peak for waterfowl as they travel through on their return to northern breeding grounds. April brings early shorebird migrants and the emergence of reptiles and amphibians from winter hibernation. Shorebirds are at their highest concentrations during May and June, primarily due to the arrival of horseshoe crabs laying eggs along the bay shore and mud flats. These eggs provide the shorebirds with needed energy to complete their northward migration. Wading birds such as herons, egrets, and glossy ibis, reach their peak numbers during the summer months. Mammals can be seen year round, particularly in the early morning and evening hours. These include white-tail deer, beaver, muskrat, red fox, river otter, woodchuck and opossum.

Public Use

The public is welcome to visit the refuge for wildlife observation, nature study, and photography year round during daylight hours.

Visitor facilities include a visitor center, auto tour route, observation towers, and nature trails. Bear Swamp Trail and the Visitor Center are handicapped accessible. A cassette tape interpreting the auto tour is available.

The Visitor Center is normally open Monday – Friday from 8:00 a.m. to 4:00 p.m., and on weekends from 9:00 a.m. to 5:00 p.m. It is closed on summer and winter weekends. Tours, habitat studies, nature walks, and audiovisual programs are available to groups upon advance request. Volunteer, teacher, and leader workshops are offered in the spring and fall.

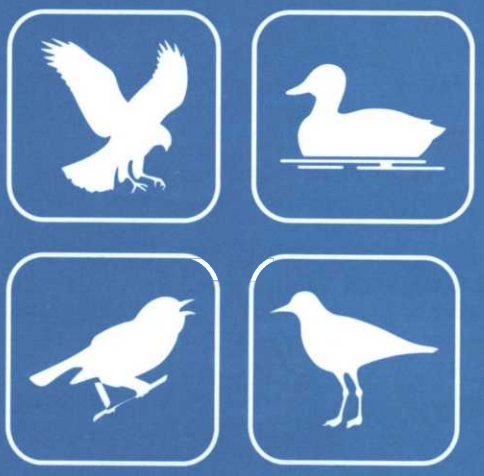
A 12-mile round-trip auto tour route and several nature trails (ranging from 1/4 to 1 mile in length) provide opportunities to observe and photograph wildlife. A photography blind is available by advance request. Three of the trails also have 30-foot observation towers.

Public hunting, primarily for waterfowl and deer, is permitted under special regulations on portions of the refuge during the Delaware state season.

U.S. Fish & Wildlife Service

Birds

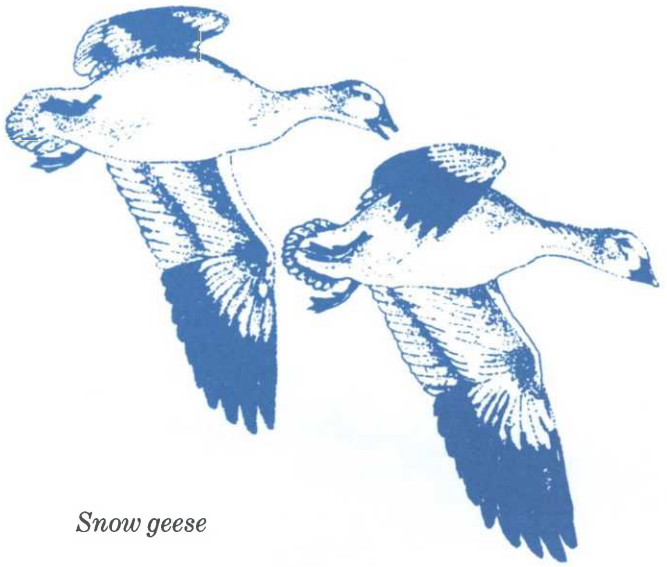
Bombay Hook National Wildlife Refuge



Introduction

Bombay Hook National Wildlife Refuge lies low and flat on the Atlantic Coastal Plain along the western shore of Delaware Bay. Nearly two-thirds of its almost 16,000 acres spreads out into tidal salt marsh and cordgrass meadows interrupted by winding rivers and creeks. Away from the bay and marsh are man-made freshwater ponds called impoundments. Upland woods, swamps, brushy thickets, grassy fields, and croplands complete the diversity of habitat which attracts a wide variety of bird life.

Look for greatest numbers of waterfowl during March and November. Shorebirds, wading birds and songbirds are most abundant during May, August and September.



Snow geese

This brochure lists 267 species that have been identified on or seen from the refuge, and is in accordance with the sixth American Ornithologists Union Checklist. A list of approximately 70 accidental birds (seen at intervals of 5 or more years) is available on request.

Most birds are migratory, therefore, their seasonal occurrence is coded as follows:

Season

s	spring	March – May
S	summer	June – August
F	fall	September – November
W	winter	December – February

• Birds known to nest on or near the refuge
Italics indicate threatened/endangered species

Relative Abundance

Relative abundance indicates how frequently you might see a bird in its favored habitat.

a	abundant	a species which is very numerous
c	common	likely to be seen or heard in suitable habitat
u	uncommon	present, but not certain to be seen
o	occasional	seen only a few times during a season
r	rare	may be present but not every year

Habitat Types

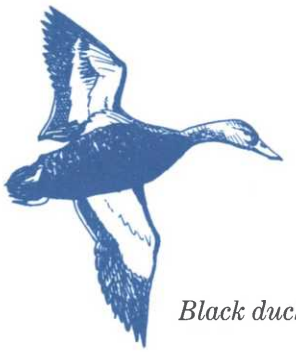
F Forest, woodlands, thickets
W Wetlands (includes all bodies of water and fresh and salt water marshes)
M Meadows, fields

Black-necked stilt

		s	S	F	W	H
LOONS – GREBES						
___	Red-throated Loon			r	r	W
___	Common Loon		r			W
___ •	Pied-billed Grebe	o	o	u	o	W
___	Horned Grebe	o	u	o	u	W
___	Eared Grebe				r	W
PELICAN – CORMORANT						
___	American White Pelican		r		r	W
___	Double-crested Cormorant	u	u	c	u	W

BITTERNS – HERONS – IBISES

		s	S	F	W	H
___	• American Bittern	o	u	u	o	W
___	• Least Bittern	o	u	o		W
___	Great Blue Heron	c	c	a	c	W
___	Great Egret	u	a	c	o	W/M
___	Snowy Egret	o	a	c	r	W/M
___	Little Blue Heron	o	c	c		W
___	Tricolored Heron	o	u	o	r	W
___	Cattle Egret	o	u	o		W/M
___	• Green-backed Heron	c	c	c	r	W
___	Black-crowned Night-Heron	c	c	c	u	W
___	Yellow-crowned Night-Heron	o	o	o	o	W
___	Glossy Ibis	c	c	u		W/M



Black duck

SWANS – GEESE – DUCKS

___	Fulvous Whistling-Duck	r	r	r		W
___	Tundra Swan	o	r	c	u	W/M
___	Mute Swan	r	r	r	o	W/M
___	Greater White-fronted Goose	r		r	r	W/M
___	Snow Goose	c	r	a	a	W/M
___	Ross' Goose	r		r	r	W/M
___	• Canada Goose	a	c	a	a	W/M
___	• Wood Duck	c	c	a	o	W/F
___	Green-winged Teal	a	o	a	c	W/M
___	• American Black Duck	c	c	c	c	W
___	• Mallard	a	c	a	a	W/M
___	Northern Pintail	a	o	a	a	W
___	• Blue-winged Teal	c	u	a	r	W/M
___	• Northern Shoveler	c	o	a	u	W
___	• Gadwall	c	a	a	u	W
___	Eurasian Wigeon	r	r	r	o	W
___	American Wigeon	c	o	a	c	W/M
___	Canvasback			o	o	W
___	Redhead	o		o	o	W
___	Ring-necked Duck	o		u	o	W
___	Greater Scaup	u	o	u	u	W
___	Lesser Scaup	u		u	u	W
___	Oldsquaw		r	u	o	W
___	Black Scoter	o	r	o	o	W
___	Surf Scoter	o		o	o	W
___	White-winged Scoter	o		o	o	W
___	Common Goldeneye	u	r	u	u	W
___	Bufflehead	c	r	c	c	W
___	Hooded Merganser	u	o	u	c	W
___	Common Merganser	u	r	c	c	W
___	Red-breasted Merganser	u	r	u	u	W
___	Ruddy Duck	c	o	c	c	W

VULTURES – HAWKS – FALCONS

___	• Black Vulture	o	o	o	o	F/M/W
___	• Turkey Vulture	c	c	c	c	F/M/W
___	• Osprey	o	o	o		W/F
___	• *Bald Eagle*	*u*	*u*	*u*	*u*	*W/F/M*
___	• Northern Harrier	c	o	c	c	W/M
___	Sharp-shinned Hawk	o	o	o	o	F/M
___	Cooper's Hawk	o	r	o	o	F/M
___	• Red-shouldered Hawk	o	o	o	o	F/M
___	Broad-winged Hawk	r	r	r		F/M
___	• Red-tailed Hawk	u	o	c	c	F/M/W
___	Rough-legged Hawk	o		o	c	F/W/M
___	Golden Eagle			r	r	F/M/W
___	• American Kestrel	u	u	c	c	M/F
___	Merlin	r		o	r	W/F
___	*Peregrine Falcon*	*r*		*u*	*r*	*W/F*

PHEASANT – QUAIL – TURKEY

___	• Ring-necked Pheasant	c	c	c	c	M/F
___	• Wild Turkey	c	c	c	c	M/F
___	• Northern Bobwhite	c	c	c	c	M/F

RAILS – CRANES

___	Black Rail	r	r	r		W
___	• Clapper Rail	c	c	c	o	W
___	• King Rail	c	c	c	o	W
___	• Virginia Rail	u	u	u	o	W
___	Sora	u	o	u		W
___	• Common Moorhen	o	u	o	r	W
___	• American Coot	u	u	u	u	W

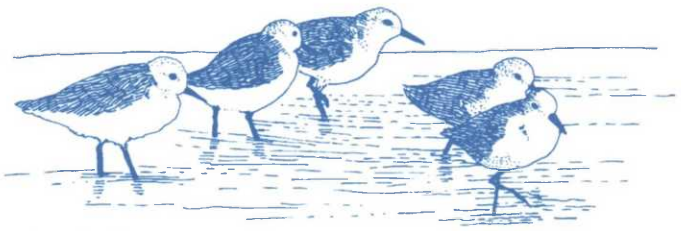
PLOVERS – SANDPIPERS

___	Black-bellied Plover	c	u	c	o	W/M
___	Lesser Golden-Plover	o	r	o		M/W
___	Semipalmated Plover	c	u	c	r	W/M
___	• Killdeer	c	c	c	u	M/W
___	American Oystercatcher	r				W

		s	S	F	W	H
___	• Black-necked Stilt	u	c	o		W
___	American Avocet	u	c	u	r	W
___	Greater Yellowlegs	c	c	a	o	W/M
___	Lesser Yellowlegs	c	c	c	o	W/M
___	Solitary Sandpiper	o	o	o		W/M
___	• Willet	a	a	o	r	W
___	Spotted Sandpiper	u	o	u		W
___	Upland Sandpiper	r		r		M
___	Whimbrel	r	r	r		M/W
___	Hudsonian Godwit	r	o	o		W
___	Marbled Godwit		r	r		W
___	Ruddy Turnstone	a	o	u		W
___	Red Knot	a	o	o		W
___	Sanderling	c	o	c		W
___	Semipalmated Sandpiper	a	c	a		W/M
___	Western Sandpiper	o	o	c	r	W/M
___	Least Sandpiper	c	c	c	r	W/M
___	White-rumped Sandpiper	u	o	u		W/M
___	Baird's Sandpiper	r	r	r		W/M
___	Pectoral Sandpiper	o	c	c	r	W/M
___	Dunlin	a	o	a	c	W
___	Curlew Sandpiper	r	r	r		W
___	Stilt Sandpiper	u	c	u		W
___	Buff-breasted Sandpiper		r	r		M/W
___	Ruff	r	o	o		W/M
___	Short-billed Dowitcher	c	c	a	r	W/M
___	Long-billed Dowitcher		o	o		W/M
___	Common Snipe	c	o	c	u	W/M
___	• American Woodcock	c	u	c	r	W/F
___	Wilson's Phalarope	o	u	o		W
___	Red-necked Phalarope	o		r		W

GULLS – TERNS

___	Laughing Gull	c	c	c		W/M
___	Bonaparte's Gull	o	o	o		W
___	Ring-billed Gull	c	u	a	c	W/M
___	Herring Gull	c	c	a	c	W/M
___	Great Black-backed Gull	c	c	c	c	W/M
___	Gull-billed Tern	o	o			W
___	Caspian Tern	o	u	u		W
___	Royal Tern		o	r		W
___	Common Tern	o	o	o		W
___	• Forster's Tern	o	c	c		W
___	*Least Tern*	*o*	*c*			*W*
___	Black Tern	r	o	o		W
___	Black Skimmer	o	u	o		W



Sanderlings

DOVES – CUCKOOS – OWLS – HUMMINGBIRDS

___	• Rock Dove	o	o	o	o	M
___	• Mourning Dove	c	c	a	c	M/F
___	• Black-billed Cuckoo	o	o	o		F
___	• Yellow-billed Cuckoo	c	c	c		F
___	• Barn Owl	u	u	u	u	F
___	• Eastern Screech-Owl	u	u	u	u	F
___	• Great Horned Owl	c	c	c	c	F
___	• Barred Owl	c	c	c	c	F
___	Long-eared Owl			r	r	F
___	Short-eared Owl	o		o	o	M/W
___	Northern Saw-whet Owl	r		r	r	F
___	Common Nighthawk	o	o	o		F
___	Whip-poor-will	o	o			F
___	Chimney Swift	c	c	c		M
___	• Ruby-throated Hummingbird	c	c	c		F
___	• Belted Kingfisher	c	u	c	c	W

WOODPECKERS – FLYCATCHERS

___	Red-headed Woodpecker	r		r	r	F
___	• Red-bellied Woodpecker	c	c	c	c	F
___	Yellow-bellied Sapsucker	o		o	o	F
___	• Downy Woodpecker	c	c	c	c	F
___	• Hairy Woodpecker	u	u	u	u	F
___	• Northern Flicker	c	c	c	o	F
___	• Eastern Wood-Pewee	c	a	c		F
___	• Acadian Flycatcher	u	c	o		F
___	Alder Flycatcher	r		r		F
___	• Willow Flycatcher	o	c	o		F
___	Least Flycatcher	o		o		F
___	• Eastern Phoebe	c	u	c	r	F
___	• Great Crested Flycatcher	c	c	c		F
___	• Eastern Kingbird	c	a	c		F/M

LARKS – SWALLOWS – JAYS – CROWS

___	• Horned Lark	u	o	u	u	M
___	• Purple Martin	c	c	o		M/W
___	• Tree Swallow	c	a	a	r	M/W
___	Northern Rough-winged Swallow	u	o	u		M/W
___	Bank Swallow	o	c	c		M/W

		s	S	F	W	H
___	• Barn Swallow	c	c	c	r	M/W
___	• Blue Jay	c	c	c	c	F
___	• American Crow	c	c	c	c	F
___	• Fish Crow	c	c	c	o	F/W

TITMICE – NUTHATCHES – WRENS

___	Black-capped Chickadee			r	r	F
___	• Carolina Chickadee	c	c	c	c	F
___	• Tufted Titmouse	c	c	c	c	F
___	Red-breasted Nuthatch	o		u	u	F
___	White-breasted Nuthatch	u	o	u	u	F
___	Brown Creeper	c		c	c	F
___	• Carolina Wren	c	c	c	c	F
___	• House Wren	c	c	c	r	F
___	Winter Wren	u		c	c	F
___	• Sedge Wren	o	o	o	r	W
___	• Marsh Wren	c	c	c	o	W

KINGLETS – THRUSHES – THRASHERS

___	Golden-crowned Kinglet	o		c	c	F
___	Ruby-crowned Kinglet	c		c	o	F
___	• Blue-gray Gnatcatcher	c	u	o	r	F
___	• Eastern Bluebird	u	u	u	u	F/M
___	Veery	c	o	c		F
___	Gray-cheeked Thrush	o		o		F
___	Swainson's Thrush	u		u		F
___	Hermit Thrush	c		c	o	F
___	• Wood Thrush	c	c	c		F
___	• American Robin	c	c	c	o	F/M
___	• Gray Catbird	c	c	c	c	F
___	• Northern Mockingbird	c	c	c	c	F/M
___	• Brown Thrasher	c	c	c	o	F

WAXWINGS – SHRIKES – STARLINGS

___	American Pipit	u		u	o	M/W
___	• Cedar Waxwing	o	r	o	o	F
___	Loggerhead Shrike	r		r	r	F
___	• European Starling	a	a	a	a	F/M/W

VIREOS – WOOD WARBLERS

___	• White-eyed Vireo	c	c	c		F
___	Solitary Vireo	o		o		F
___	• Yellow-throated Vireo	o	o	o		F
___	• Red-eyed Vireo	a	a	a		F
___	Blue-winged Warbler	o		o		F
___	Golden-winged Warbler	o		o		F
___	Tennessee Warbler	o		o		F
___	Nashville Warbler	o		o		F
___	Northern Parula	c	o	c		F
___	• Yellow Warbler	c	c	c		F
___	Chestnut-sided Warbler	c	o	c		F
___	Magnolia Warbler	c		c		F
___	Cape May Warbler	o		o		F
___	Black-throated Blue Warbler	c		c		F
___	Yellow-rumped Warbler	a		a	c	F
___	Black-throated Green Warbler	c		c		F
___	Blackburnian Warbler	o	o	o		F
___	Pine Warbler	c	o	o		F
___	Prairie Warbler	c	o	o		F
___	Palm Warbler	c		c	r	F
___	Bay-breasted Warbler	o		o		F
___	Blackpoll Warbler	c		c		F
___	Cerulean Warbler	r				F
___	Black-and-white Warbler	c	o	c		F
___	• American Redstart	c	o	c		F
___	• Prothonotary Warbler	u	o	o		F/W
___	Worm-eating Warbler	o		r		F
___	Ovenbird	c	u	c		F
___	Northern Waterthrush	c	o	c		F/W
___	• Louisiana Waterthrush	o	o	o		F/W
___	• Kentucky Warbler	u	u	o		F
___	• Common Yellowthroat	c	a	c	r	F/W
___	Hooded Warbler	r	r	r		F
___	Wilson's Warbler	o		o		F
___	Canada Warbler	c	o	o		F
___	• Yellow-breasted Chat	u	u	u	r	F

Black-and-white warbler

TANAGERS – SPARROWS

___	• Scarlet Tanager	c	c	c		F
___	• Northern Cardinal	c	c	c	c	F
___	Rose-breasted Grosbeak	o	u	o		F
___	• Blue Grosbeak	c	c	u		F
___	• Indigo Bunting	c	c	u		F/M
___	• Rufous-sided Towhee	c	c	c	o	F
___	• American Tree Sparrow	o		u	u	F

		s	S	F	W	H
___	• Chipping Sparrow	u	u	u	r	F/M
___	• Field Sparrow	c	c	c	c	F/M
___	Savannah Sparrow	c	r	c	c	F/W
___	• Grasshopper Sparrow	o	u	o		M
___	• Sharp-tailed Sparrow	a	a	a	o	W
___	• Seaside Sparrow	a	a	a	o	W
___	Fox Sparrow	o		u	u	F
___	• Song Sparrow	c	c	c	c	F
___	• Swamp Sparrow	c	c	c	c	M/W
___	White-throated Sparrow	a		a	a	F
___	White-crowned Sparrow	o		o	o	F
___	Dark-eyed Junco	c		c	c	F
___	Lapland Longspur				o	M
___	Snow Bunting			o	u	M

BLACKBIRDS – FINCHES

___	Bobolink		u	c		M
___	• Red-winged Blackbird	a	a	a	a	F/M/W
___	• Eastern Meadowlark	u	u	u	u	M
___	Rusty Blackbird	c		c	u	F/W
___	Boat-tailed Grackle	o	o	u	u	W/M
___	• Common Grackle	a	c	a	c	F/M
___	• Brown-headed Cowbird	c	c	c	c	F/M
___	• Orchard Oriole	c	u	o		F
___	• Northern Oriole	u	u	o		F
___	Purple Finch	o		r	r	F
___	• House Finch	o		u	u	F
___	Common Redpoll			r	r	F
___	Pine Siskin	r		r	r	F
___	• American Goldfinch	u	c	c	u	F
___	Evening Grosbeak	r		r	r	F
___	• House Sparrow	u	u	u	u	F

American goldfinch

NOTES

Location _____

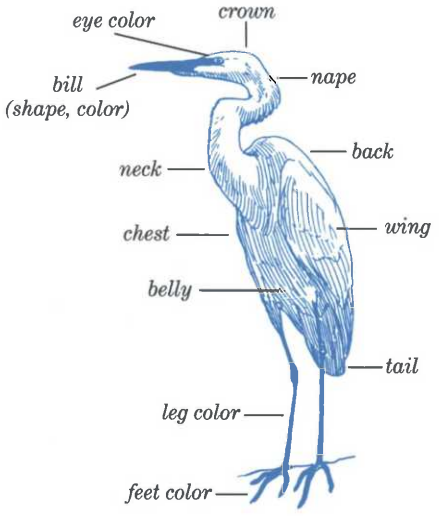
Date _____ Time _____

Observers _____

Weather _____

TIPS FOR FIELD I.D.

The identification of birds is greatly aided by simply noting a few key field marks. The diagram below illustrates several of these. In addition, general size, color, habitat, song and behavior help narrow down the options. Remember, use more than one field mark, as many species are similar and can only be distinguished by using a combination of several marks.

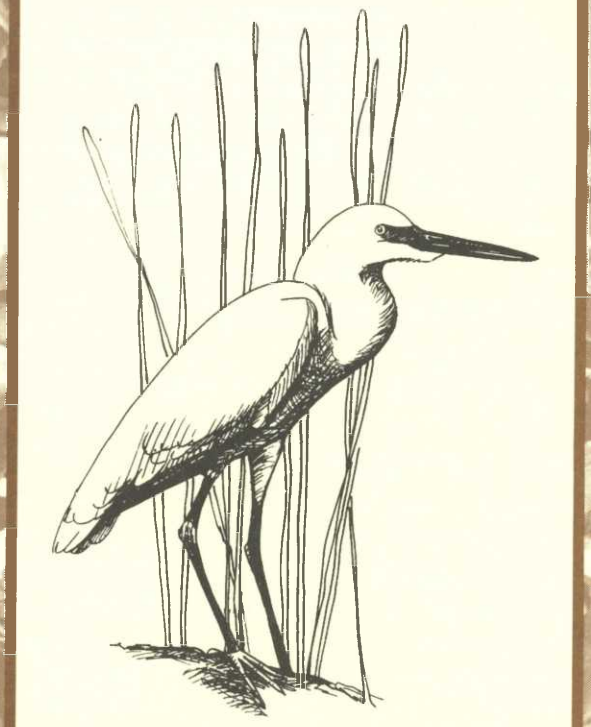


Bombay Hook National Wildlife Refuge
2591 Whitehall Neck Road
Smyrna, DE 19977
Telephone: 302/653 9345
1 800/232 5460 TDD/1 800/232 5470 voice.

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

September 1997

Auto Tour



U. S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

BOMBAY HOOK
National Wildlife Refuge
Smyrna, Delaware

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

History

1 Recorded history of the area began in 1679 when the Indian Machacksett, Chief Sachem of Kahansink, sold some marshland called "Boompies Hoock" 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.

Bombay Hook Refuge, comprising 15,978 acres, was established March 16, 1937. Soon afterward, Civilian Conservation Corps members began constructing pools for wildlife habitat as well as buildings to administer the area.

Waterfowl habitat management is very active here, and is done in conjunction with the North American Waterfowl Plan's Atlantic Coast Joint Venture. The North American Plan is an agreement by several federal agencies, states, Canada, and the private sector to conserve, restore and enhance wetlands habitat.

Cooperative Farming

2 A major refuge wildlife objective is to support migrating geese and ducks. Much food for these birds is supplied by the aquatic environment. However, crops are planted on about 1,000 acres of the refuge to provide additional food. Corn and soybeans are the primary crops harvested by refuge farmers for market, while other crops (winter wheat, buckwheat, grass/clover pasture) are left for wildlife. Farmers supply some corn for the refuge to use in conjunction with waterfowl banding.

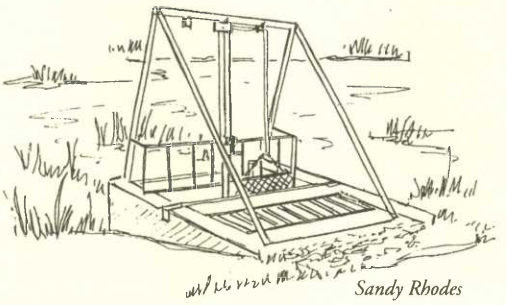
The gray-green tower on your left is a lookout used during goose banding. To capture geese, corn is spread on the field in front of a carefully-spread net. Several cannons with black powder charges are attached to the net. When enough birds have been attracted by the corn, the cannons are fired. This hurls the net over the geese without harming them. All birds are released after numbered bands have been placed on their legs.

Wheat *Sandy Rhodes*

Freshwater Impoundments

3 The ability to manipulate water levels in these pools is the key to creating necessary habitats. Pool levels are maintained by the use of water control structures with stoplogs. In the spring, excess water in the pool is released to the salt marsh to create mudflats which provide a food source for wading birds and shorebirds.

During the summer, emergent plants like wild millet, three-square bulrush, cattail, pond weed, wigeon grass, and wild rice thrive and produce seed in the shallow waters and exposed pool margins. Low pool levels that favor the growth of waterfowl foods also favor invertebrate species that are a food source for shorebirds.



Sandy Rhodes

Water control structure

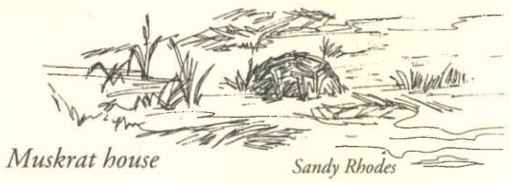
Fall rains permit pool water levels to flood the seed-bearing plants. This flooding provides suitable conditions for waterfowl to feed on the plants, maximizing the food supply.

Tidal Saltmarsh

Tidal saltmarsh supplies organic materials for the food chain, circulates nutrients, provides nesting habitat for waterfowl and serves as a nursery area for fish.

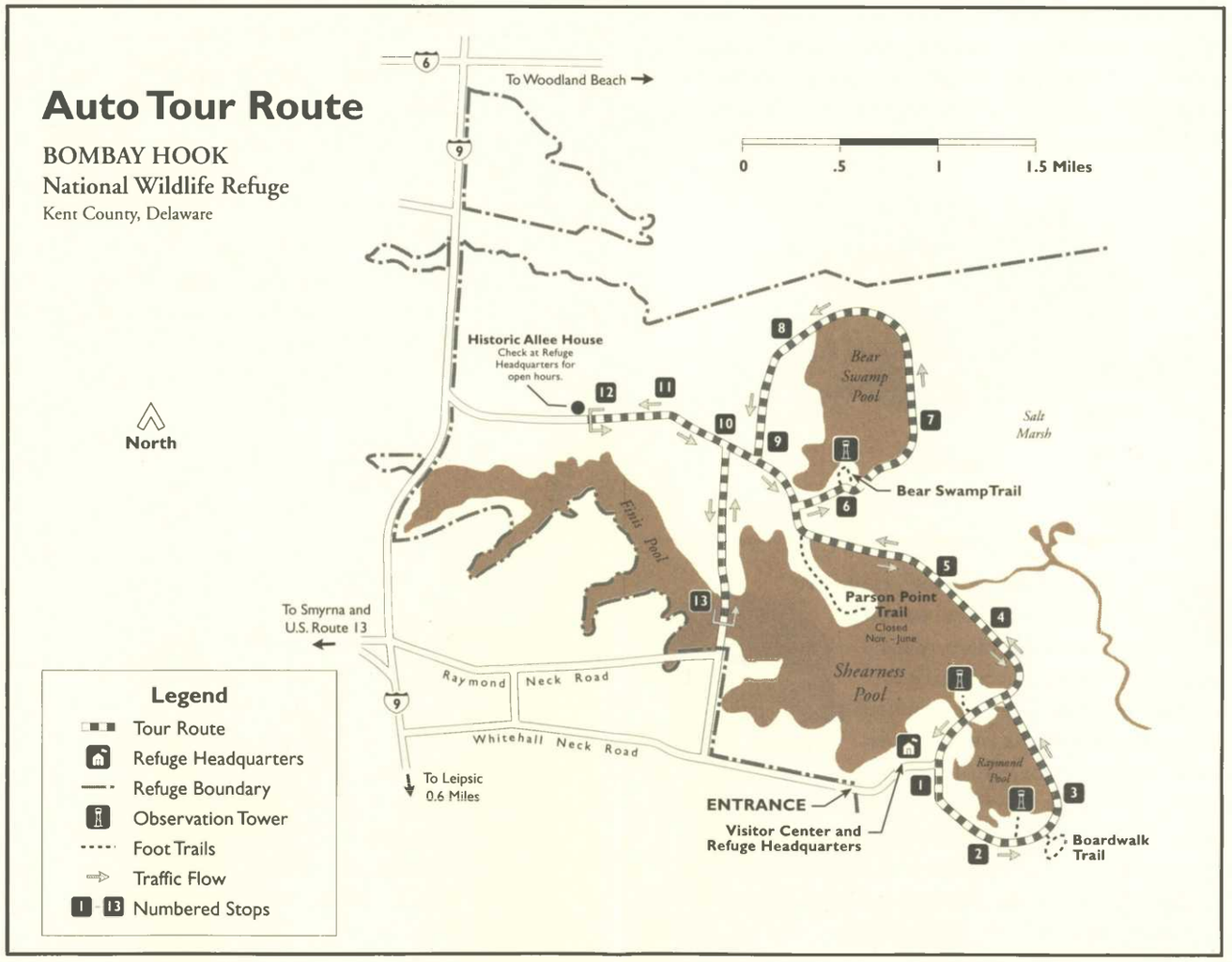
A variety of waterfowl nest in the marsh, including black ducks, mallards, gadwalls, and blue-winged teal.

Bombay Hook Refuge hosts up to 85,000 migrating greater snow geese every year. Large numbers of geese can "eat out" salt marsh vegetation when they feed on the roots of wetland plants. To lessen this damage, managed snow goose hunts are used on the refuge to disperse the flocks.



Muskrat house — *Sandy Rhodes*

The mud and reed mounds scattered across the tidal salt marsh are muskrat houses. Because a large population of muskrats can damage marsh vegetation, trapping by permit is used to control muskrat numbers.



Shearness Pool

Shearness Pool, on your left, is the largest of the four freshwater impoundments. It is the most likely area on the refuge to see southern bald eagles, which may be perched in trees, or feeding on fish, crippled ducks, or geese. Bald eagles nest on the refuge.

The trap beyond the Shearness Pool parking lot is used to capture ducks for banding. The trap, which is baited with corn, allows ducks to enter, but does not allow them to escape.

Wildlife Food Plot

To your left is a wildlife food plot, planted with bicolor lespedeza. Other food plots on the refuge may consist of buckwheat, millet, or autumn olive. These food plots attract a variety of wildlife, and supplement natural food sources. Food plots also provide habitat for ground-nesting birds and breeding areas for small mammals.

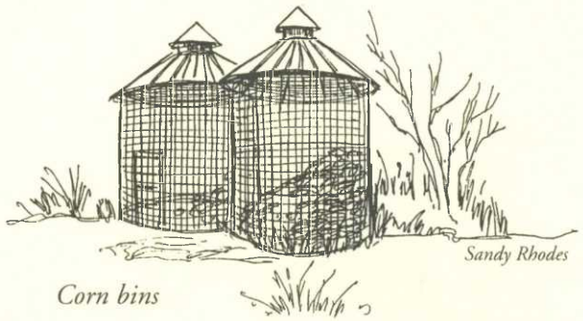
Buckwheat — *Sandy Rhodes*

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

Loafing Area

The islands to your left in the Bear Swamp Pool are loafing (or resting) areas for wading birds. Throughout the summer, these islands are used by snowy egrets, great egrets, great blue herons, and black-

crowned night herons. During the fall hunting season, you may see grass-covered water blinds, used by Young Waterfowlers. Under this program, youths aged 12 to 18 are taught hunting safety, ethics, regulations, and waterfowl identification before participating in a refuge hunt.


Sandy Rhodes

Corn bins

Corn Bin

8 The bin to your left can store corn used during waterfowl banding. When banding takes place, the age and sex of captured birds are recorded and matched with the numbers on the band. Information on the birds is sent to the Migratory Bird Banding Laboratory in Laurel, Maryland. If you recover a banded bird, the band, along with information about where the bird was found, should be sent to the Bird Banding Laboratory. Through bird band returns, much valuable information is gained about waterfowl populations and migration patterns.

Sandy Rhodes

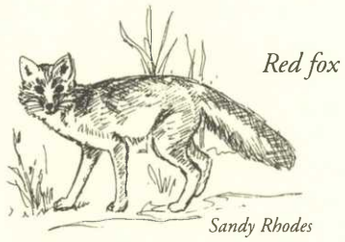
Old Field

9 On a regular basis fields are rotated from agricultural production and planted to a grass/lespedeza mixture. Areas like this throughout the upland portions of the refuge provide ideal nesting or breeding cover for a wide variety of birds and mammals, including ducks, quail, rabbits, pheasants and white-tailed deer. The old fields are mowed and/or burned every two or three years to prevent the growth of woody vegetation.

Woodland

10 Beyond the water to your left is a 410-acre woodland. It is managed to provide habitat for many species of plants and animals. Sweet gum, white oak and black tupelo are the larger trees in these woods. American holly, jack-in-the-pulpit and blood root also grow here.

Animal species that use these woods for food and cover include white-tailed deer, opossums, skunks, raccoons and foxes. Each spring the woodland is alive with the sound of warblers.


Red fox

Sandy Rhodes

Moist Soil Management

11 The small land depression to the left is one of a series of units being created throughout the refuge to provide wetland habitat diversity. The small levee in the ditch to your right accommodates a water control structure which allows us to hold up to several inches of water. Varying water levels throughout the growing season in turn encourage desirable wetland plants to grow. Many species of birds, mammals, reptiles, and amphibians utilize moist soil management areas.

Allee House

This small country-style dwelling of the Queen Anne period preserves a bit of history on the refuge. Built about 1753, it is on the National Register of Historic Places. Check at refuge headquarters for open hours.


Sandy Rhodes


Beaver

Sandy Rhodes

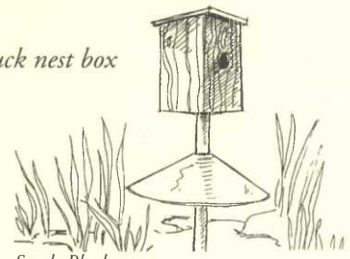
During the fall, you may notice goose blinds and elevated deer stands (platforms) in fields and woodlands along the road near the Allee House. On specified days, this area is open to waterfowl and deer hunting on a permit basis.

Finis Pool

12 Finis Pool contains the freshest water of any impoundment on the refuge. Beyond the pool is Finis Branch, the primary fresh water source for all impoundments. Beavers are occasionally trapped and relocated from here to reduce the potential for beaver dams to clog the water control structures and flood the road.

Wood ducks, which need cavities for nesting, use the wooden boxes you see here. The cone skirts prevent raccoons and snakes from getting into the nest and destroying the eggs or ducklings.

Wood duck nest box


Sandy Rhodes

The refuge staff hopes you enjoyed your tour. Please let us know about your wildlife encounters. To do this, either stop at the visitor center or record your sightings on the observation list kept in the brochure rack near the restrooms.

U.S. Fish and Wildlife Service

Bombay Hook is one of over 500 refuges in the National Wildlife Refuge System administered by the U.S. Fish and Wildlife Service. The National Wildlife Refuge System is a network of lands and waters managed specifically for the protection of wildlife and wildlife habitat and represents the most comprehensive wildlife management program in the world. Units of the system stretch across the United States from northern Alaska to the Florida Keys and include small islands in the Caribbean and South Pacific. The character of the refuges is as diverse as the nation itself.

The Service also manages National Fish Hatcheries, and provides Federal leadership in habitat protection, technical assistance, and the conservation and protection of migratory birds, certain marine mammals and threatened and endangered species.

For further information please contact:

Refuge Manager
Bombay Hook National Wildlife Refuge
2591 Whitehall Neck Road
Smyrna, DE 19977-9764

Office: (302) 653-9345
Visitor Center: (302) 653-6872

Hearing impaired visitors may call the Delaware Relay Center at 1-800-232-5460 TDD/1-800-232-5470 voice.

Illustrations except cover by Sandy Rhodes, courtesy of Delaware State College, Department of Agriculture and Natural Resources

UNITED STATES
DEPARTMENT OF THE INTERIOR
U.S. Fish and Wildlife Service

September 1996

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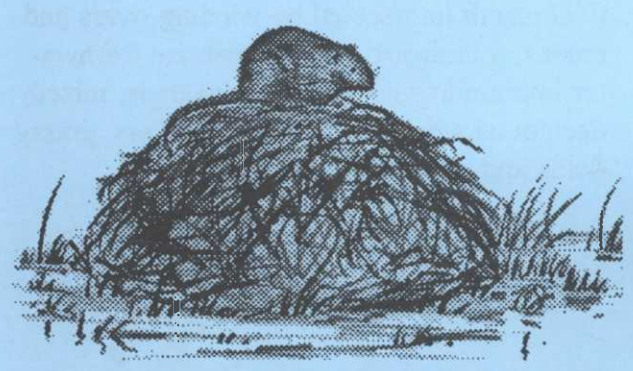
MAMMALS OF BOMBAY HOOK



NATIONAL WILDLIFE REFUGE

SMYRNA DELAWARE

--- **Woodchuck** (Marmota monax). Abundant. Lives in deep burrows excavated in fields, woods, and along dikes

--- **Eastern Chipmunk** (Tamias striatus). Lives among logs and stumps in the hardwood areas.

--- **Eastern Gray Squirrel** (Sciurus carolinensis). Inhabits the oak-hickory woodlands.

--- **Southern Flying Squirrel** (Glaucomys volans). Inhabits hollow trees to emerge only after darkness fills the wetlands.

--- **Beaver** (Castor canadensis) Discovered during the fall of 1977, after an approximate twenty year absence. Presently common in Finis, Upper Shearness Pool, and Bear Swamp.

--- **White-footed Mouse** (Peromyscus leucopus). Abundant in wooded and brushy areas. Very white belly.

--- **Rice Rat** (Oryzomys palustris). Common in the salt marsh areas. Chiefly nocturnal.

---**Meadow Vole** (Microtus pennsylvanicus). Abundant in grassy, upland fields and among the grasses of the salt marsh.

--- **Pine Vole** (Pitymys pinetorum). Tunnels through the carpet of leaf mold and loose soil on the forest floor.

--- **Muskrat** (Ondatra zibethica). Common in the freshwater impoundments and in the salt marsh.

--- **Norway Rat** (Rattus norvegicus). Lives around buildings, grain fields, and marsh edges. Often moves into tidal debris along beaches.

---**House Mouse** (Mus musculus). Found about buildings and in weedy and grassy fields.

--- **Meadow Jumping Mouse** (Zapus hudsonius). Inhabits the grassy fields. Might be miskaken for frogs as they leap through the grass.

--- **Eastern Cottontail** (Sylvilagus floridanus). Abundant. Lives in bushy areas and grassy fields. Often seen from the roads in the early morning and late afternoon.

---**Whitetail Deer** (Odocoileus virginianus). Common in the uplands and along the marsh edges. Most active at early morning and evening.

Other species are probably present on the refuge but have not yet been verified. Reports of additional species are welcome.

MAMMALS
of the
BOMBAY HOOK
National Wildlife Refuge

Bombay Hook National Wildlife Refuge is located in coastal Delaware. The 15,978 acre refuge is relatively flat with most elevations less than ten feet above sea level. The major habitat type, consisting of 13,113 acres, is tidal marsh intersected by winding rivers and creeks. Landward of the marsh are freshwater impoundments, timbered swamps, mixed deciduous woodlands, brushy thickets, grassy fields and croplands.

This variety of habitats provides essential food and cover requirements for an interesting combination of mammal species. Those most frequently seen, especially in the early morning and the late afternoon, are the cottontail rabbit, woodchuck, gray squirrel, muskrat, and whitetail deer. Less commonly observed are the raccoon, skunk, opossum and red and gray foxes.

Because of a combination of small size, secretive habits, or nocturnal activity, many mammals are seldom seen. However, the careful observer will see tracks, trails, tunnels, burrows, nests and other signs that reveal their presence.

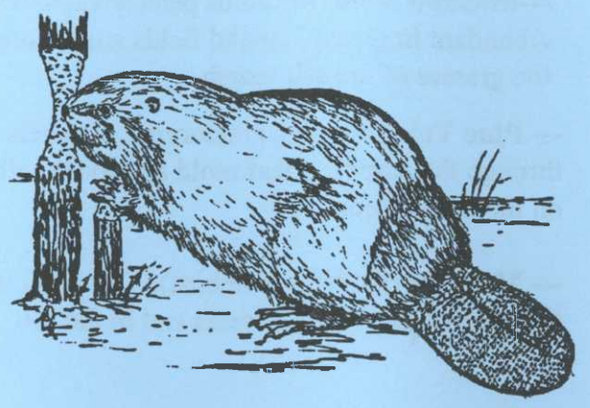
The following list of 34 species was prepared by refuge personnel with the cooperation of Frederick A. Ulmer, Jr. of the Philadelphia Zoological Garden. Order of listing, scientific names and common names are from Burt and Grossenheimer (Peterson Series). Art work by Bob Jones USFWS.

--- **Opposum** (Didelphis marsupialis). Commonly found in all sheltered habitats. Normally active only at night.

--- **Masked Shrew** (Sorex cinereus). Inhabits all lands areas. Hunts for insects and other food day or night.

--- **Shorttail Shrew** (Blarina brevicauda). Most abundant in damp woods with thick leaf mold.

--- **Least Shrew** (Cryptotis parva). Found in open, grassy areas.



--- **Eastern Mole** (Scalopus aquaticus). Inhabits moist, upland soils where it tunnels its way under the surface.

--- **Starnose Mole** (Condylura cristata). Prefers low, wet ground where it burrows for insects.

--- **Little Brown Myotis** (Myotis lucifugus). Present during the warm months. Seen in flight at dusk near the woods and over the pools.

--- **Silver-haired Bat** (Lasionycteris noctivagans). Found in the swamps flying among the flooded trees.

--- **Eastern Pipistrel** (Pipistrellus subflavus). Active during summer evenings. One of the smallest bats.

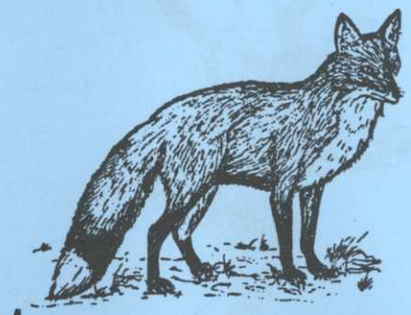
--- **Big Brown Bat** (Eptesicus fuscus). Active on warm evenings when beetles are flying.

--- **Red Bat** (Lasiurus borealis). A common woodland bat that roosts in trees all day, until deep dusk.

--- **Hoary Bat** (Lasiurus cinereus). The largest eastern bat, it is found in the woodlands; flies late, high and solitary.

--- **Raccoon** (Procyon lotor). Common in the woodlands, along the field edges and in the salt marsh. Most active at night.

--- **Longtail Weasel** (Mustela frenata). A few are present in the upland areas.



--- **Mink** (Mustela vison). An occasional mink may be found in the marsh or along the streams.

--- **River Otter** (Lutra canadensis). A few live in the refuge impoundments.

--- **Striped Skunk** (Mephitis mephitis). Common in the upland areas at night.

--- **Red Fox** (Vulpes fulva). Common in the upland habitats.

--- **Gray Fox** (Urocyon cinereoargenteus). Rare Normally active by night, prefers upland areas.

--- **Harbor Seal** (Phoca vitulina). Occasional sightings along Bay and mouth of Rivers; particularly Port Mahon and Leipsic River.

U.S. Fish and Wildlife Service

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UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

RL-51550-3 Feb 1998
HB

Amphibians and Reptiles

Bombay Hook National Wildlife Refuge

Smyrna, Delaware

Snakes

Northern Water Snake (Nerodia s. sipedon). Most commonly encountered snake on Refuge. Harmless, but will bite if provoked. Common in and about fresh and brackish water. Feeds on frogs and fish.

Eastern Garter Snake (Thamnophis s. sirtalis). Frequently seen. Inhabits fields, woods and marsh edges.

Eastern Ribbon Snake (Thamnophis s. sauritis). A semiaquatic snake found along the edges of the freshwater pools, swamps and ditches, and also occasionally in fields and woods.

Ringneck Snake (Diadophis punctatus). Secretive. Hides under stones and bark slabs in woodlands, especially near damp spots. Bright yellow to orange ring around neck.

Northern Black Racer (Coluber c. constrictor). A large snake, active during the day. Seen occasionally in the woods and along field edges.

Rough Green Snake (Opheodrys aestivus). Difficult to observe because it blends with the background. Favors dense vegetation along shallow bodies of freshwater. Feeds on insects.

Black Rat Snake (Elaphe o. obsoleta). A large, thick-bodied snake. Seen commonly, usually in the upland woods or on field edges. Excellent climber, often found in trees.

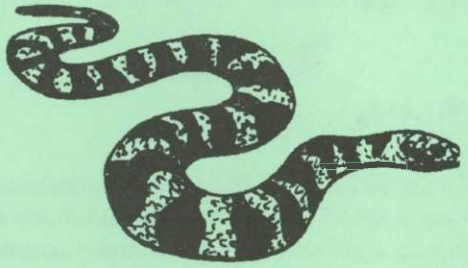
Eastern Kingsnake (Lampropeltis g. getula). Uncommon. Often secretive, hiding under boards and logs. Hunts along the banks of freshwater pools and swamps. May feed on other snakes.

Eastern Milk Snake (Lampropeltis t. triangulum). Rare on Delaware's coastal plain. Secretive about farm buildings and in fields and woods.

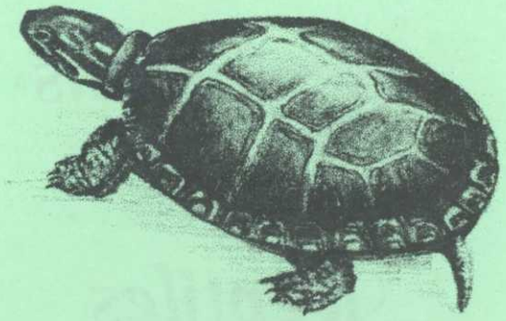
Eastern Hognose Snake (Heterodon platirhinos). Uncommon. Prefers cultivated fields and woodland meadows. Feeds on toads and frogs. Will play dead if harassed.

Eastern Worm Snake (Carphophis a. amoenus). Uncommon. Inhabits farmland bordering woodlands; dwells in damp situations under rocks, decaying logs, and loose soil.

The 35 species on this list have been identified on the Bombay Hook Refuge by refuge personnel with cooperation from the staff of the Philadelphia Zoological Garden. A special thanks also goes to Dr. Roger Conant, author of the Field Guide to the Reptiles and Amphibians of Eastern and Central North America, in the Peterson Series. To Skip Conant USFWS volunteer; Jim White of the Delaware Nature Society, Mick McLaughlin associated with Delaware conservation groups who assisted in updating this list. Bob Jones State Fish and Wildlife for original artwork. Names were taken from "Common and Scientific Names" by the Society for the Study of Reptiles and Amphibians.



Other species no doubt exist on the refuge and reports of their identification will be welcomed at the refuge headquarters. Following is a list of other possible species: Northern Brown Snake (Storeria dekayi), Ground Skink (Scincella lateralis), Eastern Mud Salamander (Pseudotriton montanus), Northern Red Salamander (Pseudotriton ruber), Cope's Gray Treefrog (Hyla chrysoscelis), and Eastern Spadefoot (Scaphiopus h. holbrookii).



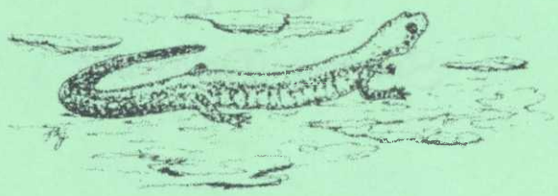
The variety of habitats within Bombay Hook Refuge provides the essential living requirements for an interesting array of amphibians (salamanders, toads, and frogs) and reptiles (turtles, snakes and lizards).

Many of these kinds of animals are often overlooked by visitors. They are hard to see; however, closer scrutiny may expose a "clump of moss" as a frog or "part of a vine" to be a snake. A slight movement on their part as you approach may be the giveaway. The frogs and toads can also be identified by their voices which ring out in loud chorus during spring nights, and into the summer.

Amphibians

Salamanders

Redback Salamander (Plethodon cinereus). A fairly common woodland salamander. Hides beneath logs, bark slabs and stones during the daytime. In this area, it is usually in the "lead" phase, that is, the reddish pigment is usually lacking.



Marbled Salamander (Ambystoma opacum). Uncommon. Found in woodland areas hiding under logs. Fall breeder. A mole salamander, spending most of its life underground.

Spotted Salamander (Ambystoma maculatum). Uncommon. Found in woodland and pond areas. Early spring breeder. Like marbled salamander, breeds in fishless pools. Hides beneath logs during the day. Recognized by bright yellow spots.

Toads and Frogs

Fowler's Toad (Bufo woodhousii fowleri). Common in woodland and grassy areas. Has three or more warts in each dark spot unlike the American toad which has 1 or 2. Breeds in shallow temporary pools.

Northern Cricket Frog (Acris c. crepitans). Common. Inhabits the emergent and shoreside vegetation of the freshwater pools. Call sounds like two marbles hitting together.

Green Treefrog (Hyla cinerea). Common in woodland areas adjacent to ponds. Seen particularly during spring. Visits windows at night, seeking insects attracted by light. Cowbell-like breeding call can be heard early to mid summer.

Gray Treefrog (Hyla versicolor). Uncommon. Breeds in quiet shallow waters. Forages aloft in small trees and shrubs near water.

Northern Spring Peeper (Pseudacris c. crucifer). Common. Congregates and calls loudly in early spring where shrubs stand in shallow water.

New Jersey Chorus Frog (Pseudacris triseriata kalmi). Common. Congregate during the spring in low vegetation along the edges of freshwater pools and ponds. Call is reminiscent of a finger going across a comb.

Bullfrog (Rana catesbeiana). A common large frog of the freshwater pools. The familiar jug-o-rum call can be heard throughout the warm weather.

Green Frog (Rana clamitans melanota). Inhabits the shallow freshwater of the pools, ponds and ditches. It's call sounds like a loose banjo string.

Southern Leopard Frog (Rana u. utricularia). Common in shallow freshwater areas. Travels into grass fields, far from water, during the summer.

Pickerel Frog (Rana palustris). Common. Inhabits shallow, freshwater areas. Travels into grass fields during the summer.

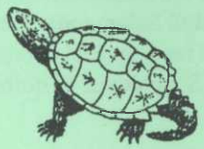
Wood Frog (Rana sylvatica). Common. Should be looked for in shallow woodland pools during the early spring. One of the first frogs to call in spring. Gasping or clacking like call heard in early March.

Reptiles

Turtles

Common Snapping Turtle (Chelydra s. serpentina). Common in the freshwater pools, but also inhabits brackish and salt water. The largest nesting turtle in Delaware, it lays its eggs in the upland fields and dike road during the late spring.

Common Musk Turtle (Sternotherus odoratus). Common. Lives in the freshwater pools. May give off musky smell when handled, sometimes called stinkpot.



Eastern Mud Turtle (Kinosternon s. subrubrum). More common than the musk turtle which it resembles. Inhabits both fresh and brackish water.

Spotted Turtle (Clemmys guttata). Uncommon. Inhabits shallow freshwater in the pools, ponds and ditches. Most individuals have yellow or orange spots on shell.

Eastern Box Turtle (Terrapene c. carolina). Uncommon. This is a dry-land turtle most frequently seen in the woodlands. Feeds on slugs, worms and vegetation. May live to 80+ years.

Northern Diamondback Terrapin (Malaclemys t. terrapin). A common estuarine species. Lives in unpolluted salt marsh and brackish water habitats. Lays eggs on the dikes or other accessible areas in early June to early July.

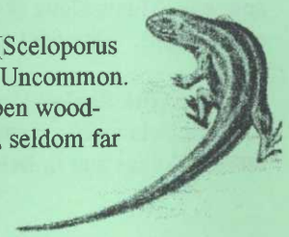
Eastern Painted Turtle (Chrysemys p. picta). The most frequently seen turtle. Basks in the warm sunlight on logs, stumps and vegetated clumps in the freshwater pools.

Redbelly Turtle (Pseudemys rubriventris). Uncommon. Inhabits the freshwater pools. Basks like the painted turtle but is much larger. Feeds primarily on aquatic vegetation.

Lizards

Five-lined Skink (Eumeces fasciatus). Uncommon. Lives in cut-over woodlands that have rotting stumps and logs. Mainly terrestrial, but can climb trees. Juveniles have bright blue tails. Adult males have reddish orange heads.

Northern Fence Lizard (Sceloporus undulatus hyacinthinus). Uncommon. Favors rotting logs and open woodlands. Primarily arboreal, seldom far from trees.



Bear Swamp Trail

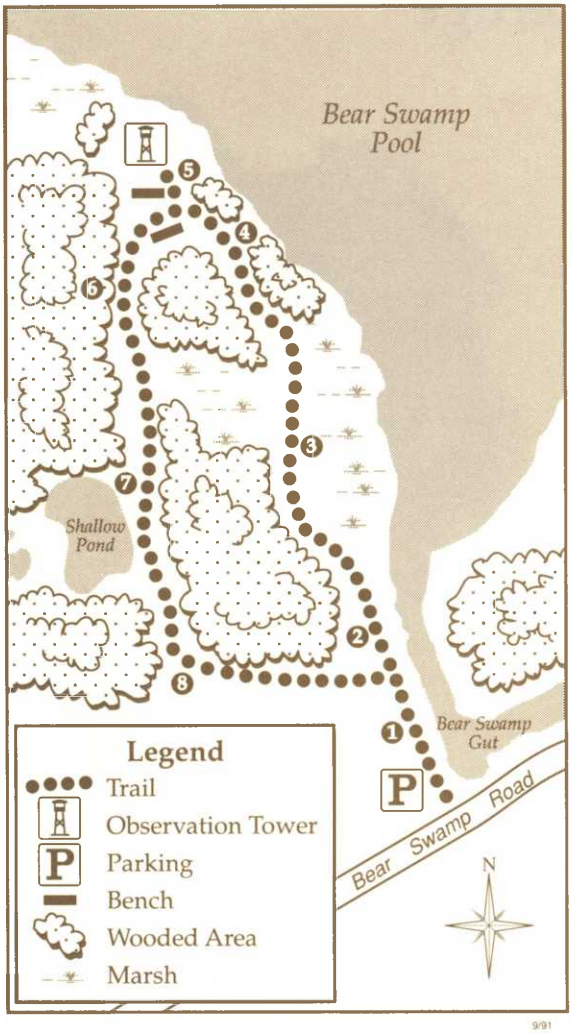
Bombay Hook National Wildlife Refuge

Delaware

Welcome!

Welcome to Bombay Hook National Wildlife Refuge! The Bear Swamp Trail was constructed in 1961 and is located on the south end of Bear Swamp Pool. Bear Swamp is the name given to the wetland area beyond the dike, according to early records. Bears no longer live in Delaware; the last recorded sighting was in 1905.

As you walk the trail today, please use caution to avoid poison ivy shrubs and vines. Although poison ivy provides food for flickers, woodpeckers, and other birds, it can cause a serious skin rash in humans.



1 In this part of the United States, abandoned fields usually give way to a variety of shrubs and trees including bayberry, winged sumac, and sweetgum. Next, trees such as maple and beech appear. Finally, oak and hickory trees emerge. This slow changing of vegetation is called forest succession.

Here, you can see the first stage of forest succession. The large sweetgum trees produce spiny "monkey balls." The dark red fuzzy fruit clusters of winged sumac are eaten by wildlife when other foods are scarce. Bayberry, or wax myrtle, is a plentiful shrub in Refuge wetlands, and provides a waxy-coated fruit eaten by many bird species.

2 Near this stop, the trail passes through the forest and along the marsh. The red maple trees indicate this area is in the second stage of forest succession. Look here for the sassafras, which produces a fleshy blue fruit eaten by songbirds and quail.

The marsh just ahead is important for breeding, migrating, and wintering ducks and geese. Because it is so important, protection of this kind of wetland is being addressed by several conservation groups and plans. The North American Waterfowl Management Plan, a joint effort between the United States and Canada, outlines population goals for waterfowl and focuses on preserving and improving habitats needed to produce healthy populations of ducks, geese and swans.

The Federal Duck Stamp Program also helps preserve wetlands. The money collected from the

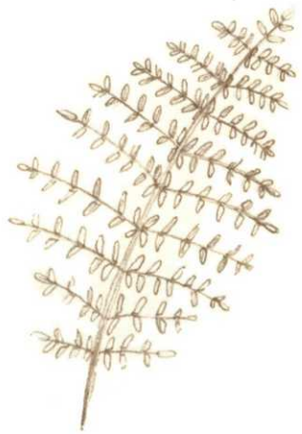
sale of Duck Stamps to waterfowl hunters, conservationists, and stamp collectors is used to purchase waterfowl habitat for the National Wildlife Refuge System. Over 3.7 million acres of waterfowl habitat have been preserved through this program since the 1930's.

3 Along the water's edge is Phragmites, or common reed, which flourishes where man has disturbed the soil by dredging or ditching. This plant grows from 5 to 15 feet tall and has a feathery plume-like top. The stem is round and jointed like a bamboo. Introduced from Eurasia, Phragmites is not desirable because it crowds out native vegetation and has very little value for wildlife. Refuge managers are trying to control Phragmites at Bombay Hook by manipulating water levels, chemical spraying, and burning.

4 Along the trail are many shrubs, bushes and tall trees to study and admire. The forest floor, or understory, offers many plants interesting to human visitors and important to wildlife.

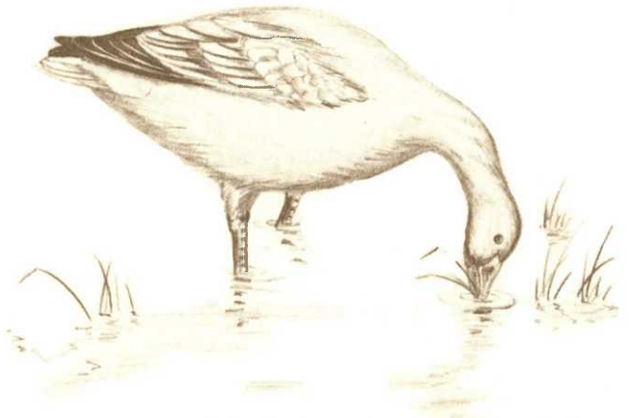
Ferns are common along the Bear Swamp Trail due to ideal growing conditions. Fern species you may see include bracken, royal, cinnamon, New York, lady's, sensitive, and marsh ferns.

Ferns are delicate, flowerless plants usually found in moist, shady areas. They reproduce by spores enclosed in small, brownish cases found on the backs of leaves or on separate stalks. When the spores ripen, the cases burst open and the spores fall on the ground where they develop into tiny, green, heart-shaped plants. These plants then develop a female sex cell, an egg, and a male sex cell which fertilizes the egg. The fertilized egg then grows into a mature fern.



5 The 30-foot observation tower is a good place to observe waterfowl and other wildlife on Bear Swamp Pool. Bear Swamp is a 240-acre freshwater impoundment constructed in 1961. Water in Bear Swamp is manipulated by Refuge managers to produce desired vegetation within the pool. In the spring, water levels are lowered to promote desirable plant growth. Migrating shorebirds are attracted to the warmer, shallow water and to the newly-created mudflats. In the fall, water levels are raised by rainfall. Arriving waterfowl respond to these conditions and to the seed-bearing plants which will become a winter food source for them.

Snow geese are one of the many species of waterfowl that arrive in the fall. Each year, Bombay Hook and Prime Hook Refuges attract the largest



wintering populations of greater snow geese in the country. Unfortunately, such large numbers of birds can destroy the saltmarsh by "eating out" large areas of vegetation. To help prevent this problem, Refuge managers provide alternative food crops to attract geese to other areas, burn sections of the marsh to attract birds who will feed on the plant roots, and permit snow goose hunts to disperse the flocks.

Another waterfowl species that uses Bear Swamp is the small, colorful wood duck. The nest boxes visible from the tower were built to increase the number of wood duck nesting sites. The metal collar below the box prevents raccoons and snakes from getting into the box and preying on the female, her young, or the eggs. These nest boxes are helping to reverse damage done to wood duck populations when timber harvesting early in the 20th century removed most of the mature trees. Very liberal hunting regulations also contributed to wood duck population decline. The Migratory Bird Treaty Act of 1918, implementing a treaty signed between the United States and Canada, may have saved the wood duck from extinction.

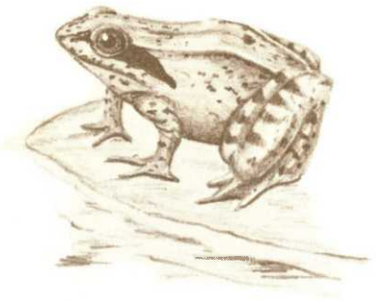
From the observation tower, you may be able to spot muskrat houses scattered across the saltmarsh. Because a large population of muskrats can damage marsh vegetation, trapping by permit is used by Refuge managers to control muskrat numbers.

Grass-covered water blinds, used in the Young Waterfowlers Program, can be seen in the impoundment during the fall hunting season. Young Waterfowlers are youths between 12 and 18 who are taught hunting regulations, safety, ethics, and waterfowl identification before they participate in regular Refuge hunts.

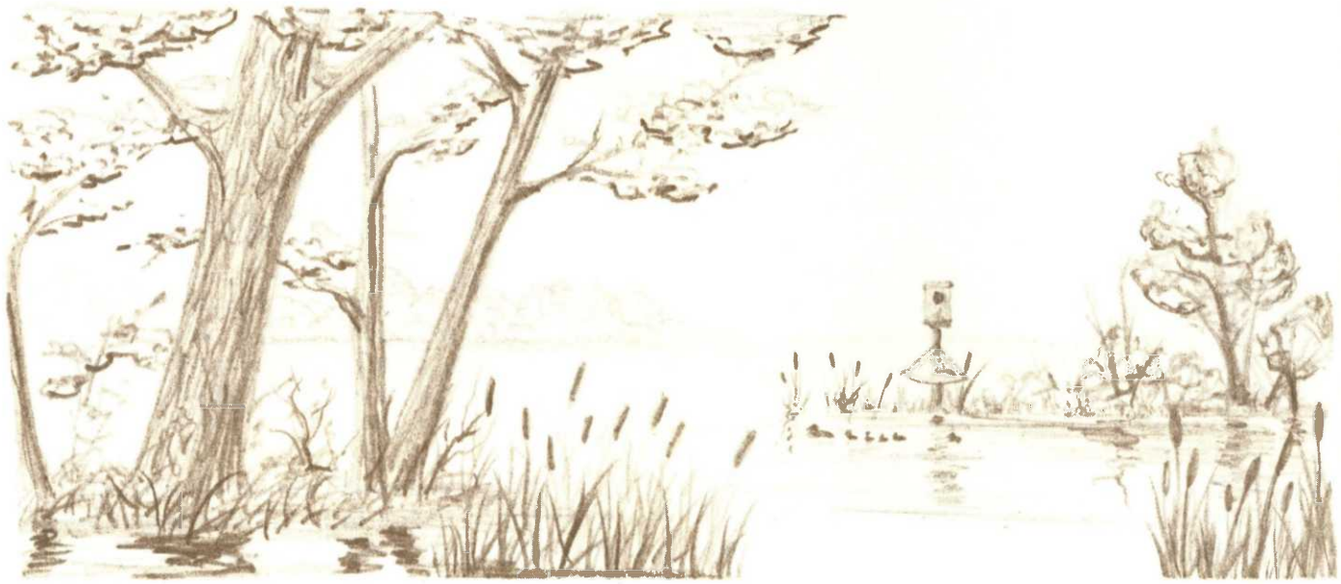
6 Look here for evidence of the third stage of forest succession - oak and hickory trees. Below these large trees on the forest floor are mushrooms and fungi, "Mother Nature's house cleaners." These non-flowering plants break down dead plant and animal products, thus supplying minerals to other plants.

In late summer, look for blackberry, wild raspberry, and wild strawberry plants which provide fruit for songbirds. Jack-in-the-Pulpit is another plant which yields clusters of berries enjoyed by ring-necked pheasants and wood thrushes.

While studying the low-growing plants, you may discover tracks of deer or other animals. Deer populations are closely monitored on the Refuge, to prevent overbrowsing of vegetation. Regulated deer hunts are used at Bombay Hook and other refuges as a management technique to control deer and to provide wildlife-oriented recreation.



7 This small pond is a good place to look for frogs and salamanders, and is a favorite area for woodpeckers and barred owls. Although barred owls are nocturnal, or active at night, they will sometimes hunt or hoot during the day. Owls like this area because they can find crayfish, frogs, and fish here.



8 We hope you enjoyed your walk today. Freshwater ponds such as Bear Swamp Pool add a whole group of plants and animals to Bombay Hook Refuge. These ponds give waterfowl and shorebirds a place to rest, feed, and nest. Mammals attracted to freshwater ponds include beavers, otters, raccoons, and mink. Bear Swamp and other freshwater ponds are favorite places for bald eagles to catch fish for dinner.

Thoughtful management of Bombay Hook wetlands benefits man as well as wildlife. Wetlands help replenish groundwater, control pollution and limit soil loss, prevent floods, and provide places for educational, scientific and recreational activities. Healthy wetlands provide benefits for everyone. Please do your part to protect them.

U.S. Fish and Wildlife Service

Bombay Hook is one of more than 470 refuges in the National Wildlife Refuge System administered by the U.S. Fish and Wildlife Service. The National Wildlife Refuge System is a network of lands and waters managed specifically for the protection of wildlife and wildlife habitat and represents the most comprehensive wildlife management program in the world. Units of the system stretch across the United States from northern Alaska to the Florida Keys and include small islands in the Caribbean and South Pacific. The character of the refuges is as diverse as the nation itself.

The Service also manages National Fish Hatcheries, and provides Federal leadership in habitat protection, fish and wildlife research, technical assistance and the conservation and protection of migratory birds, certain marine mammals and threatened and endangered species.

For further information please contact:

Refuge Manager
Bombay Hook National Wildlife Refuge
RFD #1, Box 147
Smyrna, DE 19977
Telephone: (302) 653-9345 Office
(302) 653-6872 Visitor Center

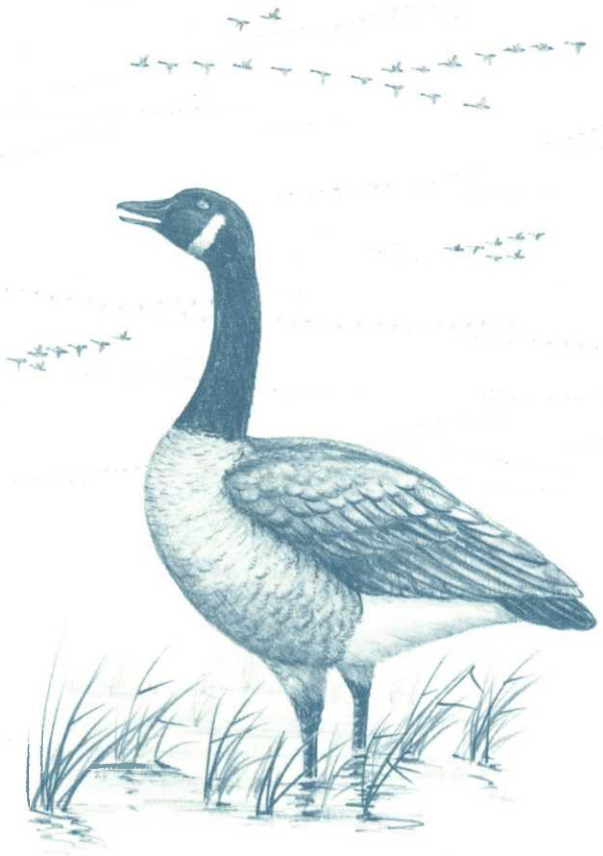
Illustrations by Bob Jones

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE

RL-51550-1 October 1991

Boardwalk Trail

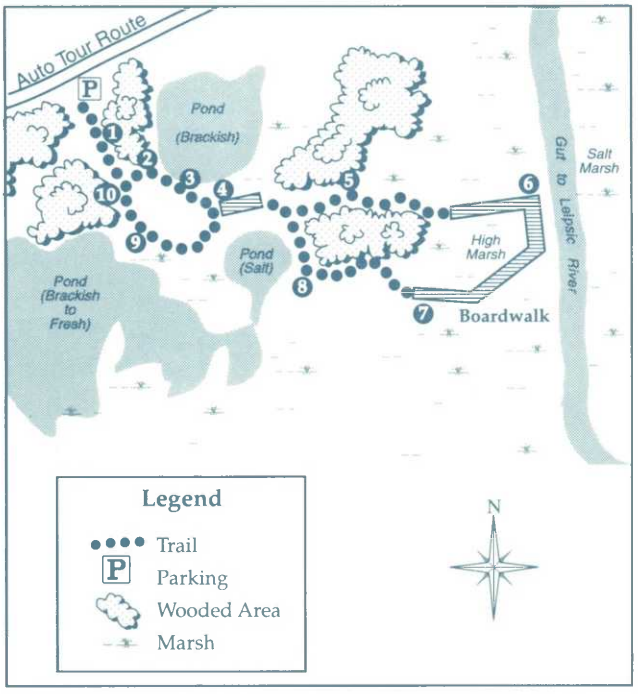
Bombay Hook National Wildlife Refuge



Delaware

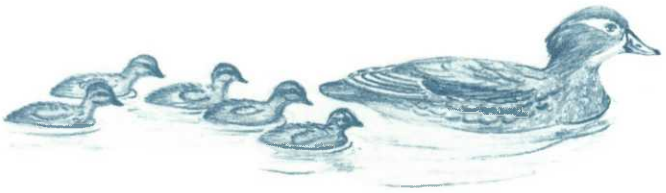
Welcome!

Welcome to Bombay Hook National Wildlife Refuge. The Boardwalk Trail passes through four different refuge habitats: woodland, freshwater pond, brackish pond, and saltmarsh. The Trail is about one-half mile long and will take you about 30 minutes to complete.



1 Each season brings changes along the Boardwalk Trail. In spring, many low plants grow and reproduce before leaves appear on the trees, making this an excellent time for sighting songbirds. During the late spring and summer months, shady woods along the Boardwalk Trail provide a home for many wildlife species which alert visitors may notice. Warmer weather also increases the number of ticks, mosquitoes, and flies along the trail. When insects are present, most visitors feel comfortable wearing a long-sleeved shirt, slacks, and insect repellent, but headnets are sometimes needed. During the fall, leaves change color and many wildlife species prepare for winter. The winter season helps create different patterns, shapes, textures, and colors along the trail. Many animals and birds remain active all winter and may be easily seen as their search for food intensifies.

2 There are three types of wetland habitats at Bombay Hook Refuge. Freshwater habitat may be recognized by the lily pads and frogs living there. In brackish water habitat, transition plants such as three square and other bulrushes *(Scirpus sp.)* can be seen. The pond you see at this stop is brackish. In saltmarsh habitat, vegetation consists mostly of cordgrasses *(Spartina cynosuroides, S. patens, S. alterniflora)* and spike grass or saltgrass *(Distichlis spicata)*. The saltmarsh at Bombay Hook becomes more salty during droughts, and becomes less salty during and immediately after heavy rain. Ocean water is always more salty than the saltmarsh at Bombay Hook.



Notice the wood duck box near the edge of the pond. Although wood ducks usually nest in tree cavities, they will use man-made nests if hollow trees are not available. The cone skirt under the box prevents predators such as snakes or raccoons from getting into the nest and destroying eggs or young ducklings. Wildlife managers maintain many nest boxes to increase the number of wood ducks produced at Bombay Hook Refuge. If you own similar habitat, you can help wildlife by installing your own nest boxes.

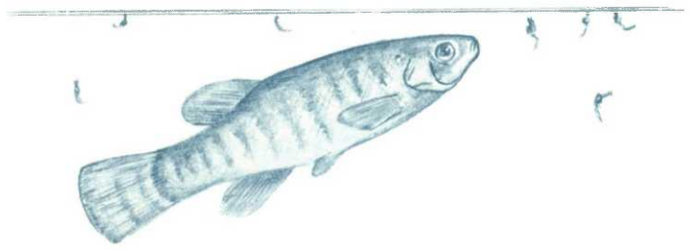
Careful management of Bombay Hook wetlands benefits man as well as wildlife. Some of these benefits include: nesting, migration, and wintering habitat for waterfowl, shorebirds, and other wildlife

(such as river otters, rare fur-bearers in Delaware); habitat for marine and freshwater fish; water pollution and sediment control; saltwater intrusion control, reduction of coastal storm damage; and recreational, educational, and scientific uses.

3 Many trees in this area are persimmon trees, an important food source for wildlife such as raccoons, foxes, and opossums. Persimmon fruit is round, smooth and orange, and remains on the tree long after the leaves have fallen. Persimmon tree bark is rugged and corrugated and looks a lot like alligator skin.

Japanese honeysuckle, introduced into the United States in 1898, is found in patches along this section of the trail. This plant spreads rapidly, and can dominate and shade out native plants. The flowering vine and its berries, however, are a good food source for game birds, songbirds, rabbits and deer.

Another non-native plant, Phragmites (or common reed), was introduced to the United States from Eurasia. Unlike the Japanese honeysuckle, it has very little wildlife value. Phragmites crowds out native plants such as cattails, pond lilies, bulrushes, and smartweed in freshwater areas, and cordgrasses in saltwater areas. Refuge managers are controlling Phragmites with water level manipulation and herbicides in late summer followed by burning during the winter months. Individual sites are treated for two consecutive years. Because this process destroys the root system of Phragmites, native plants can regrow without competition.



4 If you stand on the short boardwalk and look to your left, you may see poison ivy plants entangled with marsh reeds. The white berries produced by this plant can often be seen along the Boardwalk Trail during the fall and winter months. Although poison ivy berries provide food for pheasants, quail, catbirds, flickers, finches and sparrows, humans can catch a severe rash from handling the berries, the leaves, or even the hairy vine.

During the warm months, minnows and killifish may be seen in the water under and adjacent to the boardwalk. If you are a quiet observer, you may also see northern water snakes sunning themselves here.

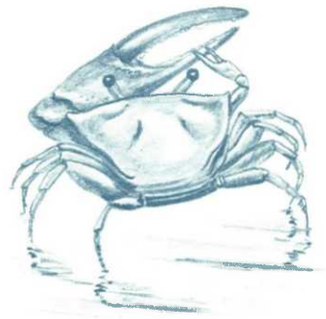
5 This woodland area contains several sweetgum trees, an early successional species. Sweetgums are medium-sized trees with star-shaped leaves, winged corky bark, and a large prickly fruit smaller than a golf ball and brown when ripe.

You may also see wild cherry trees in this area. Older cherry trees develop a rough, shaggy, dark bark, while younger trees can be identified by the lenticels or lines in the bark. Birds and mammals prefer cherries over the fruit produced by the sweetgum tree.

Near the boardwalk are many bayberry or wax myrtle bushes, whose berries are popular with songbirds. Humans have used the waxy coating of the berries to make candles and scent soaps.

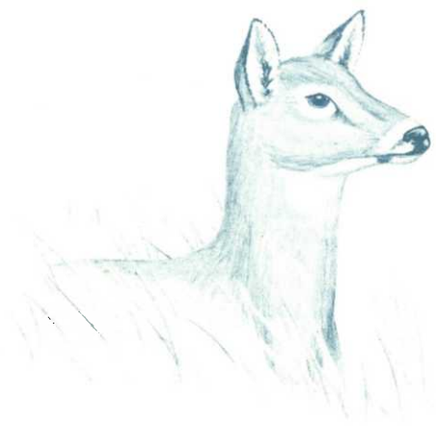
6 This is a high marsh, made up mostly of salt meadow cordgrass *(Spartina patens)* or salt grass *(Distichlis spicata)*. This marsh type is only flooded during spring tides or by major storms. The major low marsh species is saltmarsh cordgrass *(Spartina alterniflora)*. Low marshes are flooded during every high tide, normally twice per day.

If the tide has gone out, you may see small fiddler crab holes in the mud during warm weather. Fiddler crabs are smaller than the familiar blue crab which is abundant in many local tidal marshes. Male fiddler crabs have one claw larger than the other. Marsh crabs may also be found here, along with many different species of waterbirds and shorebirds that use the marsh for feeding and resting.



The mounds you see in the saltmarsh are muskrat houses, made of mud and vegetation. Some visitors mistakenly think they are beaver lodges. Beaver lodges, however, are not found in the saltmarsh, but in freshwater only and consist of mud and sticks. Muskrats are mainly vegetarians, although they may eat clams, fish, crayfish and snails. Raccoon scat, or droppings, can often be seen on the boardwalk. The scat usually contains persimmon tree seeds, other seeds, and the remains of fiddler crabs. Look for raccoon tracks in the marsh mud along the sides of the boardwalk and along the railing.

7 Wetlands are ideal places for nesting ducks. Ducks that nest at Bombay Hook Refuge include black ducks, mallards, blue-winged teals, gadwalls, and shovelers. To help save ducks and geese, the Migratory Bird Hunting Stamp Act was passed by Congress in 1934. Today this is known as the Federal Duck Stamp Program. Money from duck stamps purchased by waterfowl hunters, conservationists, and stamp collectors provides funding for the acquisition and leasing of wildlife refuges. Today, 3.7 million acres of wetland refuges are preserved for North American waterfowl and other wildlife. Many of the more than 450 national wildlife refuges in the United States were purchased in whole or in part with money from the sale of Duck Stamps.



8 The wooden structure seen from here is a deer stand used by hunters. Deer hunting is permitted at Bombay Hook Refuge to control deer population numbers and to provide a form of wildlife-oriented recreation. These elevated deer stands are located in the headquarters hunt area and the regular deer hunt area. Six hunt sites are reserved for hunters in wheelchairs. If you would like to hunt at Bombay Hook, check at the refuge office before you leave today.

9 This pond is one of the best spots along the Boardwalk Trail to see waterfowl in the fall and shorebirds in the spring. Waterfowl often sighted include black ducks, gadwalls, blue-winged teals, and mallards. Willets, yellowlegs, and dowitchers are the most common shorebirds seen. The saltmarsh is a nesting area for willets.

To help ensure that healthy populations of ducks, geese and swans will exist in the future, the United States and Canada signed the North American Water-fowl Management Plan in 1986. The Plan establishes population goals for waterfowl through the year 2000, and gives special attention to species with declining populations. The Plan identifies habitat conservation needs in regions of both countries, and encourages international cooperation by other countries such as Mexico, where many waterfowl populations spend the winter. The North American Plan is a bold step which needs the support of private citizens as well as government agencies if its goals are to be reached and maintained.

10 We hope you enjoyed your walk along the Boardwalk Trail. This trail was built by members of the Youth Conservation Corps in 1973. YCC is a summer program for youths 15 to 18 which combines environmental education opportunities with meaningful work experience. Trail maintenance projects include laying down wood chips to prevent erosion, outlining the trail with logs, and clearing brush growing onto the trail. If you would like to become a volunteer at Bombay Hook Refuge, or would like more information about the Youth Conservation Corps, please ask at the refuge office before you leave today.

After walking the Boardwalk Trail, you may realize that wetlands have many values. Wetland values include wildlife resting, feeding, and production; ground water replenishment; pollution and sediment control; flood prevention; educational and scientific uses; recreation and esthetics. Healthy wetlands provide benefits for everyone. Please do your part to protect them.

U.S. Fish and Wildlife Service

Bombay Hook is one of more than 470 refuges in the National Wildlife Refuge System administered by the U.S. Fish and Wildlife Service. The National Wildlife Refuge System is a network of lands and waters managed specifically for the protection of wildlife and wildlife habitat and represents the most comprehensive wildlife management program in the world. Units of the system stretch across the United States from northern Alaska to the Florida Keys and include small islands in the Caribbean and South Pacific. The character of the refuges is as diverse as the nation itself.

The Service also manages National Fish Hatcheries, and provides Federal leadership in habitat protection, fish and wildlife research, technical assistance and the conservation and protection of migratory birds, certain marine mammals and threatened and endangered species.

For further information please contact:

Refuge Manager
Bombay Hook National Wildlife Refuge
RFD #1, Box 147
Smyrna, DE 19977
Telephone: (302) 653-9345 Office
(302) 653-6872 Visitor Center

Illustrations by Bob Jones

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE

RL-51550-1 October 1991

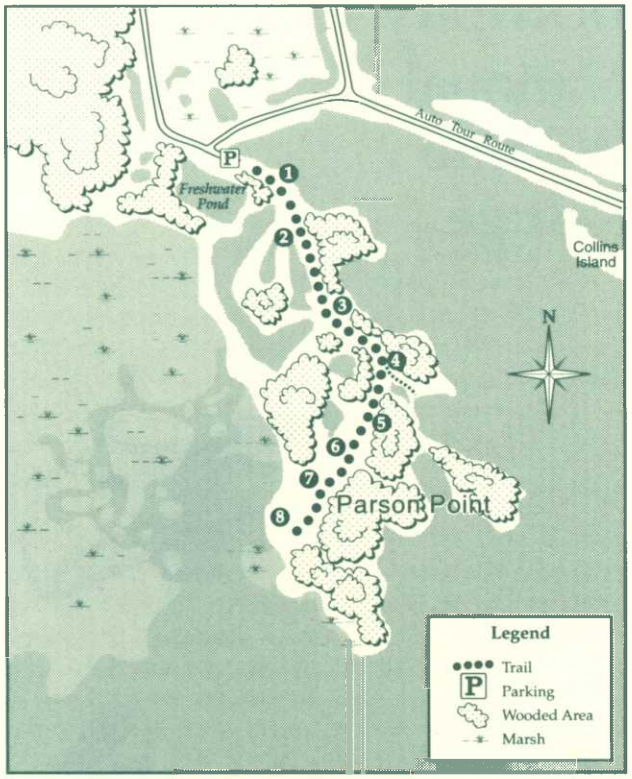
Parson Point Trail

Bombay Hook National Wildlife Refuge

Delaware

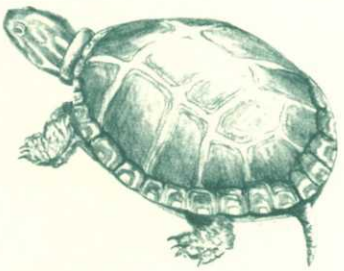
Welcome!

Welcome to Bombay Hook National Wildlife Refuge. The Parson Point Trail is one mile round trip and provides the opportunity for visitors to see many kinds of plants and animals - maybe even a bald eagle! Isolated forested areas with tall, mature trees are key requirements for nest-building eagles. Bombay Hook Refuge provides habitat for a large variety of plants and animals that might not exist here if this habitat was not protected from development.



1 This is a very unusual sweetgum tree due to its extremely winged or corked bark. In this part of the United States, sweetgum (Liquidambar styraciflua) trees usually appear in the **first stage of succession**, when abandoned fields give way to sun-loving species. Sweetgums are large, aromatic trees with shiny, star-shaped, dark green

leaves with saw-toothed edges. The spiny sweetgum fruits, sometimes called "monkey balls," are also an identifying characteristic. Sweetgums are used for making perfumes, medicines, chewing gum, popsicle sticks, furniture veneers and peach baskets. Unfortunately, the wildlife value of sweetgum trees is quite limited when compared to other hardwoods such as oak, beech, and hickory.



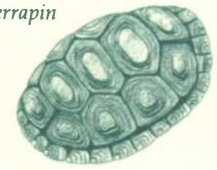
2 A small pond is visible through the trees on your right. During warm weather, painted turtles often bask in the sun around the pond. These common residents of Bombay Hook Refuge spend most of their time in or near water eating plants, insects, and other small animals. Painted turtles are easy to identify by their broad, dark, flattened, smooth-edged shells, which are trimmed with red. They are very shy and easily disturbed. Female turtles lay 6 to 12 eggs in a hole dug with their hind legs. Bald eagles will occasionally prey on painted turtles.

The pond is a roosting area for black-crowned night herons, and is home to green frogs and bull frogs.

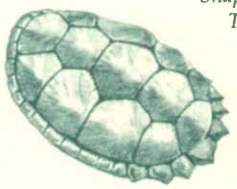
3 During the warmer months, especially June, turtles dig holes into the trail. The northern diamondback terrapin, a brackish/saltwater species, lays oblong, pinkish eggs. Often these eggs are found by raccoons or opossums, which regard them as a cherished treat.

Because diamondback terrapin meat was a highly prized delicacy around 1900, their numbers were greatly reduced. Today, laws which protect these turtles have helped restore some populations. Adults are often seen basking on the mud flats. Terrapin diet consists of marine snails, clams and worms.

Diamondback Terrapin



Snapping Turtle



The snapping turtle, a found in fresh and salt water, can be identified by its massive head and powerful jaw. The back end of the **carapace**, or top shell, is serrated, as is the tail. Snapping turtles mate from April to November and lay as many as 83 spherical eggs.

4 Shearness Pool is visible through the trees on your left. The spur trail bending to the left of the main trail will take you to the Pool. Shearness Pool is frequently visited by mallards, pintails, black ducks, Canada geese, and snow geese.

Wetlands are important to waterfowl as breeding, migrating, and wintering habitat. In recent years though, much waterfowl habitat has been lost to agriculture, industry and urban development. To help better protect and manage wetlands, the United States and Canada signed the North American Waterfowl Management Plan in 1986. This plan sets numerical goals for duck, goose, and swan populations, identifies habitat conservation needs, and recommends measures for resolving problems.

The Federal Duck Stamp Program helps preserve wetlands through funds collected by the sale of Duck Stamps to hunters, conservationists, and stamp collectors. The funds are then used to acquire waterfowl habitat for the National Wildlife Refuge System. Bombay Hook and many other refuges were purchased entirely by Duck Stamp receipts.

5 Jack-in-the-pulpit blooms from March through June in rich, moist woods. Other common names for this pretty flower are Indian turnip, wake robin, dragonroot, starch plant, memory root, wild turnip, and American arum. The plants grow one to three feet tall. Flowers are **unisexual** (having both sexes), with male parts on top of the plant and female parts below. Jack-in-the-pulpit flowers can be identified by the hood that arches over the rest of the plant. The upper part is green or purplish brown and is often striped. One or two leaves are divided into three to five leaflets. Berries are bright red and hang in clusters in the fall. If the root is dried and boiled, it can be used to make flour. The leaves and fruit are eaten by ring-necked pheasants and wild turkeys at Bombay Hook.

Other spring wildflowers you may see along the trail are may-apple, toothwort, spring beauty, bloodroot, wild strawberry, and violets. Please remember that collecting any plants is prohibited. Leave them there for the next visitor to enjoy.

6 Ferns are non-flowering plants that reproduce by spores rather than seeds. Lady ferns and New York ferns are most common along this trail, but sensitive and royal ferns also grow here. Royal ferns grow to a height of two feet or more and can look like young locust trees. The foliage is translucent pale green in a well-lit area, and bright green with reddish stalks where light is less intense. Size and shape of this fern depends on its environment.

7 An intense storm overturned and uprooted this tree, creating potential habitat for the five-lined skink. This interesting reptile prefers a brush pile or the root system of a tree as a place to search for and capture food. If you are very quiet, you may see a skink at work.

Look up in the trees for a moment, and you may spot some of the birds that make their home at Bombay Hook Refuge. Species often seen along the Parson Point Trail are red-bellied woodpeckers, flickers and warblers.

8 As you near the end of the trail, Phragmites plants will become more noticeable. Phragmites, introduced from Eurasia, grows where marshes have been disturbed by man. The plant has no food value for wildlife and competes with millets, sedges, and other plants which are a valuable source of wildlife food and shelter. Refuge managers are currently controlling the spread of Phragmites by manipulating water levels and by selective herbicide spraying. The plant is sprayed in late summer and burned in the winter months to destroy the old canes and allow more valuable wildlife food plants to thrive.

Beyond the Phragmites is the back side of Shearness Pool, where ducks may be seen most of the year. If you look closely, you may see a wood duck box in the marsh. These nest boxes have been strategically placed around the Refuge to increase the number of wood ducks nesting here.

Shearness Pool serves as a roosting and nesting area for bald eagles, which feed mainly on fish. Eagles build or repair their nest in December or January, and mate and lay eggs in February. Both males and females sit on the nest, taking turns incubating the eggs while the other is off hunting. Young eaglets are hatched in March and fledge by June. Because eagles are very shy and easily disturbed, Refuge managers seasonally close the Parson Point Trail. Please do your part by not entering the trail when it's closed. Enjoy your walk with nature and come again.

U.S. Fish and Wildlife Service

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For further information please contact:

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Smyrna, DE 19977
Telephone: (302) 653-9345 Office
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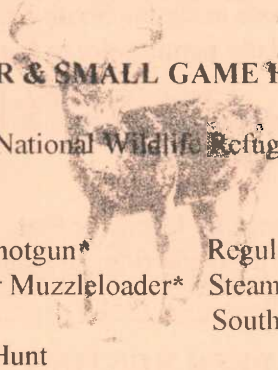
Illustrations by Bob Jones

DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE

RL-51550-1 October 1991

BOMBAY HOOK NATIONAL WILDLIFE REFUGE

PUBLIC DEER & SMALL GAME HUNTING LEAFLET



Bombay Hook National Wildlife Refuge offers the following regulated hunts:

Headquarters/Shotgun*	Regular/Fischer Shotgun*
Regular/Fischer Muzzleloader*	Steamboat Landing Shotgun*
Archery	South Upland Area
Special Youth Hunt	

*** Requires advance reservations**

Deer, turkey, and small game hunting will be allowed on Bombay Hook National Wildlife Refuge subject to applicable state and federal regulations and the following special conditions:

GENERAL REQUIREMENTS

Hunters must possess a valid state hunting license. Persons under 15 years and over 65, or permanently disabled are exempt. Persons 15 years and under must be accompanied by a licensed hunter. Non-hunting adults are allowed only to accompany a permitted juvenile or non-ambulatory hunter.

Reservations are obtained by contacting the Refuge Manager in writing for applications. **Muzzleloader applications must be postmarked prior to September 15. All other applications must be postmarked by October 8.** Archery deer and South Upland Area hunters are not required to have advance reservations. Only one application per hunter, per hunt area will be accepted. **Duplicate applications will be cause for disqualification.**

Successful applicants are selected by public lottery. Failure to appear on the day of the hunt will result in forfeiture of the

reservation. Forfeited reservations and permits not requiring advance reservation will be awarded to stand-by hunters by a ticket-lottery system the day of the hunt.

All hunters except those using the South Upland Area are required to obtain a daily permit prior to hunting.

Use or possesion of alcoholic beverages on hunt areas during any scheduled hunt is prohibited.

Hunters, when requested by federal or State enforcement officers must display for inspection, all game, hunting equipment and ammunition.

DEER HUNTING

GENERAL

Application Fee. *All applications for Regular Area/Fischer Tract, Headquarters Area and Steamboat Landing Area firearms deer hunts must be accompanied by a **$3.00** application fee.*

No nailed deer stands, platforms ladders or blinds, other than those provided by the government are permitted. Tree stands must be portable, temporary in design and completely removed after use.

All firearms hunters **must use assigned stands between the hours of 1/2 hour before sunrise until 9:00 a.m. and 3:00 p.m. until 1/2 hour after sunset. Between 9:00 a.m. and 3:00 p.m.** on the Steamboat and Regular/Fischer Tract areas hunters may leave their stands to hunt or leave the area. On Headquarters area all hunting is from stands. If a hunter leaves, he may return once more during the day and **must return prior to 3:00 p.m.** On all areas departure from stands **prior to 9:00 a.m. or between 3:00 p.m. and 1/2 hour after sunset** may result in loss of future hunt privileges.

All deer must be checked at a refuge check station before leaving the refuge.

All firearms deer hunters must display a minimum of 400 squares inches of **solid** hunter orange on the head, chest and back while hunting.

Only one antlered buck may be taken on the refuge by a hunter during the entire season (September through January).

REGULAR AREA/FISCHER TRACT

Shotgun & Primitive Firearms

Individuals selected by advance reservation must appear at headquarters prior to **one hour before** legal shooting time on the day of the hunt to be issued a daily permit.

A standby ticket-lottery will be held **one hour before** legal shooting time for all forfeited reservations. An additional drawing will be held at noon for stand vacancies.

42 hunters will be allowed on the Regular Area and 12 will be allowed on the Fischer Tract. A total of 54 elevated stands are provided.

Shotguns are permitted only during the 1st Friday, Saturday, and Wednesday of the Delaware November season; the Monday and Saturday of the Delaware December season; and the Friday of the Delaware January season.

Primitive firearms are permitted only during the Monday, Wednesday, and Thursday of the Delaware October muzzleloader season.

A fee of **$10.00** will be charged and collected prior to the issuance of a daily permit.

Archery (Regular Area)

Permits are issued at headquarters by a ticket-lottery **one hour before** legal shooting time.

Hunting is permitted on the first two Saturdays of the State season. **Hunting ends each day at 11:00 a.m.**

The maximum number of hunters allowed on the area is 60.

42 elevated deer stands are available for use on a first-come, first-served basis. Use of stands is optional.

Entrance fee required. Current Federal Duck Stamp or **$2.00** daily fee.

Archery (Fischer Tract)

Archery hunting will be permitted on the Fischer Area during all weekdays in October, when the State season is open. The maximum number of hunters allowed on the area is 12. Daily permits will be issued on a self service basis at the entrance to the Fischer Area. Permits may not be picked up earlier than 2:00 a.m. on the day of the hunt. **Hunting ends at 11:00 a.m.**

Twelve elevated deer stands are available for use on a first-come, first-serve basis. Use of stands is optional.

Entrance fee required. **Current Federal Duck Stamp or $2.00 daily fee.**

HEADQUARTERS AREA

Shotgun

Individuals having reservations must appear at headquarters prior to **1 1/2 hours before** legal shooting time on the day of the hunt to be issued a daily permit.

A standby ticket-lottery drawing will be held **1 1/2 hours before** legal shooting time for all forfeited reservations. An additional drawing will be held at noon for stand vacancies.

39 hunters will be allowed on the Headquarters Area and 34 elevated stands are provided. Five sites are designed as stands for non-ambulatory hunters. All hunters must confine hunting to their assigned stand. Non-ambulatory hunters may have an assistant accompany them; however, this assistant may not possess a firearm or ammunition nor fire a weapon for any reason.

Hunting is permitted only during Monday and the second Friday of the November State season, and the Friday of the December State season.

No hunter may possess a loaded weapon while away from his assigned stand except to pursue a deer which he cripples.

Pursuit of a crippled animal must begin within 30 minutes and end within one hour unless authorization to continue the search is given by a refuge employee.

Persons who successfully kill and retrieve a deer may leave the area at any time.

A fee of **$10.00** will be charged and collected prior to the issuance of a daily permit.

STEAMBOAT LANDING AREA

Shotgun

Individuals selected by advance reservations must appear at headquarters prior to **1 1/2 hours before** legal shooting time on the day of the hunt to be issued a daily permit.

A standby ticket-lottery will be held **1 1/2 hours before** legal shooting time for all forfeited reservations. An additional drawing will be held at noon for stand vacancies.

17 hunters will be allowed on the Steamboat Landing Area and 17 elevated stands are provided.

Hunting is permitted only during Monday and the second Friday of the Delaware November season, the Wednesday of the Delaware December season, and the Saturday of the Delaware January season.

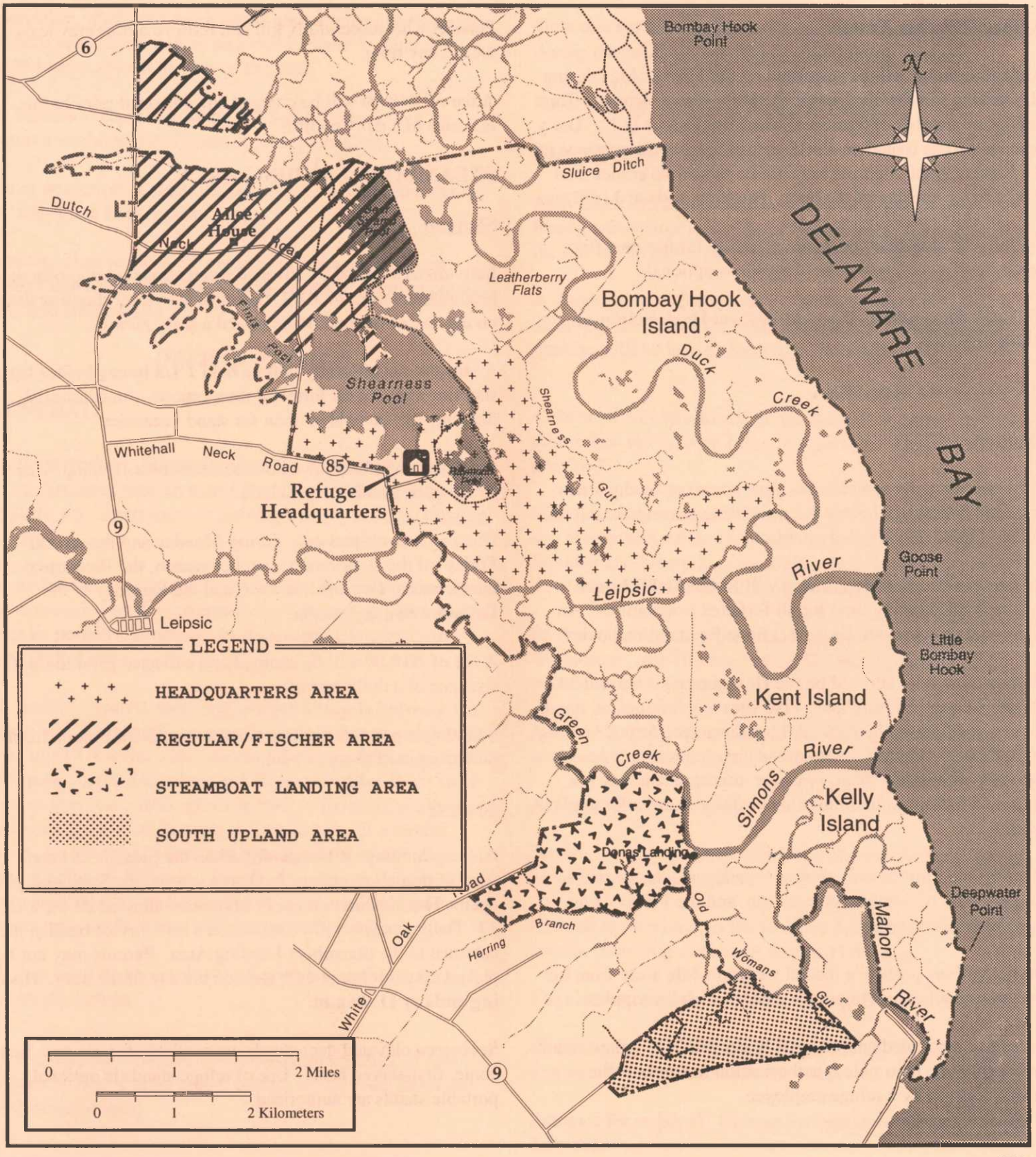
A fee of **$10.00** will be charged and collected prior to the issuance of a daily permit.

Scouting is permitted during the three weekends immediately preceding each shotgun hunt.

Archery

Archery hunting will be permitted on the Steamboat Landing Area during all weekdays in October, when the State season is open. The maximum number of hunters allowed on the area is 17. Daily permits will be issued on a self-service basis at the entrance to the Steamboat Landing Area. Permits may not be picked up earlier than 2:00 a.m. on the day of the hunt. **Hunting ends at 11:00 a.m.**

Seventeen elevated deer stands are available for use on a first come, first-served basis. Use of refuge stands is optional. portable stands are authorized.


Bombay Hook Point
N
DELAWARE BAY
Sluice Ditch
Dutch
Alice House Neck Road
Leatherberry Flats
Bombay Hook Island
Duck Creek
Shearness Pool
Shearness Gut
Whitehall Neck Road
85
Refuge Headquarters
9
Leipsic
Leipsic River
Goose Point
Little Bombay Hook
Kent Island
Green Creek
Simons River
Kelly Island
Deepwater Point
Mahon River
Old Womans Gut
Herring Branch
Oak
White
LEGEND
HEADQUARTERS AREA
REGULAR/FISCHER AREA
STEAMBOAT LANDING AREA
SOUTH UPLAND AREA
0 1 2 Miles
0 1 2 Kilometers
8/93

Scouting is permitted during each weekend in September.

Entrance fee required. **Current Federal Duck Stamp or $2.00 daily fee.**

Special Youth Hunt

A deer hunt limited to young hunters accompanied by a guardian will be conducted on the first Saturday in November on the Steamboat Landing and Fischer Tracts. The refuge will follow the criteria established by the State of Delaware for hunter/guardian ages, safety qualifications etc. Permits will be issued on the day of the hunt at refuge headquarters **two hours before** legal shooting time. Stands on nearby State Management Areas will be given out at this same lottery, and permittees may be assigned to different locations depending on stand availability. No fee will be charged.

ALL GAME HUNTING

SOUTH UPLAND HUNTING AREA

Area is open to big game and small game hunting in accordance with applicable state and federal seasons.

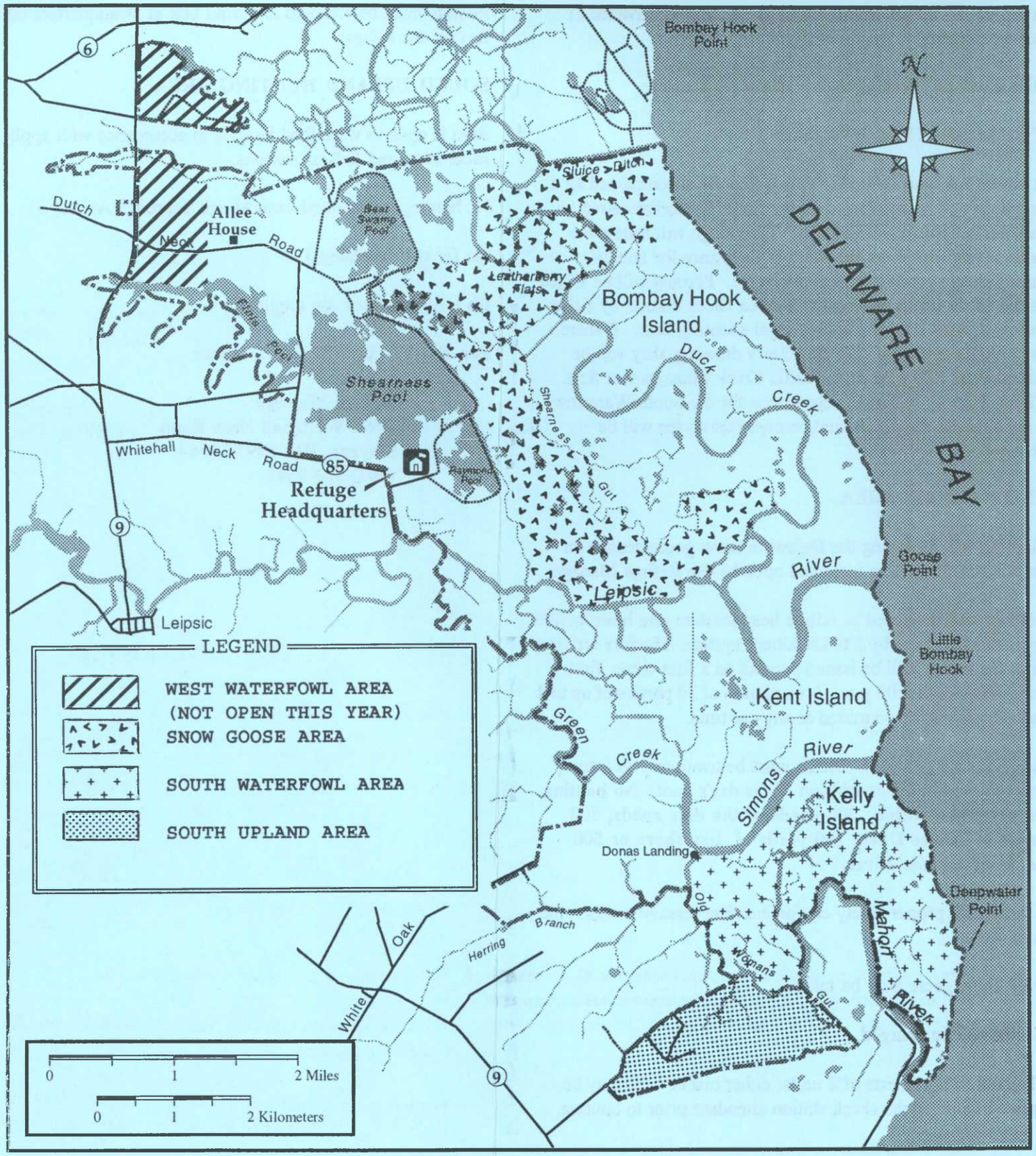
No hunting is permitted from March 1 through August 31. (Exception: turkey hunting with state permit)

No fee will be charged.

No refuge permits are required; turkey hunters must have valid state permit. Non-toxic shot required except by turkey/deer hunters.

For Further Information Contact:

Refuge Manager
2591 Whitehall Neck Road
Smyrna, DE 19977-9764
(302) 653-9345



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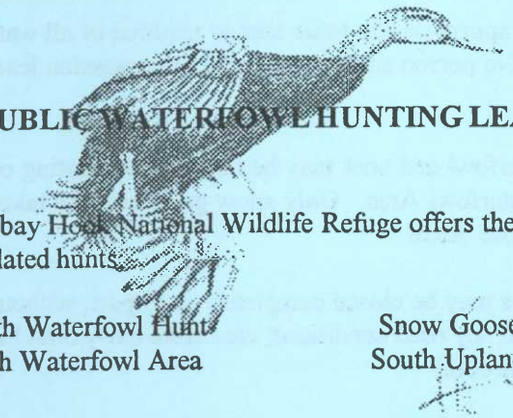
BOMBAY HOOK NATIONAL WILDLIFE REFUGE



PUBLIC WATERFOWL HUNTING LEAFLET

Bombay Hook National Wildlife Refuge offers the following regulated hunts:

Youth Waterfowl Hunt
South Waterfowl Area
Snow Goose Area
South Upland Area

Waterfowl hunting will be allowed on Bombay Hook National Wildlife Refuge subject to applicable state and federal regulations and the following special conditions:

GENERAL REQUIREMENTS

Hunters must possses a valid state hunting license. Persons under 15 years and over 65, or permanently disabled are exempt. Persons 15 years and under must be accompanied by a licensed hunter. Non-hunters are allowed only to accompany a permitted juvenile.

All hunters except those using the South Upland Area are required to obtain a daily permit prior to hunting.

Waterfowl hunters are required to have both a state and federal waterfowl stamp, according to state and federal regulations.

Use or possession of alcoholic beverages on hunt areas during any scheduled hunt is prohibited.

Hunters, when requested by federal or State enforcement officers must display for inspection, all game, hunting equipment and ammunition.

WATERFOWL HUNTING

GENERAL

Federally approved non-toxic shot is required of all waterfowl hunters. No person shall use or have in possession lead shot shells.

Only waterfowl and coot may be taken while hunting on the South Waterfowl Area. Only snow geese may be taken on the Snow Goose Area.

Hunt areas may be closed completely or in part, without notice when wind, icy road conditions, etc. make entry onto hunt areas hazardous.

Hunting is permitted only from government blinds, except in the Snow Goose Area and the South Upland Hunting Area.

The possession of an uncased gun or shooting outside of an assigned blind is prohibited except in active pursuit of crippled waterfowl. In such cases a hunter may only fire at crippled birds.

No decoys are provided.

There will be **no hunting on Christmas Day.**

SOUTH WATERFOWL AREA

Hunting is allowed only during duck season on Monday, Wednesday, Friday, and Saturday.

Permits will be issued at the Little Creek Management Area check station by a ticket-lottery system **2 hours before** legal shooting time. Hunters arriving after 7:00 a.m. will be issued permits on a first-come, first-serve basis until 1:00 p.m. at the **Little Creek Management Area Check Station.**

No more than 3 hunters may occupy a blind.

A boat with motor is necessary to reach the blinds. All boats must have proper safety equipment.

Hunters must leave the area and deposit permits in the receptacle at Port Mahon prior to one hour after sunset each hunting day.

A fee of **$5.00 per hunter** will be charged in advance of permit issuance.

Blinds will be allocated to only one party per day.

YOUTH WATERFOWL HUNT

A waterfowl hunt limited to young hunters accompanied by a guardian will be conducted on the South Waterfowl Area on the fourth Saturday in October. The refuge will follow the criteria established by the State of Delaware for hunter/guardian ages, safety qualifications etc. Permits will be issued at the Little Creek Management Area check station by ticket-lottery system **2 hours before** legal shooting time. If there are permits available after the lottery drawing, they will be issued until 1:00 p.m. at the Little Creek Management Area Check Station. All other regulations for the South Waterfowl Area apply to the youth hunt, except that no fee will be charged.

SNOW GOOSE AREA

Hunting will be during the Delaware snow goose season on days when the area is indicated open by the Refuge Manager.

Permits will be issued at refuge headquarters **one hour** before legal shooting time by a ticket-lottery system. Hunters arriving after the lottery will be issued permits on a first-come, first-serve basis until 3:00 p.m. A maximum of 30 parties of up to 4 individuals will be permitted at any one time.

No blinds are provided. Blinds must be temporary in nature, and removed at the conclusion of the day's hunt. **No hunting is permitted within 300 yards of the dike roads, 500 yards of Sluice Ditch, 100 yards of bay shore or 500 yards of Leipsic River.**

A boat with proper safety equipment is necessary to reach the hunt area.

Only snow geese may be taken.

No fee will be charged.

The hunt area consists of 2 units; either one or both may be open. Inquire of the check station attendant prior to hunting.

Permits must be returned to permit box at Headquarters before leaving the refuge.

SOUTH UPLAND HUNTING AREA

Area is open to waterfowl hunting in accordance with applicable state and federal seasons.

No hunting is permitted from March 1 through August 31.

No fee will be charged.

No refuge permits are required.

For Further Information Contact:

Refuge Manager
2591 Whitehall Neck Road
Smyrna, DE 19977-9764
(302) 653-9345


Allee House
Rte. 9 De.
© E. Doran

The Allee House at Bombay Hook National Wildlife Refuge stands today, as it did in the eighteenth century, overlooking the fields and marshes of Kent County. It is one of the most handsome and best preserved examples of an early brick farmhouse in Delaware.

According to tradition, the Allee House was built about 1753 by Abraham Allee, the son of John Allee, a Huguenot refugee from Artois, France. John Allee arrived in Hackensack, New Jersey, in the 1680's and in 1706 he obtained from John Albertson and John Manford of New York a 600-acre tract in Delaware called "Woodstock Bower." By 1712 John Allee had bought two tracts adjacent to his original purchase; in his will, probated March 16, 1718, he left a large estate to his children. His son Abraham received the eastern half of the "home plantation" at Bombay Hook.

Abraham Allee served as a member of the Assembly in 1726, was appointed a Justice of the Peace in 1738, and was Chief Ranger for the county in 1749. He purchased tracts called "Hillyard's Adventure," "Barren Hope," "Pasture Point," and "Galway" and added them to his inherited estate.

The house Abraham Allee built at Bombay Hook features fine brickwork laid in Flemish bond with a few glazed header bricks. The interior of the house is distinguished by the handsome wood panelling of the parlor. The cornice in this room has a dentil course that is particularly well formed, and the splendid panels of the chimney breast are joined on either side by two striking recessed, arched china closets. These closets have panelled doors and graduated butterfly shelves against a barrel back with a fluted center post.

The kitchen of the Allee House was added some time after the original four rooms were built. The large brick fireplace has its original lugpole and trammel. The brick hearth laid in sand is typical of most Delaware houses in Kent and Sussex counties.

During the restoration of the Allee House it was discovered that much of the early wrought iron hardware was still in place. The colors used in the house were found by carefully removing successive layers of paint in each room until the original was uncovered. Excavations in the cellar, under the kitchen floor, and around the outside walls of the house unearthed a number of metal, glass, and pottery artifacts that suggested the Chinese porcelain, pearlware and pewter that are now displayed in the dining room and parlor.

The selection of typical Delaware and southeastern Pennsylvania furniture was guided by the inventory of the estate of Jonathan's inventory, dated June 24, 1775, included: "1 Eight day clock, £15:0:0; 1 case of high mahogany drawers, £8:0:0; 1 ovel walnut dining table, 1 square ditto, £1:0:0; looking glass, £3:0:0; six walnut leathered bottom chairs, £4:0:0."

The restoration and the furnishing of the Allee House were completed in 1966, in 1971 it was placed on the National Register of Historic Places as an important example of the vernacular architecture of eighteenth century Delaware. The house is a part of the U.S. Fish and Wildlife Service and is located on Rt. 9 between Leipsic and Smyrna.

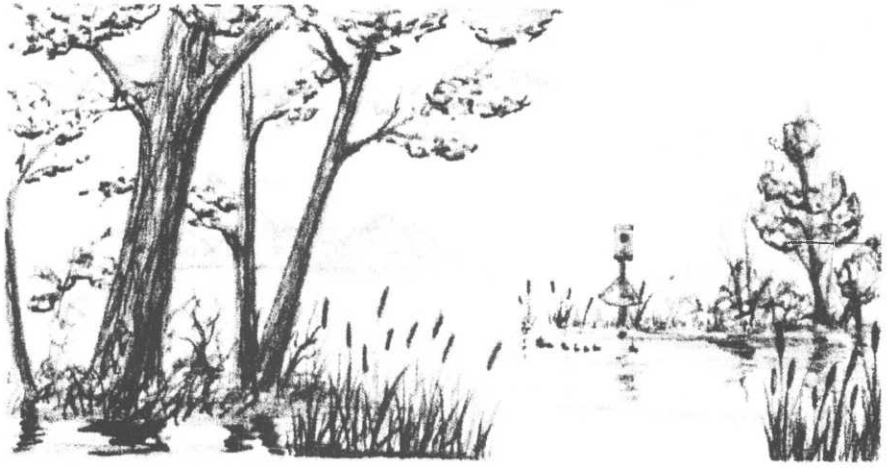
December

Eagles often seen perched on leafless branches. High populations of wintering birds, especially waterfowl, throughout the month unless a hard freeze pushes them further south.

Conclusion:

Because of the abundance of wetland habitat on the refuge, mosquitoes, and biting fly populations are very high from June through September. During these months, the refuge staff suggests you wear long sleeves and slacks, and bring insect repellant and a headnet when you visit.

Bombay Hook National Wildlife Refuge is open to visitors daily, from sunrise to sunset. Additional information on the refuge can be obtained by addressing requests to Refuge Manager, 2591 Whitehall Neck Road, Smyrna, DE, 19977-9764 or calling (302) 653-6872.



BOMBAY HOOK NATIONAL WILDLIFE REFUGE

CALENDAR OF NATURE EVENTS

The world of nature is one of continuous change. Winter gives way to the warm breezes of spring. Eagles hatch, and in a few short months young eagles test their wings over the saltmarsh. Leaves turn from green to gold and softly drop to the forest floor as migrating waterfowl once again wing south ahead of the first snows of winter. This calendar, highlighting many of the changes the natural community goes through at Bombay Hook, has been prepared to help you plan future visits to the refuge.

January

Red tailed, marsh and rough-legged hawks are commonly observed. Bald eagles begin working on their nests. Whitetail deer herds are seen in the fields at dusk.

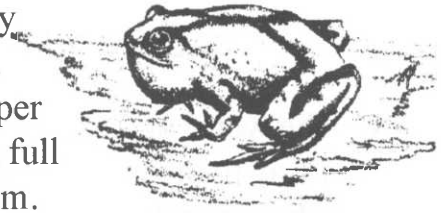
February

Bald eagle eggs are laid and incubation begins. Large flocks of Pintail ducks arrive with the first mild weather of the month.

March

The spring waterfowl migration peaks. Ducks, snow geese and Canada geese are abundant. Woodchucks and turtles emerge from hibernation. Woodcock courtship flights occur. Alders and red Maples flower. Deer ticks emerge.

April

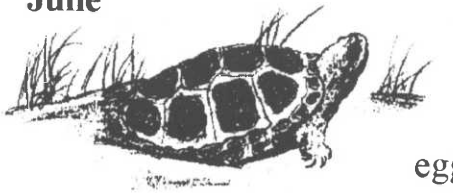


Bald eagle eggs hatch. Early spring songbird migration begins. Purple Martins return. Spring peeper chorus and wood frog chorus is in full voice. Spring wildflowers in bloom.

May

Peak concentrations of shorebirds. Horseshoe crabs move onto the bay shore and begin laying eggs. Bullfrogs and green frogs join in the swamp chorus. Warbler migration peaks. Snapping turtles lay eggs. Tulip trees and spring wildflowers are in full bloom. Duck broods appear. First whitetail deer fawns are seen.

June

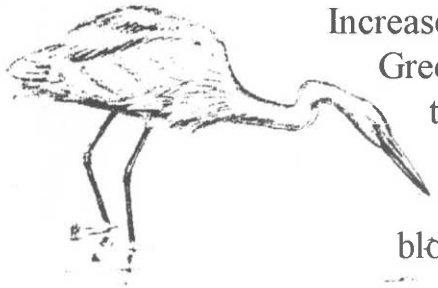


Diamond back terrapins lay eggs on dikes. Baby eagles leave the nest. Water lilies bloom. Black necked stilts begin nesting in impoundments.

July

Many duck broods are present in Bear Swamp Pool. The first shorebirds arrive late in the month on their southward migration flight. Large concentrations of wading birds, including herons, egrets and ibis are present. Whitetail deer bucks with antlers in velvet.

August



Increased numbers of shorebirds. Green-winged and blue-winged teal begin to arrive. Cardinal flowers, rose mallow and meadow beauties are in bloom.

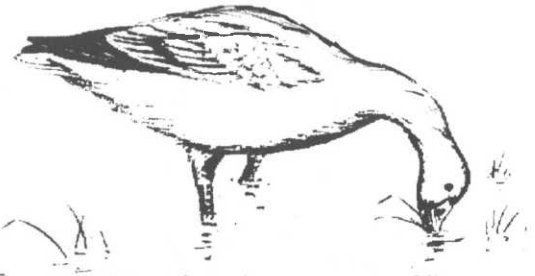
September

Late migrating shorebirds and songbirds are present. Duck numbers increase. First Canada geese arrive. Tickseed sunflower, goldenrod and Joe-Pye-weed in flower.

October

Best month for Avocets. Large numbers of Canada and Snow geese arrive. Duck numbers increase as pintail, mallard and black ducks begin their fall migration. Bur marigolds bloom in freshwater pools.

November



Peak of fall waterfowl migration. Common species include Canada geese, Snow geese, (blue and white phases), gadwall, mallard, black duck, pintail, American widgeon, wood duck, northern shoveler, blue-winged and green-winged teal, scaup, bufflehead, ruddy duck, red-breasted and hooded merganser.

Public Use Regulations

The following activities are permitted from sunrise to sunset:

- Vehicle and bicycle travel on designated roads for the purpose of nature study, photography, and general sight-seeing. The public tour route will be closed to vehicles when inclement weather creates hazardous road conditions.
- Hiking, except in areas closed to all access by posting.
- Exercising pets on a leash not more than ten feet in length, one end of which is secured so as to restrict the moves of the animal.

Activities not permitted by the above regulations are prohibited without a special written permit.

Public hunting under special regulations may be permitted on portions of the refuge. Contact the refuge office for current regulations before hunting.

Fishing and crabbing are not permitted from refuge lands. These activities are conducted in tidal waters from boats only. Boat launching ramps are located at Woodland Beach and Port Mahon.

Visitors are encouraged to drive with utmost care while on the tour route. When stopping a vehicle for wildlife observation, pull the vehicle to the right side of the roadway or shoulder in order that others may pass. Use caution when exiting your vehicle and be on the lookout for following or oncoming traffic. Speed limit is 25 m.p.h. except as otherwise posted.

Please leave wildlife, plants, and facilities undisturbed so that others may enjoy them.

Please take litter home or place it in trash containers where provided.

Environmental education activities may be restricted to designated sites and are to be coordinated through the Visitor Contact Center.

Literature describing the refuge is available in the Visitor Center and in the refuge office. Contact the refuge office about activities not specified above.

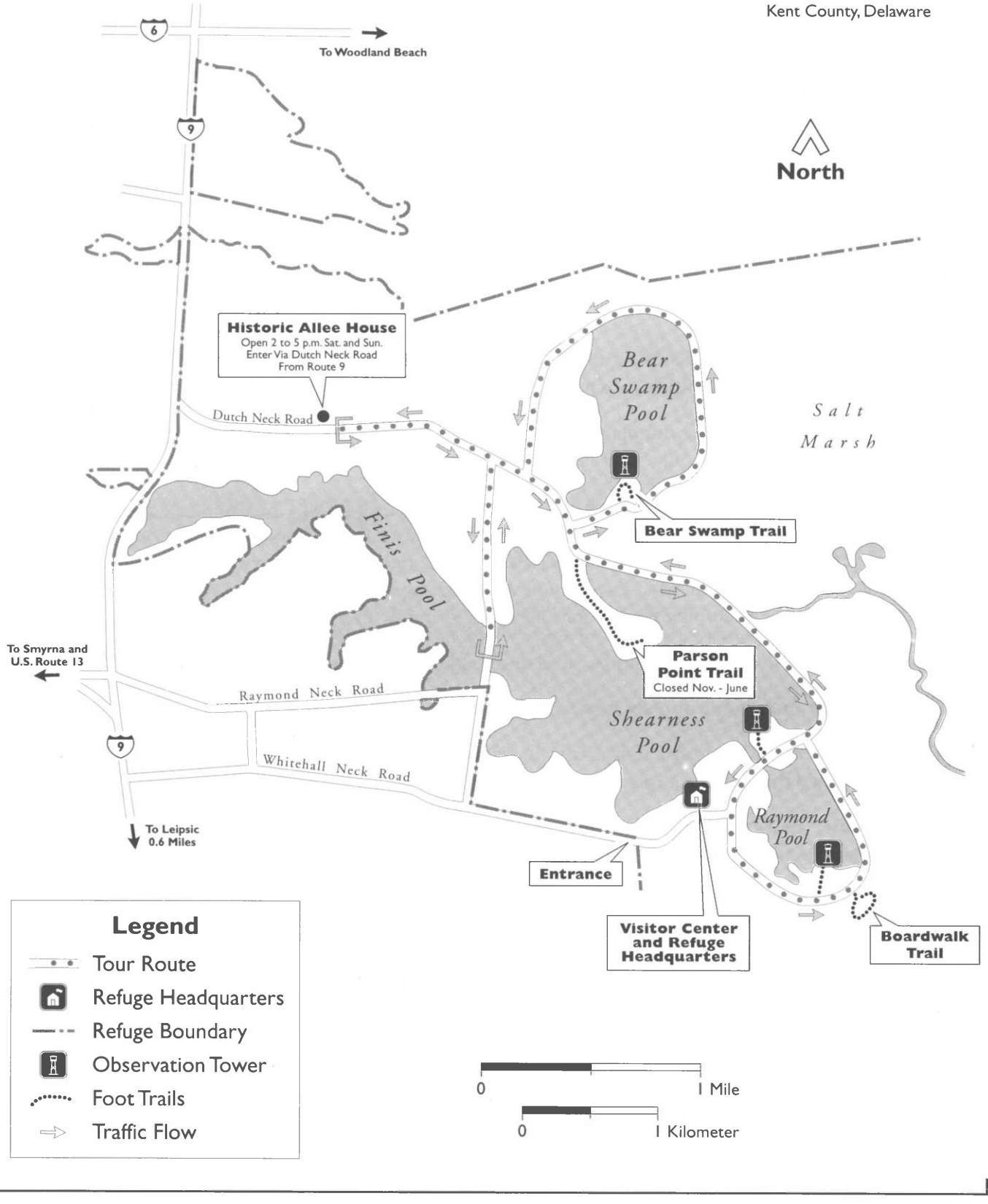
U.S. Fish & Wildlife Service
Bombay Hook National Wildlife Refuge
2591 Whitehall Neck Road
Smyrna, DE 19977-9764

Office: (302) 653-9345
Visitor Center: (302) 653-6872

Public Tour Route

BOMBAY HOOK
National Wildlife Refuge

Kent County, Delaware



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